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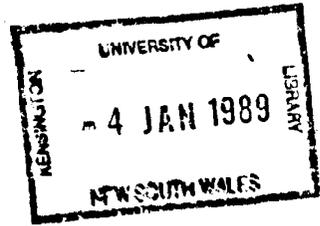


The University of New South Wales

# Engineering

1989  
Faculty Handbook



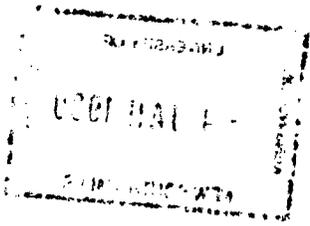


The University of New South Wales

# Engineering

1989  
Faculty Handbook

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Subjects, courses and any arrangements for courses including staff allocated, as stated in the Calendar or any Handbook 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 subjects, courses, arrangements or staff allocations at any time without notice.

Information in this Handbook has been brought up to date as at 12 September 1988, but may be amended without notice by the University Council.

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## Calendar of Dates

	1989	1990
<b>Session 1 (67 teaching days)</b>		
	27 February to 23 March	26 February to 12 April
<i>Recess</i>	24 March to 2 April	13 April to 22 April
	3 April to 8 June	23 April to 7 June
<i>Study Recess</i>	9 June to 14 June	8 June to 13 June
<i>Midyear Recess</i>	1 July to 23 July	30 June to 22 July
Examinations	15 June to 30 June	14 June to 29 June
<b>Session 2 (67 teaching days)</b>		
	24 July to 22 September	23 July to 21 September
<i>Recess</i>	23 September to 2 October	22 September to 1 October
	3 October to 1 November	2 October to 31 October
<i>Study Recess</i>	2 November to 7 November	1 November to 6 November
Examinations	8 November to 24 November	7 November to 23 November
Vacation Weeks	27 March to 2 April	16 April to 22 April
Common to Australian Universities	3 July to 9 July	2 July to 8 July
	25 September to 1 October	24 September to 30 September

## Important Dates for 1989

## January

- M 2 New year's Day - Public Holiday
- F 6 Last day for acceptance of applications by the Admissions Section for transfer to another undergraduate course within the University.
- W 18 Last day for applications for review of results of assessment.
- Th 26 Australia Day - Public Holiday
- T 31 Enrolment period begins for new undergraduate students and undergraduate students repeating first year.

## February

- M 6 Re-enrolment period begins for second and later year undergraduate and graduate students enrolled in formal courses. Students should consult the 1989 Re-enrolment Procedures booklet for details.
- F 24 Last day for students to discontinue 1989 enrolment.
- M 27 Last day for acceptance of enrolment by new and re-enrolling students. Late fee payable thereafter if enrolment approved. Session 1 begins - all courses except Medicine III, IV and V.

## March

- F 10 Last day applications are accepted from students who enrol in additional Session 1 or whole year subjects.
- F 24 Good Friday - Public Holiday
- Mid-Session Recess begins
- M 27 Easter Monday - Public Holiday

# Engineering

## April

- Su 2 Mid-Session Recess ends
- F 21 Last day for students to discontinue without failure subjects which extend over Session 1 only
- T 25 Anzac Day — Public Holiday

## May

- T 2 Confirmation of Enrolment forms despatched to all students
- T 9 Publication of Provisional Timetable for June examinations
- Th 11 Last day for acceptance of corrected Confirmation of Enrolment forms
- W 17 Last day for students to advise of examination clashes
- T 30 Publication of timetable for June examinations

## June

- Th 8 Session 1 ends
- F 9-14 Study Recess
- M 12 Queen's Birthday — Public Holiday
- Th 15 Examinations begin
- F 30 Examinations end

## July

- M 10 Assessment results mailed to students
- T 11 Assessment results displayed on University noticeboards
- Su 23 Midyear Recess ends
- M 24 Session 2 begins
- M 31 Last day for applications for review of July assessment results

## August

- F 4 Last day applications are accepted from students to enrol in additional Session 2 subjects  
Last day for students to discontinue without failure subjects which extend over the whole academic year

## September

- F 8 Last day for students to discontinue without failure subjects which extend over Session 2 only
- T 19 Confirmation of Enrolment forms sent to all students
- S 23 Mid-Session Recess begins
- Th 28 Last day for acceptance of corrected Confirmation of Enrolment forms
- F 29 Closing date for applications to the Universities and Colleges Admission Centre

## October

- M 2 Mid-Session Recess ends  
Eight Hour Day — Public Holiday
- T 3 Publication of provisional examination timetable for November examinations
- W 11 Last day for students to advise of examination timetable clashes
- T 24 Publication of timetable for November examinations

## November

- W 1 Session 2 ends
- Th 2-7 Study Recess
- W 8 Examinations begin
- F 24 Examinations end

## December

- F 8 Assessment results mailed to students
- M 11 Assessment results displayed on university noticeboards

## Staff

*Comprises Schools of Civil Engineering, Electrical Engineering and Computer Science, Mechanical and Industrial Engineering (incorporating Aeronautical Engineering, Naval Architecture and Nuclear Engineering), and Surveying; and Centres for Biomedical Engineering, Manufacturing and Automation, and Safety Science. The Faculty also associated with the Joint Microelectronics Research Centre and the Centres for Groundwater Management and Hydrogeology, Remote Sensing, and Waste Management.*

### Dean

Professor Christopher Joseph Dalzell Fell, BSc N.S.W., PhD Camb., CEng, FICHE, FIEAust, MAmerChE (Chemical Engineering)

### Chairman

Associate Professor K. K. Watson

### Administrative Assistant

Patricia M. Rooney

### Honorary Visiting Fellow

Emeritus Professor Peter Thomas Fink, AO, CB, CBE, BE Syd., CEng, FTS, HonFIEAust, FIMechE, FRAeS, FRINA, MAIAA, MSNAME

---

## School of Civil Engineering

---

### Professor of Engineering and Head of School

Hilary Max Irvine, ME Cant., CE Caltech., PhD Auck., MIPENZ, FIEAust

### Professor of Civil Engineering and Head of Department of Engineering Construction and Management

David Gordon Carmichael, BE MEngSc Syd., PhD Cant., MIEAust

### Professor of Civil Engineering and Head of Department of Geotechnical Engineering

Robin Fell, BE MEngSc Old., FIEAust

### Associate Professor and Head of Department of Structural Engineering

B. Vijaya Rangan, BE Madr., PhD I.I.S. B'lore., FIEAust, FACI

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### Executive Assistant to Head of School

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### Senior Administrative Officer

Robert William Prior

### Administrative Assistant

George John Harris, BA N.S.W.

### Analyst Programmer

Robert Peter Hegedus, BSc N.S.W., MACS, MACM

---

## Department of Geotechnical Engineering

*Includes Foundation Engineering Soil Mechanics, Rock Mechanics, Concrete Technology, Pavement Engineering.*

### Associate Professor

Somasundaram Valliappan, BE Annam., MS Northeastern, PhD DSc Wales, FIEAust, FASCE

# Engineering

## Senior Lecturers.

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Garry Robert Mostyn, BE MEngSc N.S.W., BA Macq., MIEAust  
Bruce John Francis Patten, BE Syd., PhD N.S.W., DIC Lond.  
Brian Shackel, BE Sheff., MEngSc PhD N.S.W., MIEAust  
William Otho Yandell, ME PhD N.S.W., MIEAust

## Lecturers

Viriyawan Murti, BSc BE PhD N.S.W., MACS  
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## Professional Officers

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Ghodratollah Tamaddon, BEngAg *Tehran*, DrAgSc *Gembloux*  
Calistus Vasantha Wijeyakulasuriya, BScEng *Ceyl.*, MEngAIT

Neil Colin Mickleborough, MEng *Car.*, PhD *Tas.*, DipCE *Hobart T.C.*,  
MIEAust, MASCE, MCSCE, RPEQ  
Ian James Somerville, BE PhD N.S.W., ASTC  
Francis Shay Khiet Tin Loi, BE PhD *Monash*, MIEAust

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## Teaching Fellows

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## Professional Officers

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## Department of Engineering Construction and Management

*Includes Structural Analysis, Structural Design, Stress Analysis and Solid Mechanics*

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PhD *Northwestern*

### Senior Lecturers

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Raymond Ian Gilbert, BE PhD N.S.W., MIEAust  
Alexander Cuthbert Heaney, BE MEngSc *Melb.*, PhD *Wat.*, MIEAust,  
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## Department of Structural Engineering

*Includes Structural Analysis, Structural Design, Stress Analysis and Solid Mechanics*

### Associate Professor

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## Department of Water Engineering

*Includes Hydraulics, Hydrology, Public Health Engineering, Water Resources Engineering, and the Water Research Laboratory.*

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## School of Electrical Engineering and Computer Science

---

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**Professor of Electrical Engineering — Communications**

Vacant

**Professor of Computer Science**

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**Professor of Computer Science**

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## School of Mechanical and Industrial Engineering

*Incorporates Aeronautical Engineering, Naval Architecture and Nuclear Engineering.*

### Head of School

Vacant

Nuffield Professor of Mechanical Engineering, Head of Department of Fluid Mechanics/Thermodynamics

Raymond Alfred Arthur Bryant, ME N.S.W., ASTC, CEng, FIMechE, FIEAust, MRAS

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George Bennett, BA Syd., PhD N.S.W., ASTC, CEng, FIProdE

Sir James Kirby Professor of Production Engineering

Peter Louis Brennan Oxley, BSc PhD Leeds, CEng, FTS, FIProdE, FIEAust, FIMechE

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Clifford Patterson, MA PhD Camb., FIEAust, CEng, FIMechE, CPhys, FinstP, FIMA, MIERE

Professor of Mechanical Engineeringg

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**Administrative Assistant**

Audrey Muriel Colquhoun

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**Project Scientist**

‡Peter Yo Pin Chen, BSc MEngSc ME PhD N.S.W., ASTC

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Eric Arthur Carter, BE MEngSc N.S.W., ASTC  
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Anthony Gordon Harris, BSc *Exe.*  
Yefim Kotlyar, BMechEng *Moscow Mech. Inst.*  
Alexander Lev Litvak, Dipping *Odessa*. MEngSc N.S.W., MIEAust  
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Russell Norman Overhall, BE N.S.W., MIEAust.

**Analyst Programmer**

David Alexander Herd, BSc Syd.

**Honorary Associate**Cyril Arthur Gladman, BSc(Eng) *Lond.*, ACGI, CEng, FIProdE, MIMechE, MIED**Honorary Visiting Fellows**

William Neville Holmes, BEE *Melb.*, MIEEE  
Gerhart Claus Lowenthal, BA BSc *CipPubAdm Melb.*, MSc PhD N.S.W. FAIP, MInstP

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**Department of Applied Mechanics****Associate Professors**

John Edward Baker, MSc *Syd.*, BE MEngSc PhD N.S.W.  
Kerry Patrick Byrne, BE MEngSc *Qld.*, BSc *Melb.*, PhD *S'ton.*  
Eric Joseph Hahn, BE BSc PhD N.S.W., FIEAust, MASME

**Senior Lecturers**

Jacob Alexander Bruce Cartmel, MSc *Cran.I.T.*, PhD DipEd N.S.W., CEng, SMIEEE, FIMechE, FIEAust  
John Michael Challen, BE MEngSc *Syd.*, PhD N.S.W., FIEAust  
Alexander Eric Churches, BE PhD N.S.W., ASTC, FIEAust  
Ronald Arthur Dennis, MSc *Nott.*, CEng, MIMechE  
Robin Arthur Julian Ford, BSc(Eng) PhD *Lond.*, ACGI, MIEAust  
Richard Butler Frost, BE N.S.W., CEng, FIEAust  
Chakravarti Varadachar Madhusudana, BE *Mys.*, ME *I.I.S.c.*, PhD *Monash*, MIEAust, MASME  
Robert Bond Randall, BTech *Adel.*, BA *Melb.* MAAs, FIDiagE  
Hugh Lithgow Stark, BSc PhD *Strath.*, CEng, FIMechE, MIEAust  
Richard Adrian Willgoss, BSc PhD *S'ton.*, CEng, MIEE, MInstP

**Lecturers**

George Crawford, BE BSc N.S.W., ASTC, CEng, FIEAust, MAIE, ARACI, CChem  
See Seng Leong, BE PhD N.S.W., MIEAust  
Michal John Tordon, Dipping *Bratislava*, PhD *Prague*, MIEEE

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**Department of Fluid Mechanics and Thermodynamics***Includes Aeronautical Engineering, Naval Architecture and Nuclear Engineering.***Associate Professors**\*Richard Douglas Archer, BSc *Melb.*, BE *Syd.*, MS PhD *Minn.*, FBIS, FRAeS, MIEAust, MAIAA‡Paul Robert Barrett, MSc PhD *Birm.*, CPhys, FAIP, MInstP  
Graham de Vahl Davis, BE *Syd.*, PhD *Camb.*, CEng., FIMechE, FIEAust, MASME‡Lawrence Julian Doctors, BE MEngSc *Syd.*, PhD *Mich.*, MRINA, AMSNAME  
Brian Edward Milton, BE PhD N.S.W., MSc *Birm.*, CEng, MIEAust, MRAeS  
Graham Lindsay Morrison, BE PhD *Melb.***Senior Lecturers**Masud Behnia, BSME, MSME PhD *Purdue*, MASME, MAIAA, MIEAust\* Donald Wainwright Kelly, BE *Syd.*, PhD *Lond.*‡Leslie George Kemeny, BE *Syd.*, MIEAust, FAIE, MACS  
Eleonora Maria Kopalinsky, BE PhD N.S.W.  
Eddie Leonardi, BSc(Eng) PhD N.S.W., MIEAust, MAIRAH, MASHRAE  
John Randall Page, BSc *Hat.*, MSc *Cran.I.T.*, CEng, MRAeS, FBIS, MAIAA  
‡Prabhat Kumar Pal, BME N.C.E., *Bengal*, BTech PhD *Kharagpur*, FRINA, FIEAust, MIINA, MSTG(Hamburg)  
John Arthur Reizes, ME PhD N.S.W., MIEAust**Lecturer**Ian Lachlan MacLaine-cross, BE *Melb.*, PhD *Monash*, MIEAust

‡Nuclear Engineering.

\* Aeronautical Engineering

‡Naval Architecture

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**Department of Industrial Engineering***Comprises Operations Research and Production Engineering.***Associate Professor**Bruce Albert Murtagh, ME *Cant.*, PhD DIC *Lond.*, CEng, MICHemE, MIEAust**Senior Lecturers**

Leonard Edward Farmer, BE MEngSc PhD N.S.W., MIEAust  
Roger Malcolm Kerr, BSc *Lond.*, MSc *Bath*, DPhil *Oxf.*  
Grier Cheng I Lin, DipMechEng *Natnl. Taiwan I.T.*, PhD N.S.W., MIEAust  
Philip Mathew, BE PhD N.S.W., MIEAust  
Graham Smith, BE MEngSc PhD N.S.W., ASTC, MIEAust, MACS

**Lecturers**

Peter Robin Gibson, BSc PhD *Lough.*, CEng, MIProdE  
Daniel Goodridge, Dipl IngChim *L'Aurore, Shanghai*, DiplIndEng N.S.W.

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## Centre for Manufacturing and Automation

### Director

Dr. G. C. I. Lin

### Lecturer

Khoi Hoang, BE *Saigon*, PhD *N.S.W.*

### Professional Officers

Jason Trihung Nhieu, BSc *Nat Cheng Kung*, MEngSc *N.S.W.*, MIEAust  
Alfred Win Lin Hu, BE *Rangoon I.T.*, MIEEE, AIREEE.

### Professional Officers

Brian Edward Donnelly, BSurv *N.S.W.*, RegSurv (NSW),  
GradDipCompStud *C.C.A.E.*  
Basil Lai, BSc *BE Syd.*  
Robert William Pascoe, BSurv *N.S.W.*

### Analyst/Programmers

Mohammad Hadi Aghakhani, BSc *Sh.U.T. Tehran*,  
MSc *Colorado State*, MEngSc *N.S.W.*  
Bernd Hirsch, BApplSc *M.C.A.E.*

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## School of Surveying

### Professor of Surveying and Head of School

Friedrich Karl Brunner, Diplng Drtech *T.U. Vienna*

### Professor of Surveying (on leave)

Peter Vincent Angus-Leppan, BSc(Eng) *Rand.*, PhD DipTP *Natal*,  
FISAust, MILS(*Natal*), MAIC

### Associate Professors

John Stuart Allman, AM, BSurv PhD *N.S.W.*, MISAust, MAIC  
Bruce Crosby Forster, MSurv *Melb.*, MSc *R'dg.*, PhD *N.S.W.*,  
MISAust, LS(Vic), MASPNG  
Artur Stolz, BSurv PhD *N.S.W.*, RegSurv(NSW)  
John Charles Trinder, BSurv PhD *N.S.W.*, MSc *I.T.C. Delft*,  
RegSurv(NSW), FISAust

### Senior Lecturers

Arthur Harry William Kearsley, BSurv MSurvSc PhD *N.S.W.*, MISAust  
Anthony John Robinson, BSurv MBA PhD *N.S.W.*, RegSurv(NSW),  
MISAust, MAIC  
Jean March Rueger, Dipl Ing *E.T.H. Zurich*, PhD *N.S.W.*, SIA, ACSM  
LS(Switz), MISAust

### Lecturers

Pratap Shivabhai Amin, BSc *I.T.C. Delft*, MSc *Lond.*, MISK, CLSEA,  
ARICS  
Sabapathy Ganeshan, BSc *Ceyl.*  
Ewan Gerald Masters, BSurv PhD *N.S.W.*, MISAust  
John Richard Pollard, BSc *Qld.*, BTech *S.A.I.T.*  
Christopher Rizos, BSurv PhD *N.S.W.*

### Administrative Assistant

Leo Daras, BA *N.S.W.*

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## Centre for Biomedical Engineering

### Honorary Visiting Professor and Honorary Director

Peter Craig Farrell, BE *Syd.*, SM *M.I.T.*, PhD *Wash.*, DSc *N.S.W.*,  
MASAIO, MISA0

### Assistant Director

Klaus Schindhelm, BE PhD *N.S.W.*, MIEAust, MASAIO

### Senior Lecturer

Christopher David Bertram, MA DPhil *Oxf.*  
Bruce Kenneth Milthorpe, BA *Macq.*, PhD *A.N.U.*

### Lecturers

Alberto Pompeo Avolio, BE PhD *N.S.W.*  
Ross Alexander Odell, BSE, Princeton, PhD *M.I.T.*

### Professional Officer

Laura Anne Poole-Warren, BSc *N.S.W.*

### Administrative Assistant

Rhonwen Mooney, BA DipSocWk *Syd.*

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## Centre for Groundwater Management and Hydrogeology

*In association with the Faculty of Applied Science*

### Director

Dr M. J. Knight

### Deputy Director

Associate Professor C. R. Dudgeon

**Senior Lecturers**

William Alexander Milne-Home, BSc *Leic*, MSc *Lond.*, PhD *Alta.*, FGS  
Richard Ian Acworth, BSc *Leeds*, MSc PhD *Birm.*, FGS

**Professional Officers**

Robert Gregor McLaughlin, BSc MAppSc *N.S.W.*  
Anna Eade, BSc *N.S.W.*

**Administrative Assistant**

Beverley Ann Colin

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## \* Joint Microelectronics Research Centre

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**Director**

Professor G.A. Rigby, School of Electrical Engineering and Computer Science

**Deputy Director**

Professor M.A. Green, School of Electrical Engineering and Computer Science

\*With the Royal Melbourne Institute of Technology

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## Centre for Remote Sensing

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*In association with the Faculty of Applied Science*

**Director**

Associate Professor B. C. Forster

**Deputy Director**

Dr. A. K. Milne

**Professional Officer**

Leanne Margaret Bischof, BE *Darling Downs I.A.E.*

**Analyst/Programmer**

John Charles Klingberg, BSc *Darling Downs I.A.E.*

**Research Assistant**

Arthur Mark Hall, BSc *N.E.*

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## Centre for Safety Science

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Monier Chair of Safety Engineering and Director

Jean Cross, BSc *Manc.*, PhD *Lond.*

**Associate Professor**

Michael Geoffrey Stevenson, BSc(Tech) PhD *N.S.W.*, ASTC, CEng, FIEAust, MIProdE

**Senior Lecturers**

Neil Leon Adams, BSc PhD *N.S.W.*  
\*Edward Maxwell Nicholls, MD BS *Adel.*  
Ronald Rosen, MSc *N.Z.*, PhD *N.S.W.*, CPhys, FInstP, FAIP, MACPSM

**Lecturer**

Keith Post, BE PhD *N.S.W.*

**Honorary Visiting Fellow**

Derek Broadbent, BSc *Birm.*, MEngSc PhD *Melb.*, SMIEEE, FIREEEAust, MIEAust, MIEE

**Project Scientist**

Roger Roy Hall, BSc *A.N.U.* MSc *N.S.W.*, FESAust, MIESAust

**Senior Research Assistant**

David Gavin Lloyd, BSc(Eng) *N.S.W.*

**Research Assistant**

Caroline Jay Langley, BSc *Syd.*, MSafetySc *N.S.W.*

\*Conjoint appointment with the Faculty of Medicine.

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## Centre for Waste Management

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*In associaton with the Faculty of Applied Science*

**Director**

Vacant

**Deputy Director**

Dr M. J. Knight

**Lecturer**

Eric Matthew Claus, BSc *Loyola Marymount*, MSc *Utah State*, MIEAust



## Foreword

This handbook provides information on courses of study offered by the Faculty of Engineering, at both undergraduate and graduate levels, together with descriptions of subjects available and areas in which research may be undertaken.

The Faculty consists of the Schools of Civil Engineering, Electrical Engineering and Computer Science, Mechanical and Industrial Engineering, Surveying and the Centres for Biomedical Engineering, Manufacturing and Automation, and Safety Science. The Faculty is also closely associated with the Joint Microelectronics Research Centre and the Centres for Groundwater Management and Hydrogeology, Remote Sensing, and Waste Management. The three latter Centres are joint enterprises of the Faculties of Engineering and Applied Science.

The Faculty is dedicated to the achievement of excellence in scholarship, teaching and research in technology and its application for the benefit of the community. The goals of the Faculty are to:

1. provide undergraduate, graduate and continuing education programs, and to undertake research, in the professional fields of engineering and surveying;
2. provide formal and continuing education programs, and to undertake research, in interdisciplinary fields in which engineering science and practice play a prominent role;
3. aid the advancement, development and practical application of science and technology to satisfy the needs of industry, commerce, the infrastructure of society and the efficient management of resources.

Achievement of these goals will develop the attitudes and skills required of professional engineers operating into the twenty-first century.

Schools within the Faculty offer undergraduate courses leading to the award of the degree of Bachelor of Engineering (BE) in Aeronautical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Industrial Engineering, Mechanical Engineering and Naval Architecture and Bachelor of Surveying (BSurv). Combined degree courses are also available which lead to the award of two degrees: Bachelor of Engineering and Bachelor of Science (BE BSc) and Bachelor of Engineering and Bachelor of Arts (BE BA).

Through its schools and centres, the Faculty offers an active graduate program. Formal graduate courses are available which lead to the award of the degrees of Master of Biomedical Engineering (MBiomedE), Master of Engineering Science (MEngSc), Master of Safety Science (MSafetySc), Master of Surveying Science (MSurvSc) and to the award of Graduate Diplomas. Supervision is also available for candidates undertaking research degrees leading to the awards of Master of Engineering (ME), Master of Science (MSc) and Doctor of Philosophy (PhD).

The basic objectives which are incorporated in the various engineering and surveying courses are as follows:

1. Technical and scientific and creative skills required to solve all aspects of engineering problems.
2. An understanding of human interaction with the environment so that the impact of engineering activity can be assessed.
3. The ability to direct and manage engineering activities.
4. The ability to communicate with other members of the profession, with industrial personnel, administrators and with members of the public.
5. The desire and ability for continuing self-education and reappraisal of current practice including the ability to innovate.
6. The ability to evaluate independently and to criticise constructively their own work and the work of other engineers.

As part of their training for the profession, students are required to write reports and make verbal presentations. Therefore a high level of competence in written and spoken English expression is expected.

It is also important for students to join in the development of themselves as professional engineers. Engineering is a co-operative profession where teamwork is very important. Whilst at university, students should take as many opportunities as possible to join in the activities which help to develop the whole person. Student clubs and professional institutions provide many opportunities for gaining knowledge and experience which will be valuable in later years.

Dean  
Faculty of Engineering



## Faculty Information

### Some People Who Can Help You

If you require advice about enrolment, degree requirements, progression within courses, subject content and requirements, contact the appropriate school representative listed below:

*School of Civil Engineering:* Mr. R. W. Prior, Room 406, Civil Engineering Building.

*School of Electrical Engineering and Computer Science:* Dr. C. J. E. Phillips, Room G6, or Ms A. G. M. Johnson, School Office, Electrical Engineering and Computer Science Building.

*School of Mechanical and Industrial Engineering:* Associate Professor J. E. Baker, Room 105B, or Mr G. Dusan, Room 107, Mechanical and Industrial Engineering Building.

*School of Surveying:* Mr L. Daras, School Office, Room 529, Geography and Surveying Building.

*Centre for Biomedical Engineering:* Dr K. Schindhelm, 34-36 Botany Street, Randwick, NSW 2031.

*Centre for Groundwater Management and Hydrogeology:* Dr. M. J. Knight, Room 810, Applied Science Building.

*Centre for Manufacturing and Automation:* Dr G.C.I. Lin, Room 423, Geography and Surveying Building.

*Centre for Remote Sensing:* Associate Professor B.C. Forster Room 247, Geography and Surveying Building.

*Centre for Safety Science:* Associate Professor M.G. Stevenson, Room G07, Mechanical and Industrial Engineering Building.

*Centre for Waste Management:* Mr E. Claus, Room 112, Civil Engineering Building.

**Important:** As changes may be made to information provided in this handbook, students should frequently consult the noticeboards of the schools and the official noticeboards of the University.

### Entrance Requirements

Students are selected for courses offered by the Faculty according to the scaled aggregate mark obtained in the New South Wales High School Certificate (NSW HSC). Other students are admitted on the basis of their previous academic mark. In addition, students are expected to have reached the following standards (or equivalent) in the NSW HSC subjects:

Course	NSW HSC Prerequisites For First-Year Subjects	NSW HSC Score Range Required
<i>Engineering:</i>	2u Mathematics <i>or</i>	60 - 100
<i>Aeronautical</i>	3u Mathematics <i>or</i>	1 - 50
<i>Civil</i>	4U Mathematics	1 - 100
<i>*Computer</i>		
<i>*Electrical Industrial</i>	2U Science (Physics) <i>or</i>	53 - 100
<i>Mechanical</i>	3u Science <i>or</i>	90 - 150
<i>Surveying</i>		
<i>Naval Architecture</i>	4u Science (multistrand)	1 - 50
	2u English (General) <i>or</i>	53 - 100
	2u English <i>or</i>	49 - 100
	3u English	1 - 50

\* English is not a prescribed prerequisite for courses in Electrical Engineering or Computer Engineering.

Students are advised that the lack of specified subject prerequisite/s do not preclude their selection to any course but the required standard must be achieved before enrolment in the University subject is permitted.

The University conducts Bridging Courses to assist in remedying deficiencies in subject levels. Further details are available from the Students' Information Guide published annually by the Universities and Colleges Admissions Centre (UCAC).

Introductory subjects are also available to students who do not have the New South Wales Higher School Certificate prerequisite/s in Mathematics or Physics. It should be noted that inclusion of these subjects in first-year programs could extend the duration of a course.

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## Faculty of Engineering Enrolment Procedures

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All students re-enrolling in 1989 or enrolling in graduate courses should obtain a copy of the free booklet *Enrolment Procedures 1989* available from School Offices and the Admissions Office. This booklet provides detailed information on enrolment procedures and fees, enrolment timetables by Faculty and course, enrolment in miscellaneous subjects, locations and hours of Cashiers and late enrolments.

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## Faculty of Engineering Library Facilities

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Although any of the university libraries may meet specific needs, the staff and students of the Faculty of Engineering are served mainly by the Physical Sciences Library and the Undergraduate Services.

### The Physical Sciences Library

This library, situated on Levels 6 and 7 of the Library tower, caters for the information needs of staff, graduate and undergraduate students in the pure and applied sciences, engineering and architecture. Details of the books, serials and microforms in the Physical Sciences Library are included in the microfiche monograph and serial catalogues and the items themselves are identified by the prefix 'P'.

Serial with the prefix 'PJ' are not loan, but self-service photocopying facilities are available on Level 7.

This library provides reference, reader assistance and reader education services and also, where appropriate, inter-library loan and literature-searching services. Trained staff are always available on Level 7 to assist readers with their enquiries.

Physical Sciences Librarian Marian Bate

### Undergraduate Services

- The undergraduate collection caters for the needs of students in Years 1 and 2 and other groups where large numbers require mass teaching. Levels 3 and 4.
- The Open Reserve Section houses books and other materials which are required reading. Level 2.
- The Audio Visual Section contains cassette tapes, mainly of lectures and other spoken word material. The section has wired study carrels and cassette players for student use. Level 3.
- The Reader Education program provides orientation tours and introductory library research method lectures to students.

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## Student Clubs and Societies

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Students have the opportunity of joining a wide range of clubs and societies. Many of these are affiliated with the Students' Union. There are numerous religious, social and cultural clubs and also many sporting clubs which are affiliated with the Sports Association.

Clubs and societies seeking to use the name of the University in their title, or seeking University recognition, must submit their constitutions either to the Students' Union or the Sports Association if they wish to be affiliated with either of these bodies, or to the Academic Registrar for approval by the University Council.

The following societies serve the interests of students in the various courses in the Faculty of Engineering: Biomedical Engineering Society (BioEngSoc); Civil Engineering Society (CIV-SOC); Computing Science Association (CSA); Electrical Engineering Society (ELSOC); Mechanical Engineering Society (MECHSOC); Naval Architecture Students' Association (NASA); Surveying Society (SURVSOC).

Students are encouraged to participate in the activities of their societies. Enquiries should be directed initially to the general offices of the respective Schools.

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## International Association for the Exchange of Students for Technical Experience — IAESTE

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IAESTE is an organization to facilitate overseas work in technical areas in 53 different countries throughout the world for students or recent graduates. It organizes visas, work periods for as little as 6 weeks or up to 12 months, lodging and an initial welcome.

In Australia IAESTE has a National Committee in Melbourne and local committees in the capital cities including Sydney. The UNSW local committee is made up of interested students and is run in association with the Careers and Appointments Service at Sydney University.

For more information write to the local committee President, IAESTE (UNSW), Union Box 43, UNSW, PO Box 1, Kensington 2033, or contact the local committee through the Students' Union.

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## The Institution of Engineers, Australia

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The professional body for engineering in Australia is the Institution of Engineers, Australia, which has as its first objective 'to promote the science and practice of engineering in all its branches'.

## Engineering

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, eg civil, mechanical, electrical and transportation.

Students of an approved school of engineering may join the Institution as a student member (StudIEAust).

Student members receive the fortnightly publication *Engineers, Australia* advising of site tours, conferences, technical meetings of all branches, harbour cruises, film nights, etc. For a small fee they also receive *The Transactions* which contains articles on a particular branch of engineering.

Student members are also free to use the comprehensive library and reference facilities maintained by the Institution. The library is a handy place to obtain a rare book or periodical.

For more information and membership application forms, write to The Secretary, The Institution of Engineers, Australia, Sydney Division, PO Box 138, Milsons Point NSW 2061.

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## The Institution of Surveyors, Australia

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During their years as undergraduates, students in the surveying course are encouraged to take the first steps in joining in the activities of the professional body which represents surveyors, The Institution of Surveyors. The aims of the Institution are to promote scientific, technical and educational aspects of surveying and to maintain high professional standards of practice and conduct. Student members receive the quarterly journal of the Institution of Surveyors, *The Australian Surveyor* and *Azimuth* which is published by the New South Wales Division of the Institution. Membership also entitles the student to attend all meetings of the Institution and to attend the annual Congress at a special concessional rate. Membership application forms are available at the office of the School of Surveying and from the Institution Office, Third Floor, Guild House, 363 Pitt Street, Sydney.



# Undergraduate Study

The Faculty of Engineering offers courses leading to the award of the degrees of Bachelor of Engineering (BE) in Aeronautical, Civil, Computer, Electrical, Industrial and Mechanical Engineering and in Naval Architecture. A course is also offered leading to the award of the degree of Bachelor of Surveying (BSurv). The BE courses are available on a full-time or part-time basis or in sandwich form after first-year (with the exception of courses offered by the School of Mechanical and Industrial Engineering). The BSurv course is available for full-time study and in a sandwich form. The full-time courses are designed to be taken over a period of four years, whereas part-time study usually involves a combination of day-time and evening attendance over a period of six or seven years. It may not be possible to offer evening classes in the later year subjects. The sandwich pattern provides for alternate periods of full-time study and full-time employment with part-time study.

The three major subject areas in engineering and surveying courses are **basic sciences**, **engineering sciences** and **engineering applications**. The basic sciences area is emphasised in Year 1 since it forms the foundation for the remainder of the course. Engineering sciences form the link between the basic sciences and engineering applications. The engineering applications area provides the opportunity for applying knowledge to the solution of problems and is consequently emphasised later in the course. A feature of the courses at the University of New South Wales is the inclusion of a program of General Education, the requirements for which are set out below.

**Basic Sciences** consist of Mathematics, Physics and some Chemistry. **Engineering Science** subjects are those which provide the theoretical basis for engineering applications. These include Applied Mechanics, Fluid Mechanics, Electronics, Electricity, Thermodynamics, Structural Mechanics, Materials Science. **Engineering Applications** involve Innovation and Design, Systems and Control, Production, Technical Communication, Energy Conversion, Management. General Education subjects serve to provide both an introduction to the environments in which humans function physical, biological, socio-economic, and technological; and an introduction to the cultural bases of knowledge and belief.

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## Combined Courses

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Full-time courses of five years' duration are available for the award of two degrees: Bachelor of Engineer/Bachelor of Science (BE BSc); Bachelor of Engineering/Bachelor of Arts (BE BA). Courses for the award of the degree of BE BSc are available in Aeronautical, Civil Electrical, Mechanical and Industrial Engineering and Naval Architecture. Courses are also available for the award of the degree of BE BA in Aeronautical, Electrical, Mechanical and Industrial Engineering and Naval Architecture.

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## General Education Requirement

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The University requires that undergraduate students undertake a structured program in General Education as an integral part of studies for their degree.

Among its objectives, the General Education program provides the opportunity for students to address some of the key questions they will face as persons, citizens and professionals.

A new General Education program, administered by the Centre for Liberal and General Studies, was introduced in 1988.

Students are required to participate in three categories of the General Education Program:

1. In Category A they are introduced to an environment, and the mode of thought appropriate for considering that environment, which they do not usually study in the major or professional sequence of studies they have chosen. Thus students in the Faculty of Engineering are encouraged to study some aspects of the social or symbolic environments.

2. In Category B they are exposed to subjects which require them to reflect upon their inherited assumptions about knowledge, belief, values, identity, language and so on. In Category B subjects, the emphasis shifts from the more public aspects of the environments in which we live to the conceptual and emotional equipment we bring to a consideration of them.
3. In Category C students are expected to consider in a formal and systematic way the connected issues of professional ethics and social responsibility.

Subjects in categories 1 and 2 are in preparation. The exact form of category 3 is still being decided and should be clearly defined by the end of 1988. This could involve, however, a slight subsequent change to the structure of the later years of degree programs.

There are differing requirements for students commencing before and from 1988.

### **Students who commenced their undergraduate program before 1988.**

Students must complete a program of General Studies in accordance with the requirements in effect when they commenced their degree program. Students yet to complete their General Studies requirement may select subjects from any of the three categories of the new program.

### **Students commencing their undergraduate program in 1988 and following:**

Students must complete a program of subjects selected from each of the three categories of study in accordance with the rules defined in the General Education Handbook and in sequences specified in the requirements for individual courses.

Further information may be obtained from the office of the Centre for Liberal and General Studies Room G58, Morven Brown Building, and the General Education Handbook.

### **Course Transfers**

Student who have completed the first year of an undergraduate course in one school may apply for a transfer to a course in another school of the Faculty with credit for relevant subjects completed. However, as there are considerable differences in the various Year 1 programs, students are not granted complete exemption from Year 1 of the course to which the transfer is made.

Students completing the BSc(Eng) degree course and wishing to qualify for the corresponding BE degree may, on the recommendation of the Head of the School, transfer to the corresponding full-time BE course provided they do not take out the BSc(Eng) degree. Further, provided they continue as registered students on transfer from one course to the other, they may retain any concession granted in the BSc(Eng) degree course.

## **General Rules for Progression**

Progression in all undergraduate courses in the Faculty of Engineering is permitted by subject. However:

1. Course programs will continue to be stated and timetabled by year or stage and it cannot be guaranteed that non-standard programs can be completed in the minimum number of years.

2. Students must satisfy the rules governing re-enrolment: in particular, these require students enrolled in the first year of a degree program to pass in at least half that program. Students are also required to show cause why they should be allowed to repeat a subject which has been failed more than once. Students are also required to show cause why they should be allowed to continue with their course if their average mark in a year of study falls below 50%.

3. Students must satisfy the relevant prerequisite and co-requisite requirements. This will usually necessitate students completing or attempting all subjects of a particular year or stage before proceeding to a subject in the next part of a course. Further details are available from the appropriate school.

4. Only in exceptional circumstances will students be permitted to enrol in subjects extending over more than two years of the course or for more than twenty-eight hours of course work per week if a full-time student or fourteen hours per week if a part-time student. Students repeating subjects are required to choose a program which limits their hours of course work to twenty-two per week if a full-time students, and to eleven per week if a part-time student, unless they have the express permission of the Head of School to exceed these hours.

5. Notwithstanding the above, before students can enrol in any non-standard program such program must meet with the approval of the Head of School. A non-standard program is one which involves enrolment in subjects from more than one year or stage, or comprises subjects which do not normally constitute a particular year's course work.

### **Prerequisites and Co-requisites**

- A prerequisite unit is one which must be completed prior to enrolment in the unit for which it is prescribed.
- A co-requisite unit is one which must either be completed successfully before or be studied concurrently with the unit for which it is prescribed.

### **Industrial Training Requirements**

All full-time engineering courses incorporate industrial training and reference should be made to the entries under each School heading for details of the arrangements applicable. All students are strongly recommended to gain further industrial experience in those long vacations where such training is not already prescribed.

The staff of the University will, where possible, assist students to obtain this employment, but it is emphasized that the primary responsibility for obtaining suitable industrial experience rests with each student. Progression to succeeding years of the course and the award of the degree are dependent on the completion of the requisite periods of industrial employment at a standard approved by the University.

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## Conditions for the Award of the Degree of Bachelor of Science (Engineering)

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The course leading to the award of the degree of Bachelor of Science (Engineering) is normally programmed over six years of part-time study in the University whilst the student is employed in industry. The regulations governing the award of this degree are as follows:

1. A candidate for the award of the degree of BSc(Eng) shall:

- (1) comply with the requirements for admission;
- (2) follow the prescribed course of study in the appropriate school and pass the necessary examinations;
- (3) complete an approved program of industrial training over such period as is prescribed concurrently with attendance in the course. In general, this training must be completed before 31 January in the year in which the degree is to be awarded.

2. During each year a student shall perform laboratory, drawing office and field work, attend demonstrations and excursions to such an extent and in such a manner as is prescribed from time to time by the Academic Board on the recommendation of the Faculty, and, in addition, undertake industrial training as approved by the Head of the School.

3. A student may be granted advanced standing by the Academic Board on the recommendation of the appropriate Faculty but in each case a student must follow an approved course for at least three years with such period of approved industrial training as is prescribed before being eligible for admission to the degree.

4. The degree of BSc(Eng) shall be awarded in the pass grade only but in the case of superior performance throughout the course the degree shall be conferred 'with merit'.

5. Students shall be required to conform with the general rules relating to progressing in University courses.

6. In special cases the Faculty may approve the variation of any of the preceding conditions.

Note: No new enrolments are being accepted into this course.

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## Conditions for the Award of the Degree of Bachelor of Engineering

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Conditions for the Award of the Degree of Bachelor of Engineering

1. A candidate for the award of the degree of Bachelor of Engineering shall:

- (1) comply with the requirements for admission;
- (2) follow the prescribed course of study in the appropriate School, and satisfy the examiners in the necessary subjects;
- (3) complete an approved program of industrial training for such periods as are prescribed. In general, this training must be completed before 31 January in the year in which the degree is to be awarded.

2. During each year a student shall perform laboratory, drawing office and field work, attend demonstrations and excursions to such an extent and in such a manner as is prescribed from time to time by the Academic Board on the recommendation of the Faculty. Those students who are required to undertake field work for any subject must be prepared to pay the appropriate costs and be in attendance at all scheduled examinations except in abnormal circumstances.

3. A student may be granted advanced standing by the Academic Board on the recommendation of the appropriate Faculty, but in each case must complete an adequate period of approved industrial training before being eligible for the degree. In addition to the above requirements a student coming from another institution must comply with the conditions laid down by the Academic Board for admission with advanced standing.

4. The degree shall be awarded in the pass or honours grade. Honours may be awarded in the following categories:

Honours Class I

Honours Class II, Division I

Honours Class II, Division II

5. In special cases the Faculty may approve the variation of any of the preceding conditions.

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## Conditions for the Award of the Degrees of Bachelor of Surveying and Bachelor of Surveying Science

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1. A candidate for the award of the degree of Bachelor of Surveying or Bachelor of Surveying Science shall:

## Engineering

(1) comply with the requirements for admission;

(2) follow the prescribed course of study in the School of Surveying and satisfy the examiners in the necessary subjects;

2. During each year a student shall perform laboratory, drawing office and field work, attend demonstrations, excursions and field camps to such an extent and in such a manner as is prescribed from time to time by the Academic Board on the recommendation of the Faculty. Those students who are required to undertake field work for any subject must be prepared to pay the appropriate costs and be in attendance at all scheduled examinations except in abnormal circumstances.

3. A student may be granted advanced standing by the Academic Board on the recommendation of the Faculty of Engineering. In addition to the above requirements a student coming from another institution must comply with the conditions laid down by the Academic Board for admission with advanced standing.

4. The degree shall be awarded in the pass or honours grade. Honours may be awarded in the following categories:

Honours Class I

Honours Class II, Division I

Honours Class II, Division II

5. In special cases the Faculty may approved the variation of any of the preceding conditions.

## Undergraduate Study

# Course Outlines

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## School of Civil Engineering

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**Head of School**

Professor H. M. Irvine

**Executive Assistant to Head of School**

Dr R. I. Gilbert

**Senior Administrative Officer**

Mr R. W. Prior

The School consists of five departments: **Geotechnical Engineering** (foundation engineering, soil mechanics, rock mechanics, concrete technology, and pavement engineering); **Engineering Construction and Management** (civil engineering systems, engineering economy, project planning and management and civil engineering construction); **Structural Engineering** (structural analysis and structural design); **Transport Engineering** (planning, design, operation of transport systems, statistical analysis, land use and transport modelling, economic evaluations and environmental impact studies); **Water Engineering** (hydraulics, hydrology, water resources and public health engineering).

In addition to extensive laboratory facilities on the Kensington campus, the School operates laboratories at Govett Street and King Street, Randwick and King Street, Manly Vale. The latter complex houses the School's Water Research Laboratory and the associated Water Reference Library. The School also uses the Fowlers Gap Arid Zone Research Station for construction camps and data collection for arid zone hydrology.

The School offers a course (3620) leading to the degree of Bachelor of Engineering (BE), at pass or honours level, which can be taken on a four-year full-time basis, on a part-time basis or on a combined full-time/part-time basis subject to the approval of the Head of School. Intending part-time students are advised that many subjects are offered only in the daytime. Part-time students will normally take two years for each equivalent full-time year.

Alternatively, the course may be taken in a sandwich form in which a student, after completing the first year of the course on a full-time basis, gains industrial experience during one or more periods of employment by taking leave of absence for two consecutive sessions.

The BE syllabus has been revised and will apply to Year 1 in 1989. It is planned that the revised syllabus for later years will be introduced in 1990.

A five year full-time course (3730) leading to the award of the degrees of Bachelor of Engineering and Bachelor of Science (BE BSc) is offered. Students enrol initially in Course 3620 and apply for transfer to Course 3730 on completion of Year 1.

The University requires that undergraduate students undertake a structured program in General Education as an integral part of their degree. For details of the requirements, please locate General Education in the Contents.

The requirements for the award of the BE degree include a period of at least sixty working days of approved industrial training prior to enrolment in the final year.

The degree of Bachelor of Engineering may be conferred as a Pass degree or as an Honours degree. There are two classes of Honours, Class I, and Class II in two divisions, and the award and grade of Honours are made in recognition of superior performance throughout the course with a greater weighting on subjects in the later years.

The award of the degree of Bachelor of Engineering (BE) is recognized by the Institution of Engineers, Australia, as meeting the examination requirements for admission to graduate and corporate membership. Substantial or complete recognition is accorded to BE courses by overseas engineering institutions.

### 3620 Civil Engineering — Full-time Course

#### Bachelor of Engineering BE

Year 1		Hours per week	
		S1	S2
1.981	Physics*	4	3
2.991	Chemistry 1CE†		6
8.110	Computing and Graphics	3	3
8.120	Engineering Mechanics 1	4	4
8.130	Civil Engineering Practice	3	2
10.001	Mathematics	6	6
25.5112	Geology for Civil Engineers	3	
		<hr/>	<hr/>
		23	24

\* Students are advised to attempt 1.981 Physics 1CE but if timetabling difficulties arise or other exceptional circumstances prevail permission will be given to attempt 1.001 Physics 1. Students who intend to apply for transfer to the Combined BE BSc degree program involving Level I/III Physics subjects must enrol in 1.001.

† Students who have not satisfied the Chemistry prerequisite for 2.991 Chemistry 1CE are required to take 2.111 Introductory Chemistry in Session 1 and 2.991 in Session 2. Students who intend to apply for transfer to the combined BE BSc programs involving Level I/III Chemistry subjects must enrol in 2.121 in Year 1 and 2.131 in Year 2 instead of 2.991

# Engineering

Year 2		Hours per week	
8.2110	Systems Engineering 1	2	0
8.2120	Systems Engineering 2	0	2
8.2210	Engineering Construction 2	2	0
8.2220	Engineering Construction 3	0	2
8.2310	Materials Technology	0	4
8.2320	Concrete Technology 1	4	0
8.2410	Mechanics of Solids 1	3	0
8.2420	Mechanics of Solids 2	0	3
8.2430	Structural Design 1	0	4
8.2610	Hydraulics 1	2	0
10.022	Engineering Mathematics 2	4	4
10.381	Statistics SC	2	0
29.441	Surveying for Engineers	0	6
29.491	Survey Camp†	0	3
	One General Education elective	4	0
		<b>23</b>	<b>28</b>

†Students are required to attend a one-week Survey Camp, which is equivalent to 3 class contact hours per week in a session.

Year 3			
8.3110	Engineering Computations	3	0
8.3210	Engineering Management 1	2	0
8.3220	Engineering Management 2	0	4
8.3230	Engineering Construction 4	0	2
8.3310	Soil Mechanics	3	0
8.3320	Geotechnical Engineering	0	3
8.3330	Concrete Technology 2	0	2
8.3410	Structural Analysis 1	3	0
8.3420	Structural Analysis 2	0	3
8.3430	Structural Design 2	4	0
8.3440	Structural Design 3	0	4
8.3510	Traffic Flow Theory	3	0
8.3610	Hydraulics 2	3	0
8.3620	Hydraulics 3	0	3
8.3630	Water Supply and Wastewater Disposal	3	0
8.3640	Engineering Hydrology	0	3
	One half General Education elective	0	2
		<b>24</b>	<b>26</b>

Year 4			
8.4110	Industrial Training	0	0
8.4220	Engineering Management 3	2	0
8.4320	Metals Engineering	2	0
8.4330	Pavement Engineering	2	0
8.4420	Structural Analysis 3	2	0
8.4430	Structural Design 4	2	0
8.4440	Timber Engineering	2	0
8.4520	Transport System Analysis	3	0
8.4620	Water Resources Engineering	3	0
<i>Two of the following:</i>			
8.4210	Construction Major	0	11
8.4310	Geotechnical Major	0	11
8.4410	Structures Major	0	11
8.4510	Transport Major	0	11
8.4610	Water Major	0	11
	One and one half General Education electives	6	0
		<b>24</b>	<b>22</b>

## Combined Course

### 3730 Combined Course for BE BSc in Civil Engineering

Students may seek permission to undertake a five-year full-time combined course leading to the award of the degrees of Bachelor of Engineering and Bachelor of Science (BE BSc). The course is administered by the Faculty of Engineering.

Normally, students enrolled in the BE BSc course may be awarded their degrees at the conclusion of five years' study. However, students who commence the course and do not complete the Civil Engineering component may take out a BSc degree on completion of one of the approved programs of the Science and Mathematics Course.

Similarly, students not wishing to complete the BSc degree course may revert to the Civil Engineering program (3620) with appropriate credit for subjects satisfactorily completed.

The combined course consists of the Civil Engineering program (3620), and at least fourteen units of the Science and Mathematics Course (3970) within an approved program.

There are three approved programs but additional ones may be approved if they are relevant. Approval may be given to change the programs listed below to allow for timetabling and the student's academic interests.

Although transfer from Course 3620 to Course 3730 is normally made at the end of Year 1, first year students who are considering to apply for transfer should note the requirements for 2.121 Chemistry 1A in the first program, and for 1.001 Physics 1 in the second program.

## Geography and Environmental Chemistry

### Year 1

1.981\*  
2.121  
8.110, 8.120, 8.130  
10.001  
25.5112

### Year 2

2.102A, 2.102C, 2.102D, 2.131  
8.2110, 8.2210, 8.2320, 8.2410, 8.2420, 8.2430  
10.022  
27.010 and 27.030  
1 General Education elective

**Year 3**

2.043A  
8.2220, 8.2610, 8.3110, 8.3410, 8.3420, 8.3430, 8.3440  
Two of the following subjects:  
27.133††, 27.143††, 27.153††, 27.183††  
29.441, 29.491  
2 General Education electives

**Year 4**

8.2120, 8.2310, 8.3210, 8.3220, 8.3230, 8.3310, 8.3320, 8.3330,  
8.3510, 8.3610, 8.3620, 8.3640  
27.175, 27.176, 27.193  
At least 1½ units chosen from:  
27.133††, 27.143††, 27.153††, 27.183††, 27.862, 27.863

**Year 5**

Choose 2 units from Table 1 in the Sciences Handbook at Level II or higher.  
8.4110, 8.4220, 8.4320, 8.4330, 8.4420, 8.4430, 8.4440, 8.4520, 8.4620  
Two of the following subjects:  
8.4210, 8.4310, 8.4410, 8.4510, 8.4610

Note: All material not in italic typeface refers to the BE degree component of this combined course.

\*See footnote at end of Course Outline

††These subjects are offered in pairs in alternate years. The two subjects offered in Year 3 are therefore excluded from those available in Year 4.

**Physics with Mathematics****Year 1**

1.001  
2.991\*\*  
8.110, 8.120, 8.130  
10.001  
25.5112

**Year 2**

1.012, 1.022, 1.032  
8.2110, 8.2210, 8.2320, 8.2410, 8.2420, 8.2430  
10.1113, 10.1114, 10.2111, 10.2112  
10.381  
General Education elective (Category A)

**Year 3**

1.002, 1.023, 1.043  
8.2220, 8.2310, 8.2610, 8.3110, 8.3410, 8.3420, 8.3430, 8.3440  
10.111A  
29.441, 29.491

**Year 4**

1.0333  
8.2120, 8.3210, 8.3220, 8.3230, 8.3310, 8.3320, 8.3510, 8.3610, 8.3620, 8.3630, 8.3640  
1 General Education elective  
Choose 1 unit from: 1.133, 1.0533, 1.0133, 1.0143  
Choose 2 Level II or Level III Mathematics units from Table 1 in the Sciences Handbook.

**Year 5**

8.4110, 8.4220, 8.4320, 8.4330, 8.4420, 8.4430, 8.4440, 8.4520, 8.4620  
Two of the following subjects:  
8.4210, 8.4310, 8.4410, 8.4510, 8.4610  
½ General Education elective  
Choose 1 unit from Table 1 in the Sciences Handbook at Level II or higher

Note: All material not in italic typeface refers to the BE degree component of this combined course.

†Students are encouraged to select higher level mathematics units where applicable. See footnotes.

**Computing with some Mathematics****Year 1**

1.981\*  
2.991\*\*  
8.110, 8.120, 8.130  
10.001  
25.5112

**Year 2**

6.711, 6.712  
8.2110, 8.2210, 8.2320, 8.2410, 8.2420, 8.2430  
10.111A†,  
10.1113†,  
10.1114†,  
10.381 1 General Education elective (Category A)

**Year 3**

6.721, 6.722, 6.723  
8.2120, 8.2220, 8.2310, 8.2610, 8.3410, 8.3420, 8.3430, 8.3440, 8.3640  
10.2111†,  
10.2112†,  
29.441, 29.491  
Choose ½ Level II or Level III Mathematics unit from Table 1 in the Sciences Handbook.

**Year 4**

6.733  
8.3210, 8.3220, 8.3230, 8.3310, 8.3320, 8.3330, 8.3510, 8.3610, 8.3620, 8.3630  
1 General Education elective  
Choose three units, at least one of which is a Computer Science Unit, from 6.613, 6.632, 6.633 or Level II or Level III Mathematics units from Table 1 in the Sciences Handbook.

**Year 5**

8.4110, 8.4220, 8.4320, 8.4330, 8.4420, 8.4430, 8.4440, 8.4520, 8.4620  
Two of the following subjects:  
8.4210, 8.4310, 8.4410, 8.4510, 8.4610  
1 General Education elective  
Choose 1 unit from Table 1 in the Sciences Handbook at Level II or higher.

For Notes see overleaf

Note: All material not in italic typeface refers to the BE degree component of this combined degree course.

\*Students are advised to attempt 1.981 Physics 1CE but if time-tabling difficulties arise or other exceptional circumstances prevail permission will be given to attempt 1.001 Physics 1.

\*\*Students who have not satisfied the Chemistry prerequisite for 2.991 Chemistry 1CE are required to take 2.111 Introductory Chemistry in Session 1 and 2.991 in Session 2.

†Students are encouraged to select higher level mathematics units where applicable.

## School of Electrical Engineering and Computer Science

### Head of School

Professor N. W. Rees

### Executive Assistant to Head of School

Dr C. J. E. Phillips

### Senior Administrative Officer

Mr K. J. Flynn

### Administrative Assistant

Miss A.G. M. Johnson

The School comprises five departments: **Communications** (all aspects of theory, applied electronics and engineering relating to communication systems such as telephones, broadcasting and television); **Electric Power** (electrical machines and generation, distribution and utilization of electric energy); **Electronics** (electronic circuits, devices, micro-electronics and application of electronics to such areas as solar power generation); **Computer Science** (design of computer devices and the handling of information in all forms, e.g. numeric alphabetic, pictorial, verbal); **Systems and Control** (development of theories for the control of complex systems and the application of these theories including computer simulation). The School also houses the Joint Microelectronics Research Centre.

Electrical Engineering has close links with the pure sciences and mathematics. Its technology is changing rapidly, and the School's teaching and research programs are constantly under review to meet the ever changing challenges of present and future needs.

The School offers undergraduate and graduate training in all branches of the profession of electrical engineering. A number of inter-departmental and specialized groups (such as Digital Systems, Biomedical Engineering, Measurements, Microelectronics, etc.) are also active.

## Summary of Courses

Course	Degree(s)	Usual Duration (years)
3640	BE	4 full-time <small>Note 1</small>
3645	BE	4 full-time <small>Note 4</small>
3650	BSc (Eng)	6 part-time <small>Note 2</small>
3720	BE and BA	5 full-time
3725	BE and BSc	5 full-time
3970 <small>Note 3</small>	BSc (pass)	3 full-time
	BSc (honours)	4 full-time

**Note 1** Course 3640 Full-time/Part-time Sandwich

A student in course 3640 may with the approval of the Head of School complete

the requirements by a combination of full-time and part-time study after having completed the first year full-time. To ensure that prerequisites are met and the program can be timetabled, students should consult with the School as early as possible when a change in attendance pattern is envisaged. A part-time student must be able to attend classes at least one afternoon per week as not all subjects are available in the evenings. Students commencing the part-time course after 1984 may be required to attend up to two half-days per week. After Year 1 of the BE, a form of sandwich pattern is possible by arrangement with the Head of School, comprising alternate periods of full-time study and full-time employment with part-time study.

### Note 2 Course 3650

No new enrolments are being accepted into course 3650. A student already enrolled in this course may complete it and graduate with a BSc (Eng) degree or may request to transfer to course 3640 and graduate with a BE degree.

### Note 3 Course 3970

This course is operated by the Board of Studies in Science and Mathematics and is for students wishing to major in Computer Science in a Science and Mathematics context. For more details see the Sciences Handbook. Most of the course is available in evening classes but some day attendance is essential in Year 3.

### Note 4 Course 3645

This new course, which commences in 1989, is to be phased in over four years. Only Year 1 of the course will be offered in 1989.

The undergraduate curriculums are being progressively revised to provide a flexible training to suit the needs of today and tomorrow. Individual student needs can be further met by quite extensive substitution provisions within the course programs.

## Recognition

The degrees of Bachelor of Engineering and Bachelor of Science (Engineering) are recognized by the Institution of Engineers, Australia and the Institution of Radio and Electronics Engineers, Australia, as meeting the examination requirements for admission to graduate and corporate membership. Substantial or complete recognition is also accorded to these courses by overseas engineering institutions.

## Honours

In the Bachelor of Engineering Course the same formal program is offered to both pass students and to those aiming at honours. Honours will be awarded for meritorious performance over the course; special attention is paid to a candidate's performance in the final year subjects and thesis project. A student with a creditable performance in the Bachelor of Science (Engineering) course may be awarded a degree with Merit.

The award of the BA or BSc degree at honours level requires two additional sessions of study. See the Arts and Sciences Handbooks for details.

## Substitution of Subjects

To suit the special abilities or needs of individual students a limited amount of substitution is permitted within each course. Any such substitution *must have prior approval of the Head of School* who will ensure that:

1. The replacement subject is at least the same length and level as the prescribed subject it replaced; and,
2. The resulting overall program of study is suited to the award of the degree as applicable.

Substitution is not permitted in Year 1.

## Examples

(i) Replacement of General Education subjects by subjects approved (by the Director of the Centre for Liberal and General Studies) selected from areas such as Arts, Life Sciences, Earth Sciences, Accounting and Business Administration, Law, Economics, Industrial Management.

(ii) The normal Year 4 of the BE degree program includes 5 units of Electrical Engineering IV. Students may substitute for *one* of these units, a subject of suitable level and difficulty from an area

**3640****Electrical Engineering—Sandwich Course****Bachelor of Engineering  
BE**

After the successful completion of Year 1 of the full-time Course 3640, the following sandwich pattern is available, comprising alternate periods of full-time study and full-time employment with part-time study.

	Hours per week	
	S1	S2
10.1214 Higher Pure Mathematics 2 Complex Analysis	2½	0
10.1213 Higher Pure Mathematics 2 Multivariable Calculus	2½	0
10.2211 Higher Applied Mathematics 2 Vector Calculus	2½	0
10.0331 Transform Methods	0	2
10.361 Statistics SE	0	2
1.982 Solid State Physics	4½	0
6.712 Computing 1B	6	0
6.821 Circuit Theory	2½	0
6.825 Electromagnetic Theory & Applications	2½	2½
6.827 Electrical Engineering Laboratory 2 A	1½	0
6.828 Electrical Engineering Laboratory 2 B	0	1
	<u>24½</u>	<u>7½</u>

**Year 3 (1989 only)**

6.021C Electronics 1	4	0
6.824 Digital Circuits	0	2½
6.822 Systems Theory	0	2½
6.825 Electromagnetic Theory & Applications	2½	2½
6.828 Electrical Eng. Lab. 2B	0	2
6.829 Electrical Design 1	0	3
6.0312 Utilisation of Elec. Energy	0	4
6.0313 Electronics 2	0	4
10.1214 Higher Pure Mathematics 2 Complex Analysis	2½	0
10.0331 Transform methods	0	2
10.361 Statistics (A)	0	2
	<u>9</u>	<u>24½</u>

**Year 4**

6.0314 Systems and Control 1	0	4
6.0315 Electrical Energy	0	4
6.0316 Electronics 3	0	4
6.0317 Communication Systems 1	0	4
6.0318 Microprocessor Systems and Applications	0	4
10.0332 E.E. Mathematics 3—Numerical Methods	0	2
10.361 Statistics S.E.	2	2
One General Studies Elective	4	0
	<u>6</u>	<u>24</u>

**Year 5††**

5 Professional Electives*	15	10
6.911 Thesis**	3	21
6.903 Industrial Training		
10.0331 Transform Methods	2	0
One Technical Elective or Industrial Elective***		
	<u>20</u>	<u>31</u>

†††Students who have achieved a certain standard may attempt similar material at a higher level.

†See list of Technical Electives later this section.

††Students are required to complete 168 hours of General Studies electives for the BE degree. If these have not been completed by the end of Year 4, then General Studies must be included in the Year 5 program.

\*Three electives are taken in Session 1 and two in Session 2. See list of Professional Electives later this section.

\*\*6.911 Thesis is done in the last two sessions of a student's course. See subject description.

\*\*\*See 6.931 Industrial Elective subject description.

**3645****Computer Engineering — Full-time course****Bachelor of Engineering  
BE**

This is a new course, commencing in 1989. The course is to be phased in over four years and only Year 1 will be offered in 1989. As a consequence subject description for computing subjects appearing in later years are not given in this handbook.

	Hours per week	
<b>Year 1</b>		
1.961 Physics	6	6
6.010 Electrical Engineering 1	—	6
6.710 Introduction to Computer Engineering	1½	1½
6.711 Computing 1A	6	—
6.712 Computing 1B	—	6
10.001 Mathematics 1	6	6
10.081 Discrete Mathematics	6	—
	<u>25½</u>	<u>25½</u>

**Year 2**

Proposed subjects include:

Data Organization  
Computer Organization  
Concurrent Computing  
Circuit Theory  
Analog Electronics  
Digital Circuits  
Linear Algebra  
Complex Analysis  
Finite Mathematics A  
Statistics SE

# Engineering

## Year 3

Proposed subjects include:

Parsing and Translation  
 Microprocessors and Interfacing  
 Programming Techniques  
 Systems Theory  
 Integrated Electronics  
 Signal Processing  
 Transform Methods  
 Numerical Analysis  
 Management and Economics

## Year 4

To consist of Electrical Engineering and Computer Engineering Electives.

Students intending to do honours will complete a thesis.

## 3650

### Electrical Engineering

#### Bachelor of Science (Engineering) BSc(Eng)

Please note that from 1983, no new enrolments are being accepted into the BSc(Eng) degree course.

Stage 5 and 6 of Course 3650 are identical to those of the 3640 part-time Course except for the deletion of Industrial Elective from Stage 5, the replacement of 6.911 Thesis by 6.921 Project in Stage 6 and the replacement of 6.903 Industrial Training by 6.902 Industrial Experience. 6.902 comprises 3 years of appropriate industrial experience concurrent with the course. The formal enrolment in 6.902 is in Stage 6.

#### Technical Electives — all courses

	Hours per week	
	S1	S2
1.992 Mechanics and Thermal Physics	2	2
4.964 Materials Science and Engineering for Electrical Engineers	0	4
5.065 Mechanical Engineering	4	0
6.046 Project Evaluation (½ elective)*	2	0
6.047 Reliability Engineering in Design and Development*	0	4
6.402 Introductory Physiology for Engineers	4	0
6.641 Computing 2C	5	or 5
8.6120 Civil Engineering	4	0
18.091 Industrial Management	5	0
18.1211 Production Management A (½ elective)*	3	0
48.302 Fuels and Energy	0	4

A free choice may not be possible.

\*One Technical Elective may be made up of the following alternative combinations.

- 6.046 Project Evaluation  
18.1211 Production Management A
- 6.046 Project Evaluation  
6.047 Reliability Engineering in Design and Development (Part A)
- 6.047 Reliability Engineering in Design and Development (Parts A&B)

### Electrical Engineering Professional Electives — all courses

Each elective is 5 hours per week for one session.

- 6.042 Digital and Analogue Signals
- 6.202 Power Engineering 1
- 6.203 Power Engineering 2
- 6.212 Power Engineering — Utilization
- 6.215 Industrial Electrical Systems
- 6.222 High Voltage Technology
- 6.303 Transmission Lines for Microwave and Optical Communication
- 6.313 Signal Propagation at Microwave and Optical Frequencies
- 6.322 Electronics 4
- 6.323 Communication Systems 2A
- 6.333 Communication Systems 2B
- 6.412 Systems and Control 2
- 6.413 Digital Control
- 6.432 Computer Control and Instrumentation
- 6.483 Biomedical Engineering
- 6.512 Semiconductor Devices
- 6.522 Transistor and Integrated Circuit Design
- 6.532 Integrated Digital Systems
- 6.612 Computer Organization and Digital Systems Design
- 6.622 Computer Applications
- 6.652 Data Communication and Computer Networks
- 6.672 Operating Systems and Compilers

Because of timetable clashes a free choice from all these electives is not possible.

The program selected by each student must be approved by the Head of School. Not all electives are offered each session, nor is the full range available to part-time students. Students are advised each year of the timetable of available electives. Substitution is not permitted if it unduly restricts the range of subjects studied to only one area of electrical engineering and computer science.

**Prerequisites and Co-requisites**  
**Arranged in order of full-time Bachelor of Engineering Degree Course**

Year	Subject	Prerequisites*	Co-requisites
1	1.961	See Matriculation and Admission Requirements	
	2.9111		
	5.0011	See Matriculation and Admission Requirements	
	5.0016		
	6.010	The Electricity & Magnetism section of 1.961	
	6.011		
	6.711		10.001
	10.001	See Matriculation and Admission Requirements	
10.0911	10.001		
2	1.982	1.961, 10.001	10.2111
	10.0331	10.1114, 10.2111	
	10.1213	10.001(CR)	
	10.1214	10.1213‡	
	10.2211	10.001(CR)	
	10.361	10.001	
	6.712	6.711	
	6.821	1.961, 6.010, 10.001	10.1214
	6.822	6.821, 10.1213, 10.1214, 10.0331	10.0331
	6.823	6.821, 1.982	
	6.824	6.010	
	6.825	6.010, 1.961	10.2111, 6.821
	6.827	1.961, 6.010	
	6.828	6.827, 6.821	6.822, 6.823, 6.824, 6.825
6.829	5.0016, 6.010, 6.011, 6.821	6.823, 6.824	
3	1.992	1.961, 10.001	10.2111
	4.964	1.982	
	5.065	10.2111, 10.2112, 1.961	
	10.0331	10.1114, 10.2111	
	10.0332	10.111A, 10.1113, 10.1114, 10.2111, 10.2112	
	10.361	10.001	
	6.0311	6.021A, 6.021B, 6.021C†, 10.111A**, 10.1113, 10.1114, 10.2111, 10.2112*	
	6.0312	6.021A, 6.021B	6.0311
	6.0313	6.021A, 6.021C	6.0311
	6.0314	6.0311	
	6.0315	1.972, 6.0312**	
	6.0316	6.0313	6.021E, 6.0311
	6.0317	6.0311	10.361
	6.0318	6.021D, 6.021E	
	6.047	10.361††	10.361††
	6.641	6.021D	
4	18.091	10.2112, 10.361**	
	6.041	6.0311, 6.0313	
	6.042	10.0331, 10.361, 6.0311	
	6.202	6.0312, 6.0315	
	6.203	6.202	
	6.212	6.0312, 6.0315	
	6.215	6.0315	

Year	Subject	Prerequisites	*Co-requisites
	6.222	6.0315	
	6.303	6.0317	
	6.313	6.303	
	6.322	6.0313, 6.0316	
	6.323	6.0317, 10.0331, 10.361	
	6.333	6.0316, 6.0317	
	6.412	6.0311, 6.0314	
	6.413	6.0314, 10.0331, 10.0332, 10.361	
	6.432	6.0314, 6.0316, 6.0318	
	6.483	6.0314, 6.0316, 6.402	
	6.512	6.0313	
	6.522	6.0313, 6.0316	
	6.532	6.021E, 6.0316	
	6.612	6.0318 or 6.613	
	6.622	6.641	
	6.652	6.0318 or 6.613, 6.0317, 6.672 or 6.632	
	6.672	6.0318 or 6.613	
	6.911	(in graduating program only)	

§ Pass Terminated result (PT) does not satisfy prerequisite requirements.

\*Two of 10.1113, 10.2111, or 10.2112 may be taken as co-requisites.

\*\*Attempted at an acceptable level and to be taken as a co-requisite.

†One of 6.021B or 6.021C may be taken as a co-requisite.

‡The first session of 10.361 is a prerequisite and the second session of 10.361 is a co-requisite.

‡10.1213 may be taken as a co-requisite.

## Combined Courses

Students in Electrical Engineering who maintain a creditable performance may qualify for the award of two degrees in five years of combined full-time study in which the requirements of the degrees have been merged. (The two degrees referred to here are the Bachelor of Engineering/Bachelor of Science BE BSc and the Bachelor of Engineering/Bachelor of Arts BE BA.) Students wishing to enrol in a combined course may do so only on the recommendation of the Head of School of Electrical Engineering and Computer Science and with the approval of the Faculty of Engineering and either the Faculty of Arts or the Board of Studies in Science and Mathematics, as appropriate. Students wishing to enrol in, transfer into, or continue in a combined course shall have complied with all the requirements for prerequisite study, sequencing and academic attainment (a creditable performance, ie 65% average) of both the Course Authorities concerned.

Students who commence a course but subsequently do not wish to proceed with both areas of study, or who fail to maintain a creditable performance, revert to a single degree program with appropriate credit for subjects completed. AUSTUDY support is available for the five years of the combined degree courses.

Students may transfer into a combined course after partially completing the requirements for either degree provided suitable subjects have been studied. However, the choice of subjects and the time taken to complete the program can be seriously affected by this. Thus, students considering course 3725 or course 3720 should contact the Electrical Engineering School before completing their Year 2 enrolment. Application for trans-

fer to a combined course must be made in writing to the Head of School by the end of the first week of January in the year following their completion of Year 2 of the BE course.

Students wishing to gain a degree at honours level in Arts or Science as part of their combined degree program shall meet all the relevant requirements of the Faculty concerned and of the appropriate Schools. Such students may enrol for the Honours year only on the recommendation of the Head of School of Electrical Engineering and Computer Science and with the approval of the Faculty of Engineering and either the Faculty of Arts or the Board of Studies in Science and Mathematics, as appropriate.

Re-enrolment of students in Courses 3720 and 3725 each year is arranged by the School of Electrical Engineering and Computer Science.

### 3725 BE BSc in Electrical Engineering

Changes may be made to the double degree program in 1989 due to the introduction of revisions to the BE course 3640. Students who commenced course 3640 in 1988 or later, and who wish to do the double degree, should consult with the School of Electrical Engineering and Computer Science.

Having completed Years 1 and 2 of course 3640 prior to 1989 students in their third year complete a specific course of study consisting of four Level III Science units chosen from related disciplines, the appropriate General Education electives and not less than four other Level II or Level III units, and otherwise accord with the rules of course 3970 leading to a major in Computer Science, Mathematics or Physics.

Students may open up a wider choice of subjects in their Science Year by including additional Computer Science (viz 6.641), Physics (viz 1.992) or Mathematics in their Year 2 Electrical Engineering program. Any subject omitted may be required to be taken later in the course. The extra subject in Year 2 may be credited towards either the BE or BSc requirements, but not both.

Students wishing to gain a degree at honours level in Science as part of their combined degree program shall meet all the relevant requirements of the Board of Studies in Science and Mathematics and of the School concerned. Such students may enrol for the honours year only on the recommendation of the Head of the School of Electrical Engineering and Computer Science and with the approval of the Head of the appropriate Science School, the Faculty of Engineering and the Board of Studies in Science and Mathematics. AUSTUDY support is available for the six years of the combined degree programs including honours level Science.

In their fourth and fifth years students do Year 3 and Year 4 of course 3640. Depending on the program followed in their year of Science they may have already completed parts of the normal third and fourth year programs of the Electrical Engineering course, and they will be required to omit these from their program and to include an equivalent amount of other courses chosen with the approval of the Head of School.

**Year 1**

- 1.961
- 2.121
- 5.0011
- 5.0016
- 6.010
- 6.611
- 10.001

1 General Education elective

**Year 2†**

- 1.972, 1.982
- 6.021A, 6.021B, 6.021C, 6.021D, 6.021E
- 10.111A, 10.1113, 10.1114, 10.2111, 10.2112

1 General Education elective

**Year 3†\***

- Either
- Computer Science
- 1 General Education elective

Choose at least 8 Level II or Level III units including at least 4 Computer Science units at Level III, the balance to be chosen from Level III Computer Science units and other Level II or Level III units in Table 1 or Tables 2 for program 0600\*\*

or  
Mathematics  
1 General Education elective

Choose at least 5 Mathematics units, 4 of which are Level III  
Choose at least 3 Level II or Level III units from Table 1 or Table 2 for program 1000

†Students intending to major in Computer Science should include 6.641 in their Year 2 enrolment. Students intending to major in Physics are required to take unit 1.992 in Year 2.

\*For Year 3 refer to course 3970 and the Science Handbook.  
\*\*For this strand only the Level I unit, 14.501 Accounting and Financial Management 1A may be taken in place of one of the other Level II or Level III units. Students should note that this subject is a prerequisite for the level III unit, 6.647 Business Information Systems.

or  
Physics  
1 General Education elective

Choose 7 Level II or Level III units from Table 1 of which four must be Level III Physics units, chosen to include 1.0133, 1.0143, 1.023 and 1.0333.

**Year 4**

Year 3 of Electrical Engineering course, modified as required by Head of School

**Year 5**

Year 4 of Electrical Engineering course

**3720  
BE BA in Electrical Engineering**

The combined course should include

- the requirements of a normal BE program in Electrical Engineering less the General Education subjects and one other subject approved by the Head of the School;
- subjects equivalent to 108 credit points in accordance with the regulations of the Faculty of Arts provided that this includes a major sequence of subjects available within the Faculty of Arts in addition to the studies in the School of Mathematics and the Department of Computer Science. These include the subjects in Table A or their equivalents.

Table A

	Credit Points
10.001 Mathematics 1	12
10.111A Pure Mathematics 2	4
10.1113 Pure Mathematics 2	2
10.1114 Pure Mathematics 2	2
10.2111 Applied Mathematics 2	2
10.2112 Applied Mathematics 2	2
10.361 Statistics SE	2
1.961 Physics 1	12
1.972 Electromagnetism	4
1.982 Solid-State Physics	4
6.021D Computing	4
6.021E Digital Logic and Systems	4
	<u>54</u>

Guidance should be sought from the School of Electrical Engineering and Computer Science, the relevant schools in the Faculty of Arts and the Arts Faculty office. After four years of study a student will normally have completed the BA requirements of study, together with subjects selected from course 3640 (in accordance with an acceptable program loading) and in the fifth year will complete requirements for a BE.

It is necessary for each individual student entering the course to lodge for approval a complete program of study: changes in detail are usual from year to year. Students should choose their Arts Major early so as to start the sequence in Year 1 if possible.

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**Studies in Computer Science *other than* in BE Courses 3640 and 3645, BE BA 3720 and BE BSc 3725**

**Year 3**

4 Computer Science Level III units  
3 other Level II *or* Level III units  
1 *General Education elective*  
Students intending to proceed to Honours should choose 7 Level III units

**Year 4**

6.606

For further details see the Sciences Handbook.

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**Minor Study in BA Course 3400 or BSc course 3970**

Some students will wish to include a small number of Computer Science units in courses leading to major studies in other disciplines. Level I unit 6.711, Level 1/11 unit 6.712 and Level II units 6.721, 6.722, 6.723 are freely available to such students.

Students majoring in other disciplines may also seek entry, on a competitive merit basis, to a limited range of Level III units.

**Major Study in BA Course 3400 or BSc course 3970**

For studies in Computer Science to be regarded as being major studies, at least four Level III units of Computer Science must be included after completing Level I unit 6.711, Level 1/11 unit 6.712 and the three Level II units, 6.721, 6.722, 6.723.

**Course 3400**

For further details of major studies in Computer Science within the Bachelor of Arts degree course, please see the Arts Handbook.

**Course 3970**

Entry to a Computer Science major in course 3970 is normally by direct selection at University entry.

Year 1 students in course 3970 who are not selected for direct entry into a Computer Science major may enrol in program 6806. For such students enrolment in Year 2 of a Computer Science program is based on academic performance in Year 1; a credit average (65%) is normally required.

A total of 23 units is required for graduation at the pass level.

**Year 1**

6.711, 6.712  
10.001, 10.081  
3 other Level 1 units

**Year 2**

6.721  
6.722  
6.723  
5 other Level II units  
1 *General Education elective*

## Computer Science Electives offered by the School

No.	Name	Level	Prerequisites	Co-requisites	Excluded
6.711	Computing 1A	I	As for 10.001	10.001 or 10.011	6.600, 6.611, 6.620, 6.021D
6.712	Computing 1B	I/II	6.711		6.620, 6.621, 6.021D
6.721	Data Organization*	II	6.712		6.641
6.722	Computer Organization*	II	6.712		6.631
6.723	Concurrent Computing*	II	6.712		
6.621	Computing 2A**	II	6.611 and 10.001 or 10.011		6.620, 6.021D 6.021E
6.631	Computing 2B***	II	6.620 or 6.021D or 6.621		
6.641	Computing 2C***	II	6.620 or 6.021D or 6.621		
6.613	Computer Organization and Design	III	6.631 or 6.021E, 6.021D or 6.620 or 6.621		6.0318
6.632	Operating Systems	III	6.631 or 6.021E, 6.641		6.672
6.633	Data Bases and Networks	III	6.641		14.607, 14.608, 6.622
6.642	Design and Analysis of Algorithms	III	6.641		
6.643	Compiling Techniques and Programming Languages	III	6.641		6.672
6.646	Computer Applications	III	6.620 or 6.021D or 6.621, 10.311 or both 10.311A and 10.311B or equivalent		6.622
6.647	Business Information Systems	III	6.641, 14.501 or 14.001		

\* Not offered until 1990

\*\* Not offered after Session 1, 1989

\*\*\* Not offered after Session 2, 1989

## School of Mechanical and Industrial Engineering\*

### \*Incorporating Aeronautical Engineering, Naval Architecture and Nuclear Engineering

#### Head of School

Vacant

#### Executive Assistant to Head of School

Associate Professor J. E. Baker

#### Senior Administrative Officer

Mr G. Dusan

The School consists of three departments. **Applied Mechanics** (agricultural engineering, automatic control, biomechanics, engineering design, engineering mechanics and mechanics of solids); **Fluid Mechanics and Thermodynamics** (energy utilisation and power generation, nuclear engineering, refrigeration and air conditioning, gas and liquid handling, aeronautical engineering and naval architecture); **Industrial Engineering** (eco-

nomics analysis, production planning and control, product and process design, methods engineering and operations research). The **Centre for Manufacturing and Automation** is also located within the School.

The School offers courses in **Aeronautical Engineering, Industrial Engineering, Mechanical Engineering and Naval Architecture**, either singly or in combination with Science or Arts courses.

The courses are planned to provide the appropriate academic training for the professional engineer in the fields of aeronautical, industrial and mechanical engineering, and for the naval architect. They may be taken on a full-time basis, normally over four years, or on a combined full-time/part-time basis. Part-time students will normally take two years for each equivalent full-time year and will be required to attend day classes for the equivalent of at least 1 ½ days per week. Students intending to enter part-time study are advised that most subjects in the course are only offered in the day-time.

The courses lead to the award of the degree of Bachelor of Engineering (BE).

The School also offers combined courses in conjunction with other faculties of the University, leading to the award of the two degrees of Bachelor of Engineering and Bachelor of Science (BE BSc) or Bachelor of Engineering and Bachelor of Arts (BE BA). These combined courses enable students to major in the area of computer science, materials science, mathematics, physics, statistics or another relevant field, in addition to studying their chosen engineering speciality.

For the four BE courses, the study of the basic sciences — mathematics, physics and chemistry — together with an introduction to engineering, comprise Year 1. In Year 2 further mathematical studies are undertaken, together with a study of the engineering sciences — thermodynamics, fluid mechanics, engineering mechanics, mechanics of solids — and their application in the field of design.

The first halves of the courses of Mechanical, Industrial and Aeronautical Engineering and of Naval Architecture are identical, and students attend classes together. The latter halves of these four courses contain a number of common core subjects together with specific disciplinary requirements. In the final years, in addition to core subjects and disciplinary requirements, provision is made for a limited degree of specialization in one or more elective subjects. Students with a distinguished academic record may take, subject to the approval of the Head of School, a limited number of graduate subjects offered by the School in lieu of an equivalent quantity of final year undergraduate electives. Each student is required to submit a thesis at the end of the final year and to deliver a short paper on the subject of the thesis. The University requires that undergraduate students undertake a structured program in General Studies as an integral part of their degree. For further details, please locate General Education in the Contents. In certain instances and with permission from the Head of School and the Standing Committee on General Education, students may substitute an Arts subject in lieu of two General Studies subjects.

Industrial experience is an integral part of the courses. Full-time students must complete forty working days of approved industrial training between both Years 2 and 3 and Years 3 and 4. Students are strongly recommended to gain as much industrial training as possible between Years 1 and 2.

Students taking the course on a full-time/part-time basis must complete an equivalent amount of industrial training.

Students who have had suitable industrial experience may qualify for exemption from certain subjects. The Head of School should be contacted for details.

All BE degree course students are considered for the award of Honours which is granted for meritorious performance in the course with particular emphasis on the later years. Honours in Science or Arts in the BE BSc or BE BA combined degree course require an extra year of study.

The Institution of Engineers, Australia, recognizes the degree of BE in any of the undergraduate courses offered by the School as meeting the examination requirements for admission to graduate and corporate membership. Substantial or complete recognition is accorded to the BE courses by overseas engineering institutions.

The award of the degree BE in Aeronautical Engineering is recognized by the Royal Aeronautical Society as giving

exemption from the formal examination requirements for corporate membership. Advancement from graduate membership to associate membership grade is awarded on a case by case basis after a further period of some years of professional experience.

The award of the degree BE in Naval Architecture is recognized by the Royal Institution of Naval Architects (RINA), London, as the academic qualification for corporate membership of that body.

## Course Progression Guidelines

It is the responsibility of each student to have met the course requirements by the date of application for the degree. In this context, the student's attention is directed to the Faculty's General Rules for Progression contained in the preceding chapter of this Handbook. As well, the following points should be noted.

- Progression in the School's courses is by subject, although programs and timetables are arranged by year.
- In addition to the specific subject prerequisites for a particular year of a course, a general understanding of the material in the preceding year is assumed.
- Previously failed subjects must be included in a student's current program, except that a failed elective may be replaced by another elective.
- A student who is faced with compiling a mixed year's program must give preference to subjects from the lower year of the course.
- In the event of a student dropping one or more subjects from a mixed year's program, the discarded subject(s) must be chosen from the higher year's selection.
- The subjects 5.051 Thesis and 5.062 Communications can be taken only in the final year of a student's program.

## Revision of Courses

An extensive review of all the courses in the School has taken place over the last few years and the revised courses are to be progressively introduced from 1989. Changes have been made to the Year 1 subjects, some new ones appearing this year, and there will be a continuous introduction of new or altered subjects in the later years until 1992. Thus, students commencing now will complete the new programs, while those who commenced in 1988 or earlier will continue with the existing ones.

The object of the revision has been to modernise the courses, so that a greater emphasis will be placed on electronics, microprocessors, instrumentation, robotics and computing, all of which are now important to Mechanical and Industrial Engineering. In first year this has resulted in a revised Physics course, emphasising in part the fundamentals of the above areas, and a new, more extensive Computing subject. Subject areas are to be streamed throughout the courses so that discontinuities in the teaching of material will be minimised.

In addition, owing to the increased emphasis in Australia on Manufacturing, a final-year stream in that area has been introduced. Students taking the Industrial Engineering program will henceforth have two options at the end of third year — either to continue in the more general area of Industrial Engineering or to concentrate specifically on Manufacturing.

### 3680 Mechanical Engineering — Full-time Course

#### Bachelor of Engineering BE

Note: The program as presented is for full-time study. Alternative programs are available for a combination of full-time and part-time study. Students wishing to commence studies on a part-time basis must, in Year 1, study the subjects: 1.911, 2.951, 5.0010, 5.0011, 10.001.

Year 1		Hours per week	
		S1	S2
1.911	Physics 1 (Mechanical Engineering)	4	4
2.951	Chemistry 1ME	6	0
5.0010	Professional Studies 1	1	0
5.0011	Engineering Mechanics 1	4	0
5.0300	Graphical Analysis and Communication	0	3
5.0303	Workshop Technology	3	0
5.0305	Manufacturing Technology	0	3
5.1010	Mechanical Engineering Design 1	0	3
5.421	Mechanics of Solids	0	3
5.5010	Computing 1M	0	3
10.001	Mathematics 1	6	6
		<u>24</u>	<u>25</u>

An alternative 'Science/Arts compatible' course which can be undertaken by all students, and which must be undertaken by potential combined degree students, is as follows:

1.001	Physics 1	6	6
2.121	Chemistry 1A* or	6	0
2.951	Chemistry 1ME*		
5.0010	Professional Studies 1	1	0
5.0011	Engineering Mechanics 1	4	0
5.0300	Graphical Analysis and Communication	0	3
5.0303	Workshop Technology	3	0
5.0305	Manufacturing Technology	0	3
5.1010	Mechanical Engineering Design 1	0	3
5.421	Mechanics of Solids	0	3
10.001	Mathematics 1	6	6
<i>and either</i>			
1 relevant level I unit from the School of Physics, Chemistry, Electrical Engineering and Computer Science, or Mathematics offerings in Table 1 of Sciences Handbook or*			
5.010	Computing 1M	<u>26</u>	<u>30†</u> (or 27#)

\*Students are recommended to choose 2.951 unless they wish to pursue studies requiring 2.121. Computer Science majors must choose 2.951 and subsequently 6.711 Computing 1A in Session 2. Materials Science majors must choose 2.121 and subsequently 2.131 Chemistry 1B in Session 2.

†For BE/BSc students. Computer Science majors must take 6.711. Materials Science majors must take 2.131.

#For BE/BA students.

Year 2		Hours per week	
		S1	S2
5.122	Mechanical Engineering Design 2	3	3
5.3021	Engineering Mechanics 2A	3	0

5.3022	Engineering Mechanics 2B	0	2
5.4220	Mechanics of Solids 2		
5.4222	Mechanical Engineering Materials	4½	4½
5.620	Fluid Mechanics	2	2
5.626	Thermodynamics	2	2
10.022**	Engineering Mathematics 2	4	4
10.351	Statistics SM	2	2
	General Education elective (s)	2	2
		<u>22½</u>	<u>21½</u>
Year 3			
5.034	Engineering Experimentation	2	1½
5.043*	Industrial Training 1	0	0
5.070	Optimal Engineering Strategies	1½	1½
5.079†	Numerical Methods	1½	1½
5.123	Mechanical Engineering Design 3	3	3
5.3030	Engineering Mechanics 3	0	2
5.3130	Vibration Analysis	0	2
5.343‡	Linear Systems Analysis	3	0
5.423	Mechanics of Solids 3	2	2
5.630	Fluid Mechanics 2	1½	1½
5.636	Thermodynamics 2	1½	1½
6.854	Electrical Engineering	0	3
6.856 #	Electronics for Measurement and Control	3	0
18.603	Management/Economics	2	2
	General Education elective(s)	2	2
		<u>23</u>	<u>23½</u>

Note: Appropriate concessions will be made at enrolment for students who have already completed electives which have material in common with 5.630 and/or 5.636.

\*\*Students may substitute 10.111A, 10.1113, 10.2111 and 10.2112 for 10.022. Also, if they satisfy pre-requisites, they may take one or more of these at the higher level.

\*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained prior to Year 3. Students may not enrol in 5.043 without submitting the relevant report.

†Combined degree course students who have taken 10.2116 Applied Mathematics 2 — Continuous - Time Systems or 10.2216 Higher Applied Mathematics 2 — Continuous - Time Systems or 10.212A (or 10.222A) Numerical Analysis should substitute a Technical Elective or a half Level II or Level III unit from Table 1 of the Sciences Handbook for this subject.

‡Combined degree course students who have taken 10.212M (or 10.222M) Optimal Control Theory should substitute a Technical Elective or a half Level II or III unit from Table 1 of the Sciences Handbook.

#Combined degree course students who have taken 1.9222 Electronics or 1.032 Laboratory should substitute a Technical Elective or a half Level II or III unit from Table 1 of the Sciences Handbook.

Year 4			
5.044*	Industrial Training 2	0	0
5.051	Thesis	6	6
5.062	Communications	2	2
5.350	Principles of Control of Mechanical Systems	3	0
	Technical Electives	9	12
	General Education elective(s)	2	2
		<u>22</u>	<u>22</u>

Note 1: At least six hours per week of Technical Electives must be taken from the Mechanical Engineering Technical Elective list. The remaining Technical Electives may be taken from the Industrial Engineering Technical Elective List or from Years 3 or 4 of other courses in the School or suitable subjects outside the School. Students with good academic records may include some graduate subjects. A counseling service is provided to assist students to choose electives. The selection of certain subjects or combinations of subjects may require the approval of the Head of School.

**Note 2:** Only a limited number of Technical Electives is offered each year. The actual Technical Electives offered each year are decided on the basis of staff availability and student demand. Students are advised in September of each year which Technical Electives will be offered in the following year.

\*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained between Years 3 and 4. Students may not enrol in 5.044 without submitting the relevant report.

## Mechanical Engineering Technical Electives

### Applied Dynamics

	Hours per week	
	S1	S2
5.3040 Plane Mechanism Kinematics	3	or 3
5.348 Mechanical Vibrations 2	3	or 3
5.3541 Engineering Noise 1	3	0
5.3542 Engineering Noise 2	0	3

### Mechanics of Solids

5.424 General Mechanics of Solids	3	or 3
5.434 Plates and Shells	3	or 3
5.444 Theory of Elasticity	3	or 3
5.454 Theory of Plasticity	3	or 3
5.464 Structural Instability	2	0

### Mechanical Design

5.1240 Design Project	3	3
5.1242 Design Technology	3	0
5.1243 Machinery Design Project	0	3
5.1244 Project Management	0	3
5.1245 Computer-Aided Engineering Design	0	3

### Fluid Mechanics/Thermodynamics

5.633 Turbomachines	3	or 3
5.6341 Viscous Flow Theory	1½	1½
5.6342 Lubrication	0	3
5.635 Convection Heat Transfer	3	or 3
5.643 Energy, Combustion and Engines	3	or 3
5.644 Solar Energy	3	or 3
5.654 Hydraulic Transients	3	or 3
5.664 Multiphase Flow	3	or 3
5.673 Special Fluid Mechanics Elective	3	or 3
5.674 Special Thermodynamics Elective	3	or 3

### Industrial Engineering

18.004 Manufacturing Management	2	2
18.224 Numerical Control of Machine Tools	3	or 3
18.303 Methods Engineering	2	2
18.403 Production Design and Technology	4	4
18.404 Design for Production	2	2
18.503 Operations Research A	3	3
18.551 Operations Research	3	3
18.803 Optimization	3	0

### Other Technical Electives

	Hours per week	
	S1	S2
4.913 Materials Science	3	3
5.074 Computing Science for Mechanical Engineers	3	0
5.235 Nuclear Power Technology	3	0
5.811 Aerodynamics 1†	3	3
5.831 Aircraft Propulsion	2	2

**Note:** The graduate subjects listed should be examined by undergraduate students; with approval, graduate subjects from this and other Schools may be taken by students with a distinguished academic record.

## 3681

### Mechanical Engineering — Combined Course

#### Bachelor of Engineering/Bachelor of Science BE BSc

The combined degree course of five years full-time study enables a student in the School to qualify for the award of the two degrees of Bachelor of Engineering and Bachelor of Science (BE BSc). The course enables such combined degree students to major in the areas of computer science, materials science, mathematics, physics or statistics. It is administered by the Faculty of Engineering.

All students who are accepted into the Year 1 'Science/Arts compatible' course in the School may enrol directly into this course. Continued enrolment in Year 2 requires a pass at first attempt in all subjects of Year 1 and students who fail to achieve this will automatically be transferred to the normal Engineering program. Alternatively, students may transfer into the Year 2 of this course, provided they have obtained a pass at first attempt in the Year 1 'Science/Arts compatible' course.

Normally, students enrolled in this BE BSc degree course are awarded their degrees at the conclusion of five years study. However, it is possible for students to take out the Science degree prior to the Engineering degree provided they have: **1.** completed the requirements for Years 1, 2 and 3, **2.** completed the General Studies requirements for the Science degree, and **3.** obtained approval from the Board of Studies in Science and Mathematics.

Students may also undertake an additional honours year in Science and Mathematics and automatically re-enter this course without having to re-apply for admission. To undertake such an honours year in Science and Mathematics, permission is to be obtained at the end of Year 3 both from the Head of the School in which the honours year is to be undertaken and from the Head of the School of Mechanical and Industrial Engineering.

Students who commence the course and do not complete the Engineering component may take out a BSc degree on completion of one of the approved programs in the Science and Mathematics course. Similarly, students not wishing to complete the BSc degree course may revert to the normal Engineering program with appropriate credit for subjects satisfactorily completed.

Year 1 of the combined course is equivalent to the Year 1 'Science/Arts compatible' course in the School of Mechanical and Industrial Engineering, and is as detailed in course **3680** Mechanical Engineering. Having completed Years 2 and 3, as outlined below, students in Years 4 and 5 do Year 3 and Year 4 of their selected Engineering course except that significant repetition of subject material is not allowed. Instead, students are required to substitute either an appropriate Technical Elective or an appropriate Level II or III subject from Table 1\* or Table 2\*, or in exceptional circumstances, some other equivalent subject with the permission of the Head of the School of Mechanical and Industrial.

**Note:** In order to limit the combined degree courses to five years, the workload in the first three years is higher than in the single degree course. Students who have barely satisfied the minimum entrance requirements are therefore advised against enrolling for the combined degree course. Those who do enrol and whose average mark at the end of Session 1 of Year 1 is less than 65% are advised to contact the School to see whether or not they should continue in the combined course in Session 2 of Year 1, as the workload in Session 2 is higher than in Session 1.

**Year 2<sup>1,5</sup>.**

	Hours per week	
	S1	S2
5.3021 Engineering Mechanics 2A	3	0
5.3022 Engineering Mechanics 2B	0	2
5.4220 Mechanics of Solids 2 <sup>5</sup>		
5.4222 Mechanical Engineering <sup>5</sup> Materials	4½	4½
10.111A Pure Mathematics 2 — Linear Algebra	2½	2½
10.1113 Pure Mathematics 2 — Multivariable Calculus	2½	0
10.1114 Pure Mathematics 2 — Complex Analysis	0	2½
10.2111 Applied Mathematics 2 — Vector Calculus	2½	0
10.2112 Applied Mathematics 2 — Mathematical Methods for Differential Equations 4 appropriate units from Table 1* or Table 2* for course <b>3681</b> <sup>2</sup> .	0	2½
	8 +	8 +
	<hr/>	<hr/>
	23 +	22 +

**Year 3**

5.043** Industrial Training 1	0	0
5.122 Mechanical Engineering Design 2	3	3
5.620 Fluid Mechanics 1	2	2
5.626 Thermodynamics 1 5 appropriate units from Table 1* or Table 2* for course <b>3681</b> <sup>2</sup> .	10 +	10 +
General Education elective <sup>6</sup> .	2	2
	<hr/>	<hr/>
	19 +	19 +

Subject selections which satisfy the specific requirements for the various majors are summarized below. Provided co and prerequisites are satisfied, there is scope for some subjects to be taken either in Year 2 or Year 3.

\*Tables refer to the Sciences Handbook.

\*\*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained prior to Year 3. Students may not enrol in 5.043 without submitting the relevant report.

**Computer Science Majors<sup>13</sup>.****Year 2**

5.3021, 5.3022, 5.4220, 5.4222  
6.621, 6.631<sup>7</sup>, 6.641  
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214),  
10.2111 (or 10.2211), 10.2112 (or 10.2212), 10.331 (or 10.351)

**Year 3**

1.002 or 1.012 or 2.102A<sup>3</sup>  
5.043, 5.122, 5.620, 5.626  
4 Level III units from Table 1\* and Table 2\* offerings of School of Electrical Engineering and Computer Science for course 3681<sup>8</sup> - 1 General Education elective<sup>6</sup>

**Materials Science Majors****Year 2**

2.102A<sup>3</sup>  
4.412A<sup>9</sup>, 4.422B, 4.432, 4.642<sup>9</sup>  
5.3021, 5.3022, 5.4221  
and either (Option 1):  
2.102B, 2.131  
4.732 or 4.742 (recommended)  
10.022  
or (Option 2):  
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.2111 (or 10.2211),  
10.2112 (or 10.2212)  
1 unit from<sup>10</sup>: 1.022, 1.982, 2.131, 4.732, 4.742, 10.1114 (or 10.1214)

**Year 3**

4.413, 4.433C, 4.443, 4.453, 4.634, 4.713  
5.043, 5.122, 5.620, 5.626  
10.331 (or 10.351)  
1 General Education elective<sup>6</sup>  
and either (Option 1):  
48.403  
or (Option 2):  
1 appropriate Level III unit from School of Physics, Chemistry or Materials Science and Engineering offerings in Table 1\* or Table 2\* for course **3681**<sup>14</sup>

**Mathematics Majors****Year 2**

Same Year 2 as for Computer Science or Materials Science (3 units of Level II mathematics option) or Physics or Statistics majors  
or  
1.002 or 1.012 or 1.022 or 2.102A<sup>3</sup>  
5.3021, 5.3022, 5.4220, 5.4222  
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214),  
10.2111 (or 10.2211), 10.2112 (or 10.2212)  
3 units from 10.1115, 10.1116, 10.2113 (or 10.2213), 10.2115 (or 10.2215), 10.2116 (or 10.2216) (or 10.421B) or from any other appropriate Level II units from Table 1\* or Table 2\* for course **3681**.

## Year 3

5.043, 5.122, 5.620, 5.626  
10.331 (or 10.351)<sup>12</sup>

4 Level III units from School of Mathematics offerings in Table 1\*  
1 General Education elective<sup>6</sup>

## Physics Majors

### Year 2

1.002, 1.012, 1.022, 1.032  
5.3021, 5.3022, 5.4220, 5.4222  
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214),  
10.2111 (or 10.2211), 10.2112 (or 10.2212)

### Year 3

1.0133<sup>11</sup>, 1.023, 1.0333<sup>11</sup>, 1.043<sup>11</sup>  
1 Level III unit from School of Physics offerings in Table 1\*  
5.043, 5.122, 5.620, 5.626  
10.331 (or 10.351)  
1 General Education elective<sup>6</sup>

## Statistics Majors

### Year 2

1.002 or 1.012 or 1.022 or 2.102A<sup>3</sup>  
5.3021, 5.3022, 5.4220, 5.4222  
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214),  
10.2111 (or 10.2211), 10.2112 (or 10.2212), 10.311A (or 10.321A),  
10.311B (or 10.321B), 10.3111 (or 10.3211), 10.3112 (or 10.3212)

### Year 3

5.043, 5.122, 5.620, 5.626  
4 Level III units from Statistics offerings in Table 1\*  
1 Level II or III unit from School of Mathematics or School of  
Physics offerings in Table 1\*  
1 General Education elective<sup>6</sup>

\*Tables refer to the Sciences Handbook.

#### Notes

- Subjects 5.4220 and 5.4222 must be taken together.
- The following considerations pertain to the choice of optional units in Years 2 and 3:
  - They include no more than one Level 1 unit.
  - They include at least four Level III units which satisfy the relevant major requirements.
  - They include no more than one unit from schools other than Chemistry, Electrical Engineering and Computer Science, Mathematics, Materials Science and Engineering, and Physics.
  - They include at least one Level II unit from the School of Chemistry or Physics.
  - They include 10.331 Statistics SS, 10.351 Statistics SM or 10.311B Basic Inference.
- The prerequisites of 2.121 Chemistry 1A and 2.131 Chemistry 1B may be waived on application to the Head of the School of Chemistry.
- Materials Science majors may omit 10.1114 Complex Analysis or substitute 10.022 Engineering Mathematics 2 for the mathematics subjects. The balance of the units must then be made up from units from the Schools of Chemistry, Materials Science and Engineering or Physics offerings in Table 1\* or Table 2\* for course 3681.
- If 4.432 Physical Metallurgy 1C is taken, students should take 5.4221 instead of 5.4220 and 5.4222.
- Actual General Studies requirements correspond to whatever is required in the second-year of the normal Mechanical and Industrial Engineering degree course.
- Students intending to major in Computing Science and planning to take 6.647 Business Information systems may substitute 14.501 Accounting and Financial Management 1A instead of 6.631 Computing 2B.

8. 6.646 Computer Applications is excluded for students in course 3681 who should substitute a Level III unit from Table 2\* offerings of the School of Electrical Engineering and Computer Science.

9. Provided 5.4221 is taken concurrently or has been taken, the pre- or co-requisite requirement of 4.732 is assumed to be satisfied.

10. Materials Science majors who took 2.121 Chemistry 1A in Year 1 must take 2.131 Chemistry 1B. Those who took 2.951 Chemistry 1ME and wish to keep open the option of majoring in mathematics should include 10.1114 (or 10.1214) Complex Analysis in their selection; otherwise they are advised to select 1.022 Modern Physics or 1.982 Solid State Physics.

11. Under special circumstances, with permission of the Head of the School of Physics, a student may substitute alternative Physics Level III offerings of equivalent unit value.

12. Students who followed the Year 2 for Computer Science majors should substitute 1.002 or 1.012 or 1.022 or 2.102A; those that followed the Year 2 for Statistics majors should substitute one Level II or III unit from the School of Physics or Mathematics offerings in Table 1\*.

13. Quota restrictions apply to certain Computer Science Level III units and application must be made in writing to the Head of the School of Electrical Engineering and Computer Science before the end of Session 2 in the preceding year. Prospective Computer Science Majors should aim for a creditable academic attainment (65%) over Years 1 and 2.

14. Recommend either 2.103A Physical Chemistry or 1.023 Statistical Mechanics (for which the prerequisite of 1.012 is waived provided students have passed 2.102A).

15. The mathematics units are also offered at higher level.

\*Tables refer to the Sciences Handbook.

## 3610

### Aeronautical Engineering Bachelor of Engineering BE

The first and second years of this course are identical with the first two years of the course in Mechanical Engineering. Subject to the Head of the School being satisfied that the present extent of equivalences is maintained, and on his recommendation, Faculty has approved an arrangement by which students who satisfy the requirements of the first two years of the Mechanical Engineering full-time degree course at any other Australian tertiary institution may be admitted to a two-year program leading to the Bachelor of Engineering degree in Aeronautical Engineering.

### Year 3

	Hours per week	
	S1	S2
5.034 Engineering Experimentation	2	1½
5.043* Industrial Training 1	0	0
5.070 Optimal Engineering Strategies	1½	1½
5.079† Numerical Methods	1½	1½
5.3130 Vibration Analysis	0	2
5.343 Linear Systems Analysis‡	3	0
5.423 Mechanics of Solids 3	2	2
5.800 Aircraft Design 1	3	3
5.811 Aerodynamics 1	3	3
5.822 Analysis of Aerospace Structures 1	2	2
6.854 Electrical Engineering	0	3
6.856** Electronics for Measurement and Control	3	0
18.603 Management/Economics	2	2
General Education elective(s)	2	2
	<hr/>	<hr/>
	25	23½

\*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained prior to Year 3. Students may not enrol in 5.043 without submitting the relevant report.

†Combined degree course students who have taken 10.2116 Applied Mathematics 2 — Continuous - Time Systems or 10.2216 Higher Applied Mathematics 2 — Continuous - Time Systems or 10.212A (or 10.222A) Numerical Analysis should substitute a Technical Elective or a half Level II or Level III unit from Table 1 of the Sciences Handbook for this subject.

‡Combined degree course students who have taken 10.212M (or 10.222M) Optimal Control Theory should substitute a Technical Elective or a half Level II or Level III unit from Table 1 of the Sciences Handbook.

\*\*Combined degree course students who have taken 1.9222 Electronics or 1.032 Laboratory should substitute a Technical Elective or a half Level II or III unit from Table 1 of the Sciences Handbook.

Year 4		Hours per week	
		S1	S2
5.044*	Industrial Training 2	0	0
5.051	Thesis	6	6
5.062	Communications	2	2
5.801	Aircraft Design 2	3	3
5.812	Aerodynamics 2	3	3
5.823	Analysis of Aerospace Structures 2	2	2
5.831	Aircraft Propulsion	2	2
	Technical Electives	3	3
	General Education electives(s)	2	2
		<u>23</u>	<u>23</u>

**Note 1:** The Technical Electives may be taken from the Mechanical Engineering or Industrial engineering Technical Elective List or from Years 3 or 4 of other courses in the School or suitable subjects outside the School (5.350 Principles of Control of Mechanical Systems from Year 4 of the Mechanical Engineering degree course being recommended in this respect). Students with good academic records may include some graduate subjects. A counselling service is provided to assist students to choose electives. The selection of certain subjects or combinations of subjects may require the approval of the Head of School.

**Note 2:** Only a limited number of Technical Electives is offered each year. The actual Technical Electives offered each year are decided on the basis of staff availability and student demand. Students are advised in September of each year which Technical Electives will be offered in the following year.

\*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained between Years 3 and 4. Students may not enrol in 5.044 without submitting the relevant report.

### 3611 Aeronautical Engineering — Combined Course

#### Bachelor of Engineering/Bachelor of Science BE BSc

The description of this course is identical with that for course 3681 BE BSc in Mechanical Engineering.

### 3700 Naval Architecture

#### Bachelor of Engineering BE

The first and second years of this course are identical with the first two years of the Mechanical Engineering course. The Faculty of Engineering has approved an arrangement whereby, upon the recommendation of the Head of School, students who satisfy the requirements for the first two years of the Mechanical Engineering full-time degree course at any other Australian tertiary institution may be admitted to the final two years of the BE degree course in Naval Architecture.

Year 3		Hours per week	
		S1	S2
5.034	Engineering Experimentation	2	1½
5.043*	Industrial Training 1	0	0
5.070	Optimal Engineering Strategies	1½	1½
5.079†	Numerical Methods	1½	1½
5.3130	Vibration Analysis	0	2
5.423	Mechanics of Solids 3	2	2
5.901	Introduction to Mathematical Modelling and Decision Making	3	0
5.902	Ship Management Economics	0	2
5.911	Ship Hydrostatics	2½	2½
5.921	Ship Structures 1	2	2
5.9311	Principles of Ship Design 1	3	0
5.953	Ship Hydrodynamics	3	2
6.854	Electrical Engineering	0	3
6.856**	Electronics for Measurement and Control	3	0
	General Education elective(s)	2	2
		<u>25½</u>	<u>22</u>

\*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained prior to Year 3. Students may not enrol in 5.043 without submitting the relevant report.

†Combined degree course students who have taken 10.2116 Applied Mathematics 2 — Continuous - Time Systems or 10.2216 Higher Applied Mathematics 2 — Continuous - Time Systems or 10.212A (or 10.222A) Numerical Analysis, should substitute a Technical Elective or a half Level II or Level III unit from Table 1 of the Sciences Handbook for this subject.

\*\*Combined degree course students who have taken 1.9222 Electronics or 1.032 Laboratory should substitute a Technical Elective or a half Level II or III unit from Table 1 of the Sciences Handbook.

Year 4			
5.044*	Industrial Training 2	0	0
5.051	Thesis	6	6
5.062	Communications	2	2
5.922	Ship Structures 2	2	2
5.9321	Principles of Ship Design 2	4	2
5.937	Ship Design Project	3	4
5.941	Ship Propulsion and Systems	4	4
	General Education elective(s)	2	2
		<u>23</u>	<u>22</u>

\*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained between Years 3 and 4. Students may not enrol in 5.044 without submitting the relevant report.

## **3701 Naval Architecture — Combined Course**

### **Bachelor of Engineering/Bachelor of Science BE BSc**

The description of this course is identical with that for course 3681 BE BSc in Mechanical Engineering.

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## **Combined Courses Bachelor of Engineering/Bachelor of Arts**

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### **3612 BE BA in Aeronautical Engineering**

### **3662 BE BA in Industrial Engineering**

### **3682 BE BA in Mechanical Engineering**

### **3702 BE BA in Naval Architecture**

#### **Introduction**

The Bachelor of Engineering and Bachelor of Arts combined degree course provides the opportunity of taking one of the normal accredited Engineering courses offered by the School together with a normal Arts course. Common content between the two courses makes it possible to complete the combined degree course in 5 years, although the minimum time required could be longer, depending upon the choice of Arts subjects. The course is administered by the Faculty of Engineering.

The Engineering content follows that of the standard courses offered by the School. It includes the Science/Arts compatible first year program which provides a wide range of course options at the end of Year 1. The options include, in addition to the BE BA combined program, a BE BSc combined program and a normal BA program, a normal BSc program and a normal BA program. (The Science/Arts compatible first year provides up to 30 Arts credit points towards a BA program.)

The Arts content is to be chosen from the Faculty of Arts offerings in the usual way and would depend upon the interests of each individual student. Refer to the Faculty of Arts handbook for further details.

#### **Requirements**

The broad requirements of the BE BA course are given below. The details of a particular student's program will depend upon the student's interests and the Arts content which is chosen. Sample programs are available on request to show typical arrangements.

#### **Engineering**

The program is to contain the Science/Arts compatible first year segment followed by the full program for one of the strands offered by the School of Mechanical and Industrial Engineering. Course variations may be permitted in some cases on application to the Head of School.

#### **Arts**

The Arts component of the program is to contain at least 60 Arts credit points in addition to Arts credit points allocated to components of the Engineering strand. (A session-length Arts subject normally carries 6 credit points.) The 60 must include

- no more than 30 First Level credit points (typically 5 one-session subjects)
- at least 24 Upper Level credit points forming a major sequence (typically 4 one-session subjects)
- at least 6 Upper Level credit points in a school other than that in which the major is taken.

Computing and mathematics majors are not permitted. The combined BE BSc program would be more appropriate in these cases.

#### **Honours**

In the Engineering component, Honours are awarded for superior performance in the standard program.

In the Arts components, the award of Honours requires at least one further year of study devoted exclusively to the Honours subject(s). Consult the Faculty of Arts for further details.

#### **General**

A BE BA proposal should be discussed with representatives of the School and the Faculty of Arts as early as possible. In many cases this will be at (or preferably before) first year enrolment, but a student who has satisfactorily completed the Science/Arts compatible first year will normally be able to transfer to the second year of a combined BE BA program, and the discussions could then take place at any time before second year enrolment. Enquiries should be directed to the Executive Assistant to the Head of the School and the Executive Assistant to the Dean of Faculty of Arts.

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## **Department of Industrial Engineering**

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The Department of Industrial Engineering offers a course in Industrial Engineering leading to the award of the degree of Bachelor of Engineering. This course is designed for students with engineering ability whose interests lie in the planning, developing and control of manufacturing or service operations. It may be taken either on a full-time basis, normally over four years or on a part-time basis, or on a combined full-time/part-

time basis subject to the approval of the Head of the School. Students intending to enter part-time study are advised that many subjects in the later years of the course are offered only in the day-time. Part-time students normally take two years for each equivalent full-time year and are required to attend day classes for the equivalent of at least 1 1/2 days per week.

The first two years of the degree course, taken full-time, provide the student with a sound foundation in the basic science and engineering subjects, and this knowledge is used and extended in the later years in the study of the industrial subjects in which the problems associated with the practical economics of manufacturing operations are stressed. The aim is to provide the student with the education necessary to carry out an industrial job and to examine it critically in the light of economic efficiency.

Traditional engineering courses do not embrace the problems which are characteristic of Industrial Engineering. These problems include the analysis of a product to ensure satisfactory functioning with regard to methods and sequence of manufacturing operations; the disposition of buildings and of equipment within them to permit efficient handling of materials; the avoidance of bottlenecks; the related problems of quality and cost control, testing and inspection; labour and personnel relations; and, finally, the problem of distribution and sales.

The financial and economic aspects are studied as the problem in manufacturing has not been solved until the final translation of the product into money has been accomplished successfully. While it is not intended to develop an expert in accounting practice or economics, it is intended to produce an engineer with an appreciation of the problems of cost and one who can apply considerations of ultimate economy to all industrial problems. The techniques of operations research may be applied here, where mathematical models of real life situations are constructed and manipulated to yield optimal solutions as guides to management.

## The Work of the Industrial Engineer

The industrial engineer may initially be employed in any of the following major areas of industrial activity:

### 1. Industrial Economic Analysis

One of the principal functions of industrial engineering is to analyse a product, project or process from the economic point of view to ensure that an adequate profit can be obtained. A general working knowledge of economics and management skill has to be directed towards the making of decisions on how to operate an enterprise most efficiently. The basis for such decisions is furnished largely by the logical application of mathematics and statistics.

### 2. Planning and Control of Production

Manufacturing processes and operations must be planned in detail throughout an enterprise to ensure that they proceed smoothly and economically. Functions in this field include the establishment of production standards, the setting of production targets, and the control of quality.

The ultimate responsibility of those in charge of the planning and control of production is to ensure that the goods, as originally specified, perform satisfactorily and are produced when required at an optimum cost. Computer systems are increasingly being used to achieve this.

### 3. Product and Process Design

The design interest of the industrial engineer goes beyond normal mechanical design to develop a product that will not only function effectively but also have a pleasing appearance.

Further, the product has to be adapted to suit existing manufacturing equipment, or a manufacturing process has to be developed by means of which an existing product can be manufactured at the right price and of the right quality. The design work of the industrial engineer also incorporates problems of process selection and application for both economy and performance. Fundamental scientific studies of manufacturing processes such as metal machining, forming and casting are continually being made to improve their efficiency.

The introduction of computers has led to the automation of some aspects of product and process design. For example, developments in CAD-CAM (computer aided design and computer aided manufacturing) have resulted in improvements in the competitiveness of companies in the marketplace and these techniques are becoming increasingly important.

The principles for minimizing product cost can also be effectively applied to the provision of services.

### 4. Methods Engineering

Methods engineering is concerned with the design of systems to properly utilize and co-ordinate personnel, materials and machines so that an enterprise will run efficiently. A sound knowledge of engineering in general, together with an understanding of human factors and economics is necessary for this work. It includes the design of plant layouts and materials handling systems, job design and the setting of standard times for work.

### 5. Operations Research

This is the attack of modern science on complex problems arising in the direction and management of large systems of people, machines, materials and money in industry, business, government and defence. The distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as chance and risk, with which to predict and compare the outcomes of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically.

Employment in any of these fields may well lead to a position of responsibility in industrial management if the engineer is so inclined.

## 3660 Industrial Engineering

### Bachelor of Engineering BE

The first and second years of this course are identical with the first two years of the course in Mechanical Engineering.

Year 3		Hours per week	
		S1	S2
5.043†	Industrial Training 1	0	0
6.854	Electrical Engineering	0	3
6.856	Electronics for Measurement and Control	3	0
14.001	Introduction to Accounting A	1½	0
14.002	Introduction to Accounting B	0	1½
18.003	Numerical Methods/Industrial Experimentation	1½	2
18.303	Methods Engineering	2	2
18.403	Production Design and Technology	4	4
18.413	Design for Industrial Engineers	2	3
18.503	Operations Research A	3	3
18.603	Management/Economics	2	2
18.803	Optimization	3	0
	General Education elective(s)	2	2
		<u>24</u>	<u>22½</u>

†Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained prior to Year 3. Students may not enrol in 5.043 without submitting the relevant report.

Year 4			
5.044†	Industrial Training 2	0	0
5.051	Thesis	6	6
5.062	Communications	2	2
18.004	Manufacturing Management	2	2
	Technical Electives	10	10
	General Education elective(s)	2	2
		<u>22</u>	<u>22</u>

**Note 1:** At least 6 hours per week of Technical Electives must be taken from the Industrial Engineering Technical Elective List. The remaining Technical Electives may be taken from the Mechanical Engineering Technical Elective List or from Years 3 or 4 of other courses in the School or suitable subjects outside the School. Students with good academic records may include some graduate subjects. A counselling service is provided to assist students to choose electives. The selection of certain subjects or combinations of subjects may require the approval of the Head of School.

**Note 2:** Only a limited number of Technical Electives is offered each year. The actual Technical Electives offered each year are decided on the basis of staff availability and student demand. Students are advised in September of each year which Technical Electives will be offered in the following year.

†Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained between Years 3 and 4. Students may not enrol in 5.044 without submitting the relevant report.

## Industrial Engineering Technical Electives

Production Engineering		Hours per week	
		S1	S2
5.454	Theory of Plasticity	3	or 3
18.224	Numerical Control of Machine Tools	3	or 3
18.404	Design for Production	2	2
18.360G	Ergonomics	3	or 3

### Operations Research

5.074	Computing Science for Mechanical Engineers	3	0
18.574G	Management Simulation	1	2
18.671G	Decision Theory	2	or 2
18.672G	Decision Theory for Industrial Management	3	or 3
18.673G	Energy Modelling, Optimization and Energy Accounting	3	or 3
18.760G	Discrete-Event Simulation Languages	3	or 3
18.764G	Management of Distribution Systems	2	or 2
18.765G	Optimization of Networks	2	or 2
18.777G	Time Series and Forecasting	2	or 2
18.864G	Applied Geometric Programming	2	or 2
18.868G	Industrial Applications of Mathematical Programming	3	or 3
18.874G	Dynamic Programming	2	or 2

**Note:** The graduate subjects listed should be of particular interest to undergraduate students; with approval, alternative graduate subjects from this and other Schools may be taken.

## 3661 Industrial Engineering — Combined Course

### Bachelor of Engineering/Bachelor of Science BE BSC

The description of this course is identical with that for course 3681 in Mechanical Engineering.

## 3662 Industrial Engineering — Combined Course

### Bachelor of Engineering/Bachelor of Arts BE BA

See description under *Combined Courses: Bachelor of Engineering/ Bachelor of Arts*, immediately preceding the heading *Department of Industrial Engineering*.

## School of Surveying

### Head of School

Professor F.K. Brunner

### Administrative Assistant

Mr. L. Daras

The School offers a full-time course of four years duration leading to the award of the degree of Bachelor of Surveying. Alternatively, the course may be taken in a sandwich form in which a student may, after completing the first year of the course on a full-time basis, alternate his or her studies with one or more periods of employment by taking leaves of absence of two consecutive sessions.

Specialised areas of study include the following: **Geodetic Surveying** (determining the mathematical model of the earth, and its gravity field, and the practice of surveying on the Earth's surface); **Satellite Surveying** (position determination techniques using satellite signals); **Hydrographic Surveying** (mapping the seabed and waterways for navigation and off-shore resource management); **Engineering Surveying** (the precise surveying for engineering projects); **Cadastral Surveying** (knowledge of the laws and practices for survey of property boundaries); **Land Management and Development** (environmental assessment for resource management and change of land use); **Land Information Management** (the use of computer-based information systems of spatially related data for planning purposes); **Photogrammetry and Remote Sensing** (the use of photographs and remotely sensed images for mapping and resource surveys). The course recognises the diversity of roles of graduates in government, private and academic sectors as practitioner, consultant, manager, teacher or researcher.

**Recognition**

The degree of Bachelor of Surveying is recognised by the New South Wales Surveyors' Board as meeting all examination requirements for registration as a Registered Surveyor in New South Wales, and is recognised by the Institution of Surveyors for admission as corporate members.

Students wishing to become Registered Surveyors with the New South Wales Surveyors' Board after graduation are advised to gain practical experience under a Registered Surveyor during their course. Some reduction in the period of practical experience required before registration may be granted because of practical experience gained during the University course, provided the New South Wales Surveyors' Board is informed in the prescribed manner. Details are obtainable from the Registrar, Surveyors' Board, Department of Lands, Bridge Street, Sydney 2000.

**Honours**

In the BSurv course the same formal program is offered to both pass students and to those aiming for an honours grading. Honours will be awarded for meritorious performance throughout the course, with greater emphasis placed on subjects in Year 3 and 4.

**Professional Practice**

All students in the BSurv course must gain at least 60 days of recognised professional practice after the completion of Session 1 in Year 2 as part of the requirements for subject 29.8711. Special instructions will be given before commencement of professional practice.

**Field Excursions**

Students must complete all necessary fieldwork for any subject and be prepared to pay all the appropriate costs, and must be in attendance at all scheduled examinations except in exceptional circumstances.

**Course Rules**

— Programs and timetables are arranged for each year. Progression is however, by subject.

- Students are not permitted to enrol in subjects with clashing timetables.
- In addition to the specific subject prerequisites and co-requisites a general understanding of the material in the preceding Year is assumed. Students are not normally permitted to enrol in subjects spread beyond two Years.
- Students who do not pass their full programs in any year will be limited to a reduced load in the following year. Typically, this is 20 hours per week.
- Previously failed subjects must be included, except that a failed elective may be replaced by another elective.

**Course Revision**

Following each course revision, students are assessed on the basis of the new program but retain credit for any subjects already completed and are not liable for the increased requirements if progression is normal.

It is the responsibility of students to enrol in a program consistent with the rules governing re-enrolment and admission to the degree.

The BSurv course is currently being revised. Years 1 and 2 of the new course are being introduced in 1989, Year 3 in 1990 and Year 4 in 1991.

Students with broken programs will have their status in the new course determined according to a table of equivalent subjects in the new and old courses.

**Re-enrolment**

Students must collect enrolment information from the School Office before the end of Session 2 for re-enrolment in the following February. Students not intending to re-enrol should advise the School. Leave of absence for up to one year is usually granted to students in good standing.

**3740  
Surveying  
Bachelor of Surveying BSurv**

Year 1	Hours per week
<i>Session 1</i>	
1.921 Physics 1	4
5.0302 Engineering, Drawing and Descriptive Geometry	4
10.001 Mathematics 1	6
29.1111 Introduction to Computing	4
29.1711 Introduction to Surveying	2
	<hr style="width: 100%; border: 0.5px solid black;"/>
	20
 <i>Session 2</i>	
1.921 Physics 1	4
10.001 Mathematics 1	6
29.1711 Introduction to Surveying	2
29.2041 Survey Data Presentation	3
29.2111 Principles of Computer Processing	4
29.2221 Introduction to Geodetic Science	3
	<hr style="width: 100%; border: 0.5px solid black;"/>
	22

# Engineering

## Year 2

Session 1		Hours per week
1.962	Physics of Measurements	3
10.022	Engineering Mathematics 2	4
10.341	Statistics SU	3
29.3011	Surveying Instruments	4
29.3111	Survey Computations	3
29.3231	Geodetic Computations	3
	General Education A Elective	2
		<u>22</u>

## Session 2

10.022	Engineering Mathematics 2	4
29.4011	Surveying Techniques	6
29.4051	Survey Camp 1*	3
29.4111	Data Analysis and Computing 1	3
29.4221	Geodetic Positioning 1	3
29.4721	Project Management 1	2
	General Education A Elective	2
		<u>23</u>

\*Students are required to attend a one-week survey camp, which is equivalent to 3 class contact hours per week.

Students enrolling in 1989 please note that:

- 29.3011 Surveying Instruments will be replaced in Session 1 by 29.2221 Introduction to Geodetic Science,
- 29.4051 Survey Camp 1 will be deleted from the Session 2 program,
- exemption will be given from a General Education Elective Category A on the basis of completion of a General Studies subject in 1988 of the old course.

## Year 3

### Session 1

8.6140	Engineering for Surveyors 1	3
29.5010	Surveying 5	4½
29.5110	Computations 3	4
29.5220	Geodetic Positioning	2½
29.5230	Map Projections	2½
29.5610	Cadastral Surveying and Land Law 1	3½
		2
36.411	Town Planning	<u>22</u>

### Session 2

8.6150	Engineering for Surveyors 2	3
29.6010	Surveying 6	4½
29.6220	Field Astronomy	3
29.6510	Photogrammetry 1	3
29.6610	Cadastral Surveying and Land Law 2	6
		3
29.6810	Land Management and Development 2	<u>22½</u>

## Year 4

Session 1		Hours per week
29.7010	Surveying 7	4½
29.7120	Computer Graphics	2
29.7220	Geodetic Computations	3
29.7510	Photogrammetry 2	4
29.7810	Land Management and Development 3*	2
29.7050	Survey Camp†	9
	Technical Elective††	3
	General Education Elective	4
		<u>31½</u>

\*One day field tutorial is an essential part of this subject.

†Senior Survey Camp will be held in Session 1.

††Technical electives (each of 3 hours per week) are chosen from those listed below.

### Session 2

29.8010	Surveying 8	5
29.8220	Global Geodesy	2½
29.8510	Photogrammetry 3	3
29.8710	Seminar	1½
29.8720	Management	2
29.8810	Land Management and Development 4	2
		3
	Technical Elective††	4
	General Studies Elective	<u>23</u>

††Technical electives (each of 3 hours per week) are chosen from those listed below.

## General Education Program

Students undertaking the new course will be required to study subjects in the General Education Program as specified, whereas students completing the requirements for the degree under the old course will be required to take 168 hours of General Studies electives. General Education and General Studies electives comprise 56 hours and a half elective 28 hours.

## Year 4 Electives

Every student is required to take two Technical Electives (of three hours per week each) which are chosen from:

29.9010	Advanced Surveying Instruments
29.9020	Hydrographic Surveying
29.9030	Precise Engineering Surveying
29.9210	Adjustment of Control Networks
29.9220	Advanced Geodetic Positioning
29.9510	Computer Assisted Mapping
29.9520	Remote Sensing
29.9530	Land Information Systems
29.9610	Modern Cadastral Concepts
29.9090	Project
29.9910	Special Topic A
29.9920	Special Topic B

Not all electives are offered in any one year. Subjects from other Schools and Faculties may be substituted with the approval of the Head of School.

## Undergraduate Study

# Subject Descriptions

## Identification of Subjects by Number

A subject is defined by the Academic Board as 'a unit of instruction approved by the University as being a discrete part of the requirements for a course offered by the University'.

Each approved subject of the University is identifiable both by number and by name as this is a check against nomination of subject other than the one intended.

Subject numbers are allocated by the Academic Registrar and the system of allocation is based on the following guidelines:

1. The authority offering the subject, normally a School of the University, is indicated by the number before the decimal point.
2. Each subject number is unique and is not used for more than one subject title.
3. Subject numbers may not be re-used with a new subject title within ten years of previous use.
4. Graduate subjects are indicated by a suffix 'G' to a number with three digits after the decimal point. In other subjects three or four digits are used after the decimal point.

Subjects taught are listed in full in the handbook of the faculty or board of studies responsible for the particular course within which the subjects are taken. Subject descriptions are contained in the appropriate section in the handbooks.

The identifying numerical prefixes for each subject authority are set out on the following page.

**Servicing Subjects** are those taught by a school or department outside its own faculty. Their subject descriptions are published in the handbook of the faculty which originates the subject and are also published in the handbook of the faculty in which the subject is taught.

The following pages contain descriptions for most of the subjects offered for the courses described in this book, the exception being the General Education subjects. For General Education subjects see the **General Education Handbook** which is available free of charge.

### HSC Exam Prerequisites

Subjects which require prerequisites for enrolment in terms of the HSC Examination percentile range, refer to the **1978 and subsequent Examinations**.

Candidates for enrolment who obtained the HSC in previous years or hold other high school matriculation should check with the appropriate school on what matriculation status is required for admission to a subject.

### Information Key

The following is the key to the information which may be supplied about each subject:

**S1** Session 1, **S2** Session 2

**F** Session 1 *plus* Session 2, ie full year

**S1 or S2** Session 1 *or* Session 2, ie choice of either session  
**SS** single session, but which session taught is not known at time of publication

**CCH** class contact hours

**L** Lecture, followed by hours per week

**T** Laboratory/Tutorial, followed by hours per week

**hpw** hours per week

**C** Credit *or* Credit Units

**CR** Credit Level

**DN** Distinction

**W** weeks of session

School, Department etc	Faculty	Page
*Subjects also offered for courses in this handbook		
1 School of Physics	Science	
2 School of Chemistry*	Science	
3 School of Chemical and Industrial Engineering (New Course)	Applied Science	
4 School of Materials Science and Engineering	Applied Science	
<b>5 School of Mechanical and Industrial Engineering</b>	<b>Engineering</b>	<b>31</b>
<b>6 School of Electrical Engineering and Computer Science</b>	<b>Engineering</b>	<b>22</b>
7 School of Mines* (Mineral Processing and Extractive Metallurgy and Mining Engineering)	Applied Science	
<b>8 School of Civil Engineering</b>	<b>Engineering</b>	<b>19</b>
9 School of Fibre Science and Technology (Wool and Animal Science)	Applied Science	
10 School of Mathematics*	Science	
11 School of Architecture	Architecture	
12 School of Psychology	Biological and Behavioural Sciences	
13 School of Fibre Science and Technology (Textile Technology)	Applied Science	
14 School of Accounting*	Commerce and Economics	
15 School of Economics*	Commerce and Economics	
16 School of Health Administration*	Professional Studies	
17 Faculty of Biological and Behavioural Sciences	Biological and Behavioural Sciences	
<b>18 School of Mechanical and Industrial Engineering (Industrial Engineering)</b>	<b>Engineering</b>	<b>31</b>
19 School of Information Systems		
20 Centre for Petroleum Engineering Studies	Applied Science	
21 Department of Industrial Arts	Architecture	
25 School of Mines* (Applied Geology)	Applied Science	
26 Centre for Liberal and General Studies	Liberal and General Studies	
27 School of Geography*	Applied Science	
28 School of Marketing*	Commerce and Economics	
<b>29 School of Surveying</b>	<b>Engineering</b>	<b>40</b>
30 School of Industrial Relations and Organizational Behaviour*	Commerce and Economics	
31 School of Optometry	Science	
<b>32 Centre for Biomedical Engineering</b>	<b>Engineering</b>	
34 Faculty of Arts	Arts	
35 School of Building*	Architecture	
36 School of Town Planning	Architecture	
37 School of Landscape Architecture	Architecture	
38 School of Applied Bioscience (Food Science and Technology)	Applied Science	

School, Department etc	Faculty	Page
*Subjects also offered for courses in this handbook		
39 Graduate School of the Built Environment*	Architecture	
40 Academic Board		
41 School of Biochemistry	Biological and Behavioural Sciences	
42 School of Applied Bioscience (Biotechnology)*	Applied Science	
44 School of Microbiology	Biological and Behavioural Sciences	
45 School of Biological Sciences	Biological and Behavioural Sciences	
46 Faculty of Applied Science	Applied Science	
<b>47 Centre for Safety Science</b>	<b>Engineering</b>	
48 School of Chemical Engineering and Industrial Chemistry* (Old Course)	Applied Science	
49 School of Applied Bioscience	Arts	
50 School of English	Arts	
51 School of History	Arts	
52 School of Philosophy	Arts	
53 School of Sociology	Arts	
54 School of Political Science	Professional Studies	
55 School of Librarianship	Arts	
56 School of French	Arts	
57 School of Theatre Studies	Professional Studies	
58 School of Education	Arts	
59 Department of Russian Studies	Arts	
60 Faculty of Arts	Arts	
61 Department of Music	Arts	
62 School of Science and Technology Studies	Professional Studies	
63 School of Social Work	Arts	
64 School of German Studies	Arts	
65 School of Spanish and Latin American Studies	Arts	
66 Subjects Available from Other Universities		
67 Faculty of Science	Science	
68 Board of Studies in Science and Mathematics	Board of Studies in Science and Mathematics	
70 School of Anatomy*	Medicine	
71 School of Medicine	Medicine	
72 School of Pathology*	Medicine	
73 School of Physiology and Pharmacology*	Medicine	
74 School of Surgery	Medicine	
75 School of Obstetrics and Gynaecology	Medicine	
76 School of Paediatrics	Medicine	
77 School of Psychiatry	Medicine	
78 School of Medical Education	Medicine	
79 School of Community Medicine	Medicine	
80 Faculty of Medicine*	Medicine	
81 Medicine/Science/Biological Sciences	Medicine	
85 Australian Graduate School of Management	AGSM	
90 Faculty of Law	Law	
<b>97 Faculty of Engineering</b>	<b>Engineering</b>	<b>19</b>
98 School of Banking and Finance	Commerce and Economics	
99 Department of Legal Studies and Taxation	Commerce and Economics	

## Physics

The School of Physics has introduced the specialized units 1.911, 1.961, 1.971, 1.981, 1.962, 1.972 and 1.982 for students in the Faculty of Engineering. The first-year units 1.911, 1.961, 1.971 and 1.981 are *not* available at night. Part-time students will be catered for by the Science Course unit 1.001.

All first year full-time students, including repeat students, should enrol in 1.911, 1.961, 1.971, 1.981 according to their schools. However, *full time Electrical Engineering* students may substitute 1.011 for 1.961, subject to the approval of the School of Physics.

All first year part-time students, including repeats, should enrol in 1.001.

### Physics Level I Units

#### 1.001 Physics 1

F L3T3

*Prerequisites:*

	<i>HSC Exam Score Range</i>
2 unit Mathematics* or	67-100
3 unit Mathematics or	1-50
4 unit Mathematics	1.100 or
and	(for 1.001 only) 10.021B
2 unit Science (Physics) or	57-100
2 unit Science (Chemistry) or	60-100
3 unit Science or	
4 unit Science or	31-100
1.021	

*Co-requisite:* 10.021C or 10.001 or 10.011.

\*This refers to the 2 Unit Mathematics subject which is related to the 3 Unit Mathematics subject. It does not refer to the subject 2 Unit Mathematics (Mathematics in Society).

Aims and nature of physics and the study of motion of particles under the influence of mechanical, electrical, magnetic and gravitational forces. Concepts of force, inertial mass, energy, momentum, charge, potential, fields. Application of the conservation principles to solution of problems involving charge, energy and momentum. Electrical circuit theory, application of Kirchoff's laws to AC and DC circuits. Uniform circular motion, Kepler's laws and rotational mechanics. Properties of matter: solids, liquids, gases. The wave theories of physics, transfer of energy by waves, properties of waves. Application of wave theories to optical and acoustical phenomena such as interference, diffraction and polarisation.

#### 1.911 Physics 1 (Mechanical Engineering)

F L2T2

*Prerequisites:* As for 1.001 Physics 1. *Co-requisites:* 10.001 or 10.021C. *Excluded:* 1.951

For students in the School of Mechanical and Industrial Engineering.

Rotational mechanics. Mechanics of intermolecular systems. Atomic structure of solids; forces and defects. Plasticity of solids. Fracture of solids. Thermal properties of solids, liquids and gases. Wave motion, including acoustics. Optics: geometrical optics, optical instruments interference and diffraction, polarisation, laser light. Electromagnetism: magnetic forces and fields, electromagnetic

induction. Electric fields and currents: electrostatics, direct-current circuits. Elementary circuit theory. Introduction to electronics and electronic devices. Boolean algebra and basic number systems. Introduction to instrumentation.

#### 1.961 Physics 1 (Electrical Engineering)

F L3T3

*Prerequisite:* As for 1.001 Physics 1.

For students in the School of Electrical Engineering.

Electrostatics in vacuum, electrostatics in dielectrics, steady state currents, magnetostatics in vacuum, ferromagnetism, electromagnetic induction, transient currents. Vectors motion in one dimension, motion in a plane, particle dynamics, work and energy, the conservation of energy, conservation of linear momentum, collisions, rotational kinematics, rotational dynamics, simple harmonic motion, gravitation. Temperature, heat and the first law of thermodynamics, kinetic theory of gases. Waves in elastic media, sound waves, geometrical optics, interference, diffraction, gratings and spectra, polarization.

#### 1.921 Physics 1 (Surveying)

F L2T2

*Prerequisite:* As for 1.001 Physics 1.

For students in the School of Surveying.

Aims and nature of physics and the study of motion of particles under influence of mechanical, electrical, magnetic and gravitational forces. Concepts of force, mass, energy, momentum, charge, potential fields. Application of the conservation principles to the solution of problems involving charge, energy and momentum. Electrical circuit theory, applications of Kirchoff's laws to d.c. and a.c. circuits. Uniform circular motion, Kepler's laws and rotational mechanics. Geometrical optics, optical instruments. Wave theories of physics, transfer of energy by waves, properties of waves. Application of wave theory to interference, diffraction and polarisation.

#### 1.981 Physics 1 (Civil Engineering)

S1 L2T2 and S2 L2T1

*Prerequisite:* As for 1.001 Physics 1.

For students in the School of Civil Engineering.

Aims of physics and its relation to civil engineering. Mechanical concepts, properties of matter, atomic structure, elasticity, plasticity, fracture of solids; surface tension and viscosity of fluids, electrical and magnetic forces, electromagnetism, DC and AC circuits, digital electronics. Simple harmonic motion and its relation to wave motion. Acoustic and mechanical waves, attenuation, velocity of propagation. Elastic moduli. Non-destructive testing, instrumentation, techniques and theory. Emphasis on the physics involved in non-destructive testing and the aspects of vibration important to civil engineering.

### Physics Level II Units

#### 1.002 Mechanics, Waves and Optics

S1 L3T1

## Engineering

*Prerequisites:* 1.001 or 1.011, 10.001 or 10.011. *Co-requisite:* 10.2111. *Excluded:* 1.992, 10.4111, 10.4211.

Harmonic motion, systems of particles, central force problems, Lagrange's equations, coupled oscillations, travelling waves, pulses, energy and momentum transfer, polarization, birefringence, interference, thin films, gratings, lasers, holography, fibre optics, Faraday effect, photoelasticity.

### 1.012 Electromagnetism and Thermal Physics S2 L3T1

*Prerequisites:* 1.001 or 1.011, 10.001 or 10.011. *Co-requisite:* 10.2111. *Excluded:* 1.972, 1.992.

Electric field strength and potential, Gauss' law, Poisson's and Laplace's equations, capacitance, dielectrics and polarization, magnetism, electro-magnetic induction, Maxwell's equations, electromagnetic waves. Laws of thermodynamics, kinetic theory, microscopic processes, entropy, solid state defects, Helmholtz and Gibbs functions, Maxwell's relations, phase diagrams, chemical and electrochemical potential.

### 1.022 Modern Physics FL½T½

*Prerequisites:* 1.001 or 1.011, 10.001 or 10.011. *Co-requisite:* 10.2112. *Excluded:* 1.9322, 1.982.

Special theory of relativity: time dilation, length contraction, simultaneity, Lorentz transformations, energy and mass. Photon properties, de Broglie relations, Uncertainty principle, operators in quantum mechanics, postulates of quantum mechanics, potential wells, steps and barriers, harmonic oscillator, H atom, angular momentum, magnetic moment, electron spin, nuclear spin. Atomic and molecular spectra, lasers, quantum statistics, free electron model of a metal, band theory; nuclear size, density, mass; nuclear models, fission and fusion, nuclear forces.

### 1.032 Laboratory F T3

*Prerequisites:* 1.001 or 1.011, 10.001. *Excluded:* 1.9222.

Alternating current circuits, complex impedance, resonance, mutual inductance, introductory electronics, diode and characteristics and circuits, power supplies, transistor characteristics, single stage and coupled amplifiers, experiments using AC circuits. Experimental investigations in a choice of areas including radioactivity, spectroscopy, properties of materials, Hall effect, nuclear magnetic resonance, photography, vacuum systems.

### 1.9222 Electronics S1 L1T2

*Prerequisites:* 1.001 or 1.002 or 1.021. *Excluded:* 1.032.

The application of electronics to other disciplines. Includes: principles of circuit theory and analogue computing; amplifiers, their specification and application, transducers; electronic instrumentation; industrial data acquisition.

### 1.962 Physics of Measurement (Surveying) S1 L1T2

*Prerequisite:* 1.971.

For students in the School of Surveying.

Resolution, accuracy and sensitivity of instruments. Errors of observation and their treatment. Experimental design. Displace-

ment transducers. Transducers for other mechanical quantities. Thermometry. Electrical noise. Dynamic response of measuring systems. Servo-systems. Mechanical design of apparatus. Microscopes, telescopes and other optical instruments. Lenses, optical fibres and other optical components. Photometry. Colorimetry. Measurements under adverse ambient conditions. Analogue-to-digital conversion. Digital instruments. Measurements of very large and very small quantities.

### 1.972 Electromagnetism (Electrical Engineering) S1 or S2 L2T2

*Prerequisite:* 1.961 or 1.001 or 1.011, 10.001. *Co-requisites:* 10.2111, 10.2112. *Excluded:* 1.012.

Electrostatics in vacuum, electrostatics in dielectrics, electric currents, magnetostatics in vacuum, magnetic scalar potential, magnetostatics in magnetic media, time varying fields, Maxwell's equations.

### 1.982 Solid State Physics (Electrical Engineering) S1 or S2 L2½T2

*Prerequisite:* 1.961 or 1.001 or 1.011, 10.001. *Co-requisites:* 10.211, 10.2112. *Excluded:* 1.022, 1.9322.

The concepts of waves and particles, introductory quantum mechanics, atomic structure, optical spectra and atomic structure, structural properties of solids, band theory and its applications, uniform electronic semiconductors in equilibrium, excess carriers in semiconductors.

### 1.992 Mechanics and Thermal Physics (Electrical Engineering) F L1½T½

*Prerequisite:* 1.961, 10.001 or 10.011. *Co-requisites:* 10.2111. *Excluded:* 1.002, 1.012.

Particle mechanics, harmonic motion, central force problems, systems of particles, Lagrange's equations with applications, coupled oscillations, wave equation. Thermodynamic laws, entropy, kinetic theory, M-B distribution, microscopic processes, Maxwell's relations, chemical potential, phase diagrams, multicomponent systems, electrochemical potential, statistics of defects in solids.

## Physics Level III Units

### 1.0143 Nuclear Physics S2 L1½T½

*Co-requisite:* 1.0133.

Nuclear shell model; theory of beta decay; the deuteron, nucleon-nucleon scattering; theories of nuclear reactions, resonances; mesons and strange particles, elementary particle properties and interactions; symmetries and quark models; strong and weak interactions.

**1.023 Statistical Mechanics and Solid State Physics****S1 L3T1***Prerequisites:* 1.012, 1.022, 10.2112.

Canonical distribution, paramagnetism, Einstein solid, ideal gas, equipartition, grand canonical ensemble, chemical potential, phase equilibria, Fermi and Bose statistics, Bose condensation, blackbody radiation. Crystal structure, bonding, lattice dynamics, phonons, free-electron models of metals, band theory, point defects, dislocations.

**1.0333 Electromagnetism****S1 L1½T½***Prerequisites:* 1.012, 10.2111, 10.2112. *Excluded:* 10.222C.

Electromagnetic fields; Maxwell's equations, Poynting theorem, electromagnetic potentials, electromagnetic waves. Reflection and transmission, Fresnel equations, waveguides, radiation fields, dipoles and antenna theory.

**1.043 Experimental Physics A****F T4***Prerequisite:* 1.032.

Basic experimental techniques and analysis of results in the following areas: electricity, magnetism, diffraction optics (including X-ray and electron diffraction, solid state physics, nuclear physics, atomic physics and spectroscopy, vacuum systems).

**1.0133 Quantum Mechanics****S1 L1½T½***Prerequisites:* 1.022, 10.2112. *Excluded:* 2.023A, 10.222F.

Revision of basic concepts, harmonic oscillator systems, spherically symmetric systems, angular momentum, H atom, first-order perturbation theory, identical particles, Exclusion Principle, atomic structure, spin-orbit coupling, Helium atom, introductory quantum theory of molecules.

**1.0533 Experimental Physics B1****S1 T4***Prerequisite:* 1.032.

Selected experiments and projects. Advanced experimental techniques and open ended projects in the areas covered in 1.043 Experimental Physics A together with projects involving electron and nuclear magnetic resonances, low temperature physics and super-conductivity. Fourier optics, holography.

**1.133 Electronics****S1 L2T4***Prerequisites:* 1.9222 or 1.032.

Review of AC theory. Transistors. Operational amplifiers. Voltage regulators, constant current sources, switching power supplies. Field effect transistors, noise and drift. Digital electronics. Frequency dependent networks, active and passive filters, digital filters, oscillators. Communication and storage of information. Analogue-digital conversion. Transducers.

**Chemistry****Level I Units****2.121 Chemistry 1A****S1 or S2 L2T4***Prerequisites:*

	<i>HSC Exam Score Range Required</i>
2 unit Mathematics* or	67.100
3 unit Mathematics or	1-50
4 unit Mathematics and	1.100
2 unit Science (Physics) or	53.100
2 unit Science (Chemistry) or	53.100
4 unit Science or	1-50
3 unit Science or 2.111	90-150

\*This refers to the 2 Unit Mathematics subject which is related to the 3 Unit Mathematics subject. It does not refer to the subject 2 Unit Mathematics (Mathematics in Society).

Stoichiometry and solution stoichiometry. Properties of gases; kinetic molecular theory. Thermochemistry. Atomic structure, electron configurations and the periodic table. Types of chemical bonds, electronegativity, molecular geometry. Periodicity of physical and chemical properties of common representative elements and compounds. Liquids and solids, changes of state, phase diagrams. Types of solids. Solutions and their properties. Colloids. Facts and theories about reaction kinetics.

*Note:* Students who have passed 2.121 or 2.131 may not enrol in 2.111 or 2.141. Students meeting the 2.121 or 2.141 prerequisite are not permitted to enrol in 2.111 without the permission of the Head of the School of Chemistry. Students who enrol in 2.111 must pass 2.111 before they can proceed to 2.121 or 2.131 or 2.141.

**2.131 Chemistry 1B****S1 or S2 L2T4***Prerequisite:* 2.121.

Chemical equilibrium, equilibrium constants, quantitative calculations applied to acid-base and solubility equilibria; buffers, titrations, chemical analysis. Oxidation and reduction reactions, electrode potentials. Chemical thermodynamics, entropy, free energy. Chemistry of carbon compounds, stereoisomerism; alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, aldehydes, ketones, carboxylic acids and derivatives, amines.

*Note:* Students who have passed 2.111 may be permitted to enrol in 2.131 on application to the Head of the School of Chemistry.

**2.951 Chemistry 1ME****S1 L3T3***Prerequisites:* As for 2.121.

A treatment of chemistry which illustrates the application of the principles of chemistry to problems of concern to mechanical engineers. Topics: chemistry of materials, thermochemistry, chemical kinetics and equilibrium, radioactivity and nuclear

power, electrochemistry and corrosion of metals. Introduction to organic chemistry, structure and properties of polymers, fuels and lubricants. Surface chemistry.

## 2.991 Chemistry 1CE

S2 L3T3

*Prerequisites:* As for 2.121.

Atomic and molecular structure and bonding. Chemical equilibrium. Rates of reactions. Thermochemistry. Ionic equilibria. Metals, electro-chemistry and corrosion. Colloids and clays. Colligative properties of solutions. Organic chemistry, polymers. Applications of chemical principles to engineering.

For further information regarding the following subject see the Faculty of Medicine Handbook.

## Level II Units

### 2.102A Physical Chemistry

S1 or S2 L3T3

*Prerequisites:* 2.121 and 2.131, or 2.141, and 10.011 or 10.001 or 10.021B and 10.021C. Excluded 2.002A.

Thermodynamics: first, second and third laws of thermodynamics; statistical mechanical treatment of thermodynamic properties; applications of thermodynamics: chemical equilibria, phase equilibria, solutions of nonelectrolytes and electrolytes, electrochemical cells. Kinetics: order and molecularity; effect of temperature on reaction rates: elementary reaction rate theory. Surface chemistry and colloids: adsorption, properties of dispersions; macromolecules and association colloids.

### 2.102B Organic Chemistry

F or S2 L3T3

*Prerequisite:* 2.131 or 2.141. Excluded: 2.002B

Discussion of the major types of organic reaction mechanisms (eg addition, substitution, elimination, free-radical, molecular rearrangement) within context of important functional groups (eg aliphatic hydrocarbons, monocyclic aromatic hydrocarbons, halides, organometallic compounds, alcohols, phenols, aldehydes, ketones, ethers, carboxylic acids and their derivatives, nitro compounds, amines and sulfonic acids). Introduction to application of spectroscopic methods to structure determination.

### 2.102C Inorganic Chemistry and Structure S1 or S2 L3T3

*Prerequisites:* 2.121 and 2.131, or 2.141. Excluded: 2.042C.

Fundamentals of spectroscopy as experimental basis for theories of electronic structures of atoms and molecules. Concepts and consequences of quantum theory. Molecular orbitals. Ligand field theory, magnetochemistry. Geometrical structure and chemical bonding, molecular and non-molecular structures, molecular symmetry, ionic covalent and metallic bonds. Occurrence, preparation, properties and reactions of compounds of the *p*-block elements, of transition metals and of post-transition metals. Principles of co-ordination chemistry. Thermodynamics applied to inorganic systems in solid and solution phases.

### 2.102D Chemical and Spectroscopic Analysis

S1 or S2 L3T3

*Prerequisites:* 2.121 and 2.131, or 2.141; and 10.011 or 10.001 or 10.021B and 10.021C. Excluded: 2.002D and 2.003H.

General procedures in analytical science, accuracy, propagation of errors, precision. Analytical reaction chemistry, titrimetric, and gravimetric, analysis. Solvent extraction. Electroanalytical methods. Chromatography. Instrumental aspects of all major spectroscopic methods. Optical spectroscopy, nuclear magnetic and electron spin resonances, mass spectrometry. Sample handling.

## Level III Units

### 2.043 A

## Servicing Subject

### 2.9111 Chemistry 1EE

S1 L2T1

*Prerequisite:* As for 2.121

Atomic and molecular structure and bonding. Chemical equilibrium. Rates of reactions. Thermochemistry. Ionic equilibria. Metals, electro-chemistry and corrosion. Colloids and clays. Colligative properties of solutions. Organic chemistry, polymers. Applications of chemical principles to engineering.

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## Materials Science and Engineering

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### 4.412A Physical Metallurgy 1A Unit 1: Phase Equilibria I

S1 L3

*Co-requisite:* 2.102A, 4.732.

Elements of crystallography. The crystal structure of metallic phases. Defect structures, dislocations, grain boundaries, plasticity, deformation and recrystallization. Phase equilibrium in alloy system. Genesis of microstructure. Mechanisms of phase transformations, departure from equilibrium, metastable transition phases. Use of free energy principles to determine nature of phase equilibrium, common tangent construction. Application of Hume-Rothery principles to determine liquids and solidus boundaries, electron compounds. Introduction to nucleation theory.

### 4.422B Physical Metallurgy 1B

S2 L1T1

Metallographic techniques. Principles of optical microscopy. Quantitative microscopy and stereology.

**4.432 Physical Metallurgy 1C****S2 L1T3***Prerequisite:* 4.412A

Ferrous alloys. Iron-carbon phase equilibrium. Microstructure and properties of plain carbon steels. Austenite decomposition under equilibrium and non-equilibrium conditions. Dilatometry. Heat treatment of steels. Surface hardening treatments. Microstructure and properties of ordinary cast irons, including grey, white, mottled, malleable and ductile irons.

**4.634 Metallurgical Engineering 3C****S1 L2½T½***Prerequisite:* 4.453.

Advanced materials. Interrelationship between the structure and properties of metallic and non-metallic magnetic materials. Domain magnetism. Magnetic anisotropy and control of magnetic properties by modification of microstructure. Magnetically soft and hard magnetic materials. Metallic glasses. Microstructure and properties of high temperature alloys, iron-base alloys, nickel-iron alloys, nickel-base, cobalt-base and chromium-base alloys. Strengthening mechanisms. Creep, oxidation and hot corrosion. Coatings and protection. Process metallurgy and applications of high temperature alloys. Fibre composites, Fibre and matrix materials, fabrication. Design with fibre composites. Mechanical properties and environmental effects, corrosion, fatigue, creep and damage tolerance. Mechanisms of sintering in metals. Techniques of powder metallurgy; compaction, powder characteristics. Sintering in presence of liquid phase, cementation, cermets. Preparation of super-alloys.

**4.642 Metallurgical Engineering 1D****S2 L1T1***Prerequisite:* 4.732.

Metal forming. Introduction to metal forming operations. Factors affecting deformation and workability. Processes of forging, rolling, extrusion, and wire drawing. Die materials and geometry. Deformation parameters and processing defects.

**4.713 X-Ray Diffraction and Electron Microscopy****S1 L2T2***Prerequisite:* 4.412A or 4.212

X-ray diffraction, electron optics, and analysis. Production, absorption and diffraction of X-rays. Powder and single crystal X-ray methods. Stereographic projections and crystal geometry. Applications of diffraction methods to solid solution and solubility limit, thermal analysis, stress measurement, chemical analysis. X-ray fluorescence spectroscopy and analysis, on-stream analysis. Electron optics and analysis, transmission and scanning electron microscopy. Energy-loss spectrometers, micranalysis.

**4.742 Physics of Materials****S2 L2T1***Pre-requisite:* 1.001 or 1.011.

Interatomic bonding in solid materials. Types of interatomic bonds, metallic, covalent, ionic. Introductory quantum mechanics in one dimension, free electron theory, effects of periodic potential, density of states curves. Effect of electron to atom ratio on conductivity and crystal structure; semiconductors; intrinsic, extrinsic. Exchange energy; ferromagnetism, antiferromagnetism. Elementary perturbation theory, covalent bond; crystal structures, properties. Ionic bond, crystal structure, force models, properties.

**4.913 Materials Science****F L2T1**

1. The properties of crystalline solids. Defect structure of crystals. Influence of defects on the behaviour of crystals. The properties of metals and metallic alloys in terms of modern theories. The development of alloys for specific engineering applications. The elastic and plastic properties of solids. The mechanisms of fracture in crystalline solids. Ductile and brittle fracture. Creep. Fatigue. Design of materials. 2. *Metallic corrosion. Polymer materials:* The structure and properties of polymers. Mechanisms for the modification of properties. *Ceramic materials:* The structure and properties of ceramics. Similarities and differences with other crystalline solids. Ceramic-metal composites.

**4.964 Materials Science and Engineering for Electrical Engineers****S2 L3T1***Prerequisite:* 1.982 Solid State Physics.

Metallic, ceramic, organic, polymeric and composite materials and their technology for electrical engineering applications. Structures and structure property relations, phase equilibria and their effect on mechanical, electrical, magnetic, thermal and chemical properties. The shaping, treating and joining of materials. Aqueous and gaseous corrosion. Metallic glasses, superconductors, fastion conductors. The role of materials science in the development of electrical energy systems.

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## Mechanical and Industrial Engineering

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**5.0010 Professional Studies 1****S1 L/T1***Prerequisite:*

*HSC Exam  
Score Range  
Required*

2 unit English (General) or  
2 unit English  
or  
3 unit English

53-100  
49-100  
1-50

*Excluded:* 5.061

To assess abilities in written expression; to develop a consciousness of the importance of written, pictorial and oral expression in engineering life; to begin to develop these skills, emphasising the significance of logical structure; to begin to develop an awareness of the professional attitude.

**5.0011 Engineering Mechanics 1****S1 or S2 L2T2***Prerequisite:*

*HSC Exam  
Score Range  
Required*

Either  
2 unit Science (Physics) or

53-100

3 unit Science or 4 unit Science (multistrand) or 2 unit Industrial Arts (Engineering Science) or 3 unit Industrial Arts (Engineering Science)	90-150 1-50  53-100  1-50
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Excluded: 5.010, 5.0101, 5.0201.

**Note:** Students who wish to enrol in this subject in courses other than the full-time courses in Aeronautical Engineering, Electrical Engineering, Industrial Engineering, Mechanical Engineering and Naval Architecture can make up for the lack of the prerequisite by work taken in Physics in the first half of the first year.

Equilibrium. Friction. Systems of multforce members, co-planar and three-dimensional. Mass centre; centroid. Fluid statics. Plane particle kinematics: rectilinear, curvilinear and relative motion. Plane particle kinetics: equations of motion; work, power, energy; impulse, momentum, impact.

### 5.0012 Introductory Engineering Design and Materials Science S1 or S2 L2

Excluded: 5.0016, 5.010.

*Introduction to engineering design:* Engineering method, problem identification, creative thinking, mathematical modelling; computer-aided design; materials and processes; communication of ideas; the place of engineering in society.

*Introduction to materials science:* Structure and properties of main types of engineering materials, with emphasis on the way in which properties may be controlled by controlling structure.

### 5.0016 Introductory Engineering Design and Drawing Practice S1 L/T2

Excluded: 5.0012, 5.030, 5.0302, 5.010.

This subject is intended specifically for Electrical Engineering students, and is to be taken in conjunction with 5.0011.

*Introduction to engineering design:* Engineering method, problem identification, creative thinking, mathematical modelling; computer-aided design; materials and processes; communication of ideas; the place of engineering in society.

*Introduction to drawing practice:* Graphic communication. First and third angle orthographic projection. Descriptive geometry fundamentals. Mechanical drawing practice and interpretation. Pictorial views. Theory of computer-aided drafting. Electrical drawing practice.

### 5.0300 Graphical Analysis and Communication S2 L1T2

Excluded: 5.0016, 5.030, 5.0302.

Descriptive geometry as the basis of analysis and synthesis of spatial relationships: points, lines, plans, solids, intersections. Orthographic and other projection systems. Engineering drawing as a means of definition and communication, selection of views, construction of drawings, conventions, dimensions and tolerancing. Introduction to computer-based drafting systems.

### 5.0302 Engineering Drawing and Descriptive Geometry S1 or S2 L1T3

Excluded: 5.0016, 5.030.

Graphic communication. First and third angle orthographic projection and isometric projection. Descriptive geometry fundamentals and their application to engineering problems with special emphasis on visualization of problems and development of methods for their solution. Australian standard engineering drawing practice. Applications involving detail and assembly drawings, functional dimensioning and tolerancing.

### 5.0303 Workshop Technology SS L1T2

The implementation of design and its interaction with manufacturing equipment and processes. Manufacturing capabilities and tolerancing. Approximately 30 hours of practical training including casting, welding, fitting and machining. Students who have done Industrial Arts for the HSC, have an appropriate trade or certificate course qualification, or are suitably employed, may qualify for exemption from this subject.

### 5.0305 Manufacturing Technology S2 L/T3

Prerequisite: 5.0011. Co-requisites: 5.1010, 5.421. Excluded: 5.030.

Description of the processes classified as: forming from liquid or solid, material removal, material joining. Elementary mechanics of forming and cutting processes. Analysis of the primary functions of machine tool structures and their operation. Relationship between product design and manufacture processes. Elementary functional analysis of product designs, including linear loop equations, limits and fits, dimensional accuracy of processes and alternate design and manufacturing strategies.

### 5.034 Engineering Experimentation S1 L1 T1 S2 L½T1

Prerequisites: 5.3021, 5.4220, 5.620, 5.626, 10.351. Co-requisites: 5.343, 6.856.

Analog and digital instrumentation. Transducers, computer communication interfaces, computer control of experiments. Scientific method, engineering method, report writing, errors in experiments. Nineteen experiments and demonstrations.

### 5.043 Industrial Training 1 SS

Practical work in industry at the process or shop floor level to gain experience of people, industrial problems and relations, and process equipment. (Report submitted in Week 1 of session detailing involvement and experience gained prior to Year 3.)

For details contact Mr. G. Crawford, Industrial Training Officer.

### 5.044 Industrial Training 2 SS

Practical work in industry at the professional level to gain experience in design, development, investigation or management control systems areas in collaboration with professional engineers. (Report submitted in Week 1 of session detailing responsibilities and experience gained in vacation period between Years 3 and 4.)

For details contact Mr. G. Crawford, Industrial Training Officer.

**5.051 Thesis****F T6***Co-requisite: 5.062.*

To be taken in year of completion of course.

For students in the BE degree courses in the School of Mechanical and Industrial Engineering.

**5.062 Communications****F L2***Co-requisite: 5.051.*

Development of skill in the use of the various media of communication. Effective interpersonal and mass communication using visual and oral transmission. Dynamics and performance of groups. Organizing and directing conferences. Chairmanship. Professional ethics and etiquette.

**5.065 Mechanical Engineering****SS L3/T1***Prerequisites: 1.961, 10.2111, 10.2112 or equivalent.*

Properties of matter. Laws of Thermodynamics for non-flow and flow processes, entropy, efficiency and availability. Air standard and vapour power cycles. Combined cycles and cogeneration. Manometers, Bernoulli, linear and angular momentum equations. Flow measurement. Turbomachinery velocity diagrams. Incompressible and compressible flow in adiabatic ducts. Conduction, convection and radiation heat transfer with applications.

**5.070 Optimal Engineering Strategies****FL1T½***Prerequisites: 5.3021, 10.022. Co-requisite: 5.122. Excluded: 5.073.*

Optimization: introduction to the calculus of variations; Euler-Lagrange equations and Hamilton's principle; introduction to geometric programming and network analysis. Strategies for design and analysis: system structure; variable classification; procedure generation; recycle optimization; the adjacency matrix.

**5.074 Computing Science for Mechanical Engineers****S1 L2T1***Prerequisite: 5.0721.*

*Hardware and software:* Peripheral devices and communications equipment. Program documentation, debugging and testing. Improved programming techniques. Text editors, preprocessors and debugging systems. Computer graphics. Data acquisition. Programming languages.

**5.079 Numerical Methods****F L1T½***Prerequisites: 5.0721, 10.022. Excluded: 5.073.*

Numerical methods for solution of non-linear equations, linear and non-linear systems, ordinary and partial differential equations.

**5.1010 Mechanical Engineering Design 1****S2 L/T3***Co-requisite: 5.0010. Excluded: 5.0012, 5.061.*

Introduction to hardware. Studies of a range of engineering components, considering: what they do, how they do it, how they were made, the range of possible forms for each item, why each item has its particular form. Design philosophy. Design as the

formulation and implementation of practical ways of fulfilling needs, including: recognising the need, generalising the question, considering a range of solutions, selecting a short-list, analysing the selected range, making a final choice. Commercial philosophy. Impetus for design, market competition, significance of innovation, intellectual property, financing, manufacturing, marketing, etc.

**5.122 Mechanical Engineering Design 2****F L1T2***Prerequisites: 5.0012, 5.0300, 5.0305. Co-requisites: 5.061, 5.3021, 5.4220, 5.4222, 5.620, 5.626.*

Design of basic engineering elements and simple systems. Selection and specification of materials and manufacturing processes for engineering items. Communication by means of engineering drawings (including tolerances) of manufacturing information for simple structures and assemblies. Application of standards and trade literature to design. Simple design-and-make project to meet a published specification and to demonstrate the product's performance.

**5.123 Mechanical Engineering Design 3****F L2T1***Prerequisite: 5.122. Co-requisites: 5.3030, 5.423.*

Mathematical modelling and decision making in design with applications. More advanced design analyses, component design and drawing with individual and group projects of an interdisciplinary nature.

**5.1240 Design Project****F L1T2***Prerequisite: 5.123.*

Creative design and development leading to the detail design, building and testing of systems and devices to satisfy specified objectives of set projects.

**5.1242 Design Technology****SS L2T1***Prerequisite: 5.122.*

Aspects of mechanical engineering technology which form the basis for machinery design. Hydraulic power components and circuits. Advanced welding technology. Generation of systematic strategies for design computations. Fluid couplings and torque converters. Power flow analysis in multi-path machinery.

**5.1243 Machinery Design Project****SS L1T2***Prerequisite: 5.123.*

Development of a final design to satisfy objectives involving design analysis, component selection and preparation of working drawings.

**5.1244 Project Management****SS L2T1***Prerequisite: 5.122.*

Studies of aspects of implementation of design work to ensure that design objectives are achieved. Project scheduling and control, preparation of contracts and specifications, use of standards and codes, quality assurance, product liability, patent law, marketing.

## 5.1245 Computer-Aided Engineering Design SS L2T1

*Prerequisite:* 5.123 or 5.901. *Excluded:* 18.803, 18.870G.

Mathematical modelling and analysis of component and system designs using the computer as a tool to optimize and investigate design solutions. Use of available algorithms and computer packages.

## 5.235 Nuclear Power Technology S1 L2T1

*Prerequisites:* 5.630, 5.636. *Excluded:* 23.051.

Atoms, nuclei, radioactivity, radiation detection and radiation safety, nuclear fission, neutron reactions, neutron diffusion and criticality. Design, operation and safety features of thermal fission, fast fission and fusion power reactor types. Nuclear fuel cycles from mining to waste disposal. The costs of nuclear power.

## 5.3021 Engineering Mechanics 2A S1 or S2 L2T1

*Prerequisites:* 1.001 or 1.951, 5.0011 or 5.0201, 10.001 or 10.011. *Excluded:* 5.300.

Kinetics of systems of particles; plane steady mass flow. Plane kinematics and kinetics of rigid bodies: moment of inertia; motion relative to translating and rotating frames of reference; equations of motion; work and energy, impulse and momentum. Virtual work for static and dynamic systems. Kinematics and kinetics of simple mechanisms.

## 5.3022 Engineering Mechanics 2B S1 or S2 L/T2

*Prerequisites:* 1.001 or 1.951, 5.0011 or 5.0201, 10.001 or 10.011. *Excluded:* 5.303

Differential equations of motion. Transverse vibrations of beams. Whirling of shafts. Single degree-of-freedom systems: free, forced, undamped and damped vibrations. Transmissibility.

## 5.3030 Engineering Mechanics 3 S2 L/T2

*Prerequisites:* 5.3021, 10.022. *Excluded:* 5.301, 5.333.

Kinematics of gear tooth profiles; standard and non-standard gear proportions. Gear trains; epicyclic gears. Static and dynamic balancing of rotating and reciprocating mass systems. Three-dimensional kinematics and kinetics of a rigid body; angular momentum, inertia tensor, kinetic energy, Euler's equations of motion. Gyroscope.

## 5.3040 Plane Mechanism Kinematics S1 or S2 L2T1

*Prerequisites:* 5.301 or 5.3021 or 5.333. *Excluded:* 5.318G.

Algebraic displacement, velocity and acceleration analyses of simple and complex planar mechanisms. Instantaneous kinematics: centrodes; inflection and Bresse circles; acceleration centre; Euler-Savary equation; cubic of stationary curvature; centring point curve. Coupler curves and their properties; curve cognates. Constraint and freedom; mobility; velocity closure of a loop; special configurations; singularities. Various methods of synthesis.

## 5.3130 Vibration Analysis S2 L/T2

*Prerequisites:* 5.3022, 10.022. *Excluded:* 5.303, 5.333.

Lagrange's equations of motion. Linear vibrations of multi-degree-of-freedom systems; normal modes; simple applications. Finite elements for structural dynamics; mass matrix; natural frequency and normal mode determinations; convergence; engineering applications.

## 5.343 Linear Systems Analysis S1 L2T1

*Prerequisites:* 5.0011 or 5.0201, 10.022.

*Models of physical systems:* differential equations for physical systems including mechanical, electrical, hydraulic, thermal and pneumatic systems; linearization. *System analysis techniques:* solution by Laplace transform method. Transfer functions and block diagrams. *System response:* response of first and second order systems to impulse step, ramp, sinusoidal and periodic inputs; higher order system response; system stability, applications.

## 5.348 Mechanical Vibrations 2 SS L2T1

*Prerequisites:* 5.303, 5.423. *Excluded:* 5.334, 5.338G.

Means of controlling inertia-induced vibration in machinery. Frequency response functions of damped and undamped systems; laboratory demonstrations. Eigenvalues and eigenvectors for multi-degree of freedom systems, including geared shaft systems. Beam and plate vibration via finite element analysis and laboratory demonstrations.

## 5.350 Principles of Control of Mechanical Systems S1 L2T1

*Prerequisite:* 5.343. *Excluded:* 5.344.

Introduction to modern systems analysis. Review of modelling; nonlinear systems. Digital and analogue representations. Stability; regulation; control and optimal control. Instrumentation; actuators; interfaces; control computers; programmable logic controllers. Implementation; various case studies, including microprocessor applications.

## 5.3541 Engineering Noise 1 SS L2T1

*Excluded:* 5.653G.

Acoustic plane wave equation, standing waves, energy density, intensity, decibel scales. Human response, annoyance and damage criteria. Transmission between media, absorbing materials. Mufflers. Three dimensional wave equation. Transmission in ducts. Room acoustics.

## 5.3542 Engineering Noise 2 SS L2T1

*Prerequisite:* 5.3541. *Excluded:* 5.654G.

Noise measurement, microphones, frequency analysis, transient and average measurement. Frequency weightings. Flow noise, noise from jets, fans, propellers. Noise of machines, modal response, damping.

## 5.419 Engineering Applications of Finite Elements SS L2 T1

*Prerequisite:* 5.423.

*Excluded:* 5.414G, 5.823.

Introduction to finite element and associated graphics packages.

Principles of mesh design and validation. Specification of boundary conditions and use of symmetry. Solid modelling and use of mesh generators. Estimation of the cost of the solution. Assessment of the accuracy of the results. Convergence. Applications using commercial finite element programs.

#### 5.421 Mechanics of Solids 1 S1 or S2 L2T1

*Co-requisite:* 5.0011.

Stress and strain. Bars under axial loading. Stresses and deformation due to bending. Strain energy. Flexibility and stiffness. Stress and deformation due to torsion. Helical springs.

#### 5.4220 Mechanics of Solids 2 ½S1S2L1½T2

*Prerequisites:* 5.421, 10.001 or 10.011. *Excluded:* 5.422, 5.4221.

Statics of frames and machines. Unsymmetrical bending. Analysis of stress; analysis of strain; generalized Hooke's Law. Thin-walled pressure vessels. Combined loads. Theories of failure. Stress concentrations and fatigue. Shear stress in beams; shear centre. Stability and buckling of columns.

#### 5.4221 Mechanics of Solids 2 F L1½T2

Intended for Materials Science Majors in combined BE BSc degree course.

*Prerequisites:* 5.421, 10.001 or 10.011.

*Excluded:* 5.422, 5.4220, 5.4222.

Mechanical properties of materials: tensile and compressive behaviour; hardness; testing machines. Statics of frames and machines. Unsymmetrical bending. Analysis of stress; analysis of strain; generalized Hooke's Law. Thin-walled pressure vessels. Combined loads. Theories of failure. Stress concentrations and fatigue. Fatigue of biaxial and triaxial systems. Shear stress in beams; shear centre. Stability and buckling of columns.

#### 5.4222 Mechanical Engineering Materials ½S1 L1½T2FL1

*Prerequisite:* 5.0011. *Excluded:* 5.422, 5.4221.

Mechanical properties of materials: tensile and compressive behaviour; hardness; testing machines. Solidification. Mechanical processing of metals. Phase equilibrium and its application to engineering materials. Fracture; creep; corrosion.

#### 5.423 Mechanics of Solids 3 F L1½T1½

*Prerequisites:* 5.422 or 5.4220, 5.4222 or 5.4221, 10.022.

Deflections of beams and structures. Statically indeterminate beams and structures. Introduction to theory of elasticity; stress, strain, torsion. Membrane analogy. Finite element stress analysis. Basic concepts; structural stiffness method; bar, triangular, rectangular and brick finite elements; force and displacement methods; development and use of computer programs.

#### 5.424 General Mechanics of Solids SS L2T1

*Prerequisite:* 5.423. *Excluded:* 5.417G.

Inelastic behaviour of bars, beams, shafts and columns. Thick cylinders and composite cylinders loaded by internal and exter-

nal pressures; rotating discs; contact stresses. Elementary concepts of fracture mechanics; stress intensity factor; fracture toughness; crack propagation.

#### 5.434 Plates and Shells SS L2T1

*Prerequisite:* 5.423. *Excluded:* 5.415G.

Bending of rectangular and circular plates under normal loading; thermal stresses. Shells; membrane stresses, bending stresses, discontinuities at junction of ends; design of pressure vessels.

#### 5.444 Theory of Elasticity SS L2T1

*Prerequisites:* 5.3021, 5.423, 5.622.

Mathematical foundations; analysis of stress; deformation and strain; equilibrium, motion and flow; fundamental laws of continuum mechanics; linear elasticity; viscoelasticity; applications.

#### 5.454 Theory of Plasticity SS L2T1

*Prerequisite:* 5.423 or 18.413.

Analysis of stress, strain, strain rate; plastic stress/strain relations with description of experimental verification. Application of plasticity theory to a selection of problems including metal working processes such as extrusion and rolling and metallic friction and wear.

#### 5.464 Structural Instability S1 L1½T1½

*Prerequisite:* 5.423.

Buckling of perfect and imperfect columns; bending and buckling of thin flat plates; local instability and crippling of thin-walled columns. Buckling of monocoque cylinders and curved panels. Stiffened panels. Tension field beams.

#### 5.5010 Computing 1 M S2 L/T3

*Excluded:* 5.0721.

Introduction: history, applications, hardware, software, a model of a computer system, editors, operating systems. Program design and development: programming objectives, data structures, algorithms, symbolic names, translation of algorithms, steps in programming, programming style, syntax charts, errors and debugging. Data: data types, declarations, input/output, file control. Programming constructs: arithmetic expressions, assignment, relational and logical expressions, selection, iteration, intrinsic functions, statement functions, subprograms, common, communication. Applications using existing programs: sorting, word processing, graphics and plotting, simultaneous linear algebraic equations.

#### 5.620 Fluid Mechanics 1 F L1T1

*Prerequisites:* 1.001 or 1.951, 5.0011, 10.001 or 10.011. *Co-requisite:* 5.3021.

*Excluded:* 5.622.

Units. Fluid properties; fluid statics. Flow fields; unsteady and compressible flow. Bernoulli's equation. Momentum equations. Ideal flow. Flow measurement. Dimensional analysis: similitude;

dimensionless numbers; methods of analysis. Steady one dimensional flow in ducts: laminar and turbulent; pressure loss; friction factor; losses in bends and fittings. Elementary boundary layer flow; skin friction and drag. Pumps and turbines.

## 5.626 Thermodynamics 1

FL1T1

*Prerequisites:* 1.001 or 1.951, 5.0011, 10.001 or 10.011. *Excluded:* 5.622.

Work, energy, power. Units. Systems, states and processes. Control mass and volume. Fluid properties: extensive; intensive. Equation of state. Tables of properties. First law of thermodynamics. Non-flow processes: reversible; irreversible. Flow processes: energy equation; enthalpy. Ideal processes and cycles. Reversibility. The second law of thermodynamics. Entropy. Isentropic processes. Cycles for engines and heat pumps. Energy conversion efficiency. Reciprocating pumps; compressors; engines. Energy analysis; P-V diagrams.

## 5.630 Fluid Mechanics 2

FL1T½

*Prerequisites:* 5.3021, 5.620, 5.626, 10.022. *Excluded:* 5.653, 5.663.

Dimensional analysis; similitude and modelling. Characteristics of pumps, fans and compressors; non-dimensional characteristics of turbomachines; specific speed; cavitation. Fields; dilatation vorticity; mass and momentum conservation; the Bernoulli equation; stream and potential functions; superposition. Velocity of sound; compressible flow in nozzles; Fanno and Rayleigh lines; applications to duct flows; normal shocks.

## 5.633 Turbomachines

SS L2T1

*Prerequisites:* 5.630, 5.663, 10.022.

Dimensional analysis and experience charts, cavitation, thermodynamics of a stage, blade element theory of axial machines, thin wing theory, cascade data and design procedures, aerodynamic design of an axial machine, theory of centrifugal machines, design of a centrifugal machine.

## 5.6341 Viscous Flow Theory

F L/T1½

*Prerequisites:* 5.620, 5.626, 10.022.

Review of vector analysis and Cartesian tensors. Kinematics of fluid motion. Reynolds transport theorem. Stress in fluid motion. Cauchy's equation. Constitutive equations. Couple stresses. Dynamics of fluid motion. Navier-Stokes equations. Linear and angular momentum equations. Inviscid motion. Thermodynamics of fluid motion. Energy equation. Energy transfer equation. Dissipation function. Enthalpy and entropy. Crocco's, Bjerkne's and Kelvin's theorems. Turbulent motion. Time smoothing. Time smoothed equations of fluid motion. Vortex transport equation. Creeping flow. Similarity.

## 5.6342 Lubrication

SS L/T3

*Prerequisites:* 5.620, 10.022. *Excluded:* 5.631G.

History of lubrication, types of bearings and bearing operation, nature of surfaces and their contact, modes of lubrication, properties of lubricants, viscous flow in pipes and channels, measurement of viscosity, infinitely long and short bearing approximations, one-dimensional analysis of short bearing, other slider bearing geometries, the effect of end leakage, hydrostatic or externally pressurized bearings, squeeze films.

## 5.635 Convection Heat Transfer

SS L2T1

*Prerequisite:* 5.636. *Excluded:* 5.717G, 5.602G.

*Introduction:* review of the mechanisms of heat transfer. *Governing equations for convection:* continuity, Navier-Stokes, energy. Boundary layer equations for forced and natural convection. Boundary conditions. *Approximate analytical solution methods:* momentum and energy integral equations. Polhausen technique. Similarity formulation. Solution by conversion to initial value problem. *Finite difference methods:* Finite difference approximations of partial differential equations. Consistency, stability and convergence. Application to the boundary layer and the full equations of motion and energy.

## 5.636 Thermodynamics 2

FL1T½

*Prerequisites:* 5.3021, 5.620, 5.626. *Excluded:* 5.623, 5.624.

Steady and unsteady conduction heat transfer; convection heat transfer; radiation heat transfer; combined modes of heat transfer; heat exchangers. Non-reactive gas mixtures; psychrometrics; refrigeration and air conditioning.

## 5.641 Thermal Power Plants

SS L2T1

*Prerequisites:* 5.620, 5.626. *Excluded:* 5.732G.

Energy sources, power plant thermodynamics. Fuel, combustion processes and equipment. Boilers, turbines and condensers. Heat exchangers, pumps, water supply and treatment systems. Air circulating and heating systems. Station operation and performance. Economics of electric power production. Environmental impacts of power plants. Alternative sources of energy.

## 5.643 Energy, Combustion and Engines

SS L2T1

*Prerequisites:* 5.636, 10.022. *Excluded:* 5.616G.

General thermodynamic relations, ideal and non-ideal gases, statistical thermodynamic derivations of internal energy and entropy, ideal gas mixtures. Combustible fuels, combustion equations, internal energy and enthalpy of reaction. First law analysis of combustion, adiabatic flame temperatures. Second law analysis of combustion, chemical equilibrium, chemical kinetics and rate controlled reactions. Application of chemical equilibrium and reaction rate methods to combustion and emission problems. Deflagration, detonation and diffusion flames, mixing controlled reactions.

## 5.644 Solar Energy

SS L2T1

*Prerequisites:* 5.630, 5.636, 10.022. *Excluded:* 5.722G.

Radiation heat transfer, spectral distribution of solar radiation and effect of atmospheric absorption. Solar radiation data, total and diffuse components. Analysis of heat transfer processes in solar collectors. Evaluation of performance. Descriptive treatment of indirect methods of use of solar energy.

## 5.654 Hydraulic Transients

SS L2T1

*Prerequisites:* 5.630, 10.022.

Mass oscillations in surge systems with various types of surge tanks. Stability of surge systems, comparison with experiment. Allievi's theory of water hammer, fast and slow closures, waterhammer in pumping systems, circle diagrams.

**5.664 Multiphase Flow****SS L2T1***Prerequisites: 5.630, 5.636, 10.022.*

Nature of multiphase flow. Gas-liquid, gas-solid, liquid-solid two phase and two-component flows. Three-phase flows. Vertical and horizontal flows. Flow patterns. Correlations. Pressure drop in two-phase flows. Isothermal flows. Flows with heat transfer. Hydraulic and pneumatic transportation of solid materials in pipelines.

**5.800 Aircraft Design 1****F L2T1***Prerequisites: 5.122, 5.300 or 5.3021, 5.422. Co-requisite: 5.423.*

Aircraft and helicopter types, materials, loads, load factors. The design process. Design of members in tension, compression, bending, torsion; rivetted, welded and bolted joints. Wing lift distribution, stressing, design and drawing of components, fittings. Analysis and design of composites, sandwich construction. Applications of finite element method. Helicopter rotor control, loading.

**5.801 Aircraft Design 2****F L2T1***Prerequisites: 5.303, 5.423, 5.800, 5.811, 5.822. Co-requisites: 5.812, 5.823, 5.831.*

Aerodynamics, structures and operations leading to detailed design, calculation and drawing of an original aircraft configuration.

**5.811 Aerodynamics 1****F L2T1***Prerequisites: 5.300 or 5.3021, 5.620, 10.022. Excluded: 5.653, 5.663.*

One dimensional compressible flow. Low speed aerodynamics; boundary layers, drag; industrial aerodynamics, wind tunnels, airfoils for wings, cascades, propellers, fans; potential flow for airfoils; Prandtl lifting lines, vortex induced drag. Flight mechanics; performance; static stability.

**5.812 Aerodynamics 2****F L2T1***Prerequisites: 5.811, 5.303, 5.343.*

Compressible flow: subsonic, transonic and supersonic two-dimensional flows; viscous boundary layers and heat transfer. Dynamic stability and control: characteristic solutions for rigid aircraft. Hypersonic, high enthalpy flows.

**5.822 Analysis of Aerospace Structures 1****F L1½T½***Prerequisites: 5.300 or 5.3021, 5.4220, 10.022. Co-requisite: 5.423.*

Equilibrium of forces: aerospace applications of plane frames and space structures. Beams; shear and bending stress distribution in thin-webbed beams, close-section thin-wall beams, tapered beams, beams with variable flange areas. Semi-monocoque structures; ribs and bulkheads. Deflection of structures: stresses due to torsion and shear in multicell tubes. Statically indeterminate structures; beams, trusses and frames. Structural instability; buckling of perfect and imperfect columns; bending and buckling of thin flat plates.

**5.823 Analysis of Aerospace Structures 2****F L1½T½***Prerequisites: 5.423, 5.822. Excluded: 5.414G, 5.419.*

Structural instability; local instability and crippling of thin-walled columns; buckling of stiffened panels, curved panels and monocoque cylinders; tension field beams. Stress functions. Shear lag. Warping of thin-walled open and closed section tubes. Torsional buckling. Advanced applications of finite elements; introduction to commercial f.e.m. systems. Thermal stresses. Vibrations and aeroelasticity. Fatigue.

**5.831 Aerospace Propulsion****F L1½T½***Prerequisites: 5.620, 5.626, 5.653 or 5.811.*

Propulsion systems: history, types, basic thrust, efficiency equations. Propellers, rotors and fans: engine cycle thermodynamics, performance, testing. Engine intakes: subsonic, supersonic, ram-jets. Gas turbine, piston engine, design, performance. Rockets. Noise, pollution.

**5.901 Introduction to Mathematical Modelling and Decision Making****S1 L2T1***Prerequisite: 5.122.*

This subject is identical with Session 1 of 5.123. Models and modelling: types, criteria, parameters, constraints; mathematical formulation and validation of models; fundamentals of solution algorithms; post-solution analysis. Decision making: scales and ratings; subjective decision making; mixed rating comparisons; sensitivity; pitfalls. Introduction to project control. Applications from the marine field.

**5.902 Ship Management Economics****S2 L1½T½***Prerequisite: 10.022.*

Basic concepts and definitions. Interest relationships. Present worth. Average annual cost. Capitalized cost. Rate of return. Depreciation and taxation. Economic criteria. Voyage analysis. Probability in economic studies. Sensitivity analysis in economic studies. Introduction to dynamic programming. Replacement analysis of equipment, ships and shipyards.

**5.911 Ship Hydrostatics****F L2T½***Prerequisites: 5.0011, 10.001 or 10.011.*

Basic concepts and integration methods. Hydrostatic particulars and approximate formulae. Intact stability, cross curves and righting arm, stability at small angles and free surface effects, the wall-sided formula, flooding and water tight subdivision. Damaged stability. Launching calculations and docking.

**5.921 Ship Structures 1****F L1½T½***Prerequisites: 5.4220, 5.4222, 10.022.*

Ship structural loading and response. Bending of the hull girder — deterministic aspects. Statistical prediction of wave loads and whole girder response. Basic concepts in finite element analysis — extended beam theory. Applications of extended beam theory — hull girder analysis. Frame analysis and applications in ship structures. Ultimate strength of beams and frames. Laterally loaded grillages and stiffened panels — elastic and ultimate strength analysis.

## 5.922 Ship Structures 2

F L1½T½

*Prerequisites:* 5.423, 5.921.

Plate bending — elastic and ultimate strength analysis. Orthotropic plate bending and applications. Buckling and ultimate strength of columns. Buckling and ultimate strength of plates. Buckling of stiffened panels. Ultimate strength of stiffened panels. Ship structural materials, fatigue, fracture. Geometric stress concentration. Welded connections. Pressure hulls. Ultimate strength of hull girder. Structural optimization methods. Automated and computer aided design.

## 5.9311 Principles of Ship Design 1

S2 L2T1

Development of ships and ship building. Ship structure and lines. Ocean environment. Trading environment. Ship operations. Ship types. Freeboard and tonnage. Ship design.

## 5.9321 Principles of Ship Design 2

S1 L3T1 S2 L1½T½

*Prerequisite:* 5.9311.

Theory and technique of ship design. Blocking out a ship's dimensions. Development of weights. General arrangements, depth, freeboard capacity, stability analysis. Preliminary powering, sectional area curve and lines drawing. Estimating, design for construction, ship economics. Classification rules with scantling development. Midship section drawing. Safety and protection of ships. Rudders, trials, manoeuvring, cargo gear, shipbuilding methods production and control. Computerized costing, modular construction, tendering, production concepts, shipyard management.

## 5.937 Ship Design Project

S1 T3 S2 T4

*Prerequisites:* 5.901, 5.911, 5.953. *Co-requisites:* 5.902, 5.9311, 5.9321.

Each student is required to perform the following design tasks and submit the results: 1. Rationale, specifications, weights, inboard profile. 2. Power, capacities, freeboard, trim, stability, stern gear. 3. Sectional area curve, lines drawing, prelim midship section. 4. Hydrostatics, floodable length and stability curves. 5. Powering, propeller, systems-schematic drawing, detailed capacity. 6. Section modulus calculation, bulkhead, midship section, module concept. 7. Final weights, capacity drawing, operational data, and evaluation.

## 5.941 Ship Propulsion and Systems

F L/T4

*Prerequisites:* 5.911, 5.953.

Ship resistance. Problems of modelling. Froude's Method and improvements laboratory tests. Viscous resistance, wave resistance, and other components of drag. Propulsion. Propeller terminology and momentum theory. Experiments. Design and selection of propellers. Cavitation and vibration. Manoeuvring. Theory of ship manoeuvrability. Linearized equations of motion. Determination of coefficients and trials. Rudder design. Marine Engineering systems. Steam, diesel, gas turbines, turbo and diesel electric, nuclear propulsion. Systems for fuel, transmission, electricity, pumps, compressors, purifiers, piping systems and automation.

## 5.953 Ship Hydrodynamics

S1 L2T1 S2 L1½T½

*Prerequisites:* 5.300 or 5.3021, 5.620, 10.022.

Kinematics of irrotational flow and equations of continuity for an incompressible fluid. Stream function and use of distributed singularities to generate arbitrary body shapes. Airfoils and hydrofoils. Added mass for simple two dimensional shapes. Plane progressive water waves in both deep water and in water of finite depth. Motion of a spar buoy and derivation of coefficients in equation of motion. Linearized uncoupled motion of a ship. Coupled heave and pitch motion of a ship. Ocean waves and their properties.

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# Electrical Engineering and Computer Science

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## 6.010 Electrical Engineering 1

S2 L3T3

*Prerequisite:* Electricity and magnetism section of 1.961.

Passive electrical components. Electric circuit concepts and relationship to field theory. Kirchoff's laws. Node and mesh analysis of resistive networks. Network theorems. Controlled sources. Transient conditions. Sources of periodic signals. Sinusoidal steady state operation. Concepts of impedance, resonance, bandwidth and filtering. Power in DC and AC circuits. Circuit models of diodes and transistors. Transistor switching. Combinational logic principles and circuits. Diode and transistor logic implementations. Sequential logic circuit elements: monostable, bistable and astable circuits.

## 6.011 Introduction to Electrical Engineering

F L1 T½

Introduction to the nature, history and scope of electrical engineering. Power generation, transmission and utilisation of electrical energy. Electronics, computing and information processing. Roles for electrical engineers in industry, government and the public utilities. Organisation, communication and research skills in engineering.

## 6.021A Circuit Theory 1

S1 or S2 L2T2

*Prerequisites:* 1.961 or equivalent, 6.010, 10.001.

Lumped modelling concepts used in circuit theory and their relationship to observed physical properties and behaviour. Linear circuit elements. Kirchoff's laws. Resistive network topology and systematic derivation of network equations using node and loop methods. Network theorems. Exponentials and first order transients. Sinusoidal steady state operation including phasors, impedance and admittance concepts and systematic circuit equations. Power relations and second order systems response. Resonance, Q factor and bandwidth. Three phase circuits. Controlled sources and two port analysis.

## 6.021B Power

S1 or S2 L2T2

*Prerequisite:* 6.021A attempted at an acceptable level.

Topics in electric power engineering including analysis of AC power circuits (single phase, three phase, steady state and

transient), magnetic circuits, transformers, fundamentals of electro-mechanical energy conversion and electrical safety.

### 6.021C Electronics 1 S1 or S2 L2T2

*Prerequisite:* 1.982, 6.021A (one of these to be passed, the other to be attempted at an acceptable level and to be repeated concurrently).

Principles of operation and low-frequency characteristics of PN diodes, bipolar and field effect transistors, thyristors and various optoelectronic devices. Transistor low-frequency small-signal equivalent circuits. Design and analysis of low frequency Class A transistor amplifiers. Temperature effects. Device ratings and use of data sheets.

### 6.021D Computing S1 L3T1

*Prerequisite:* 6.611. *Excluded:* 6.620, 6.621.

Assembler programming and simple machine architecture. The Unix operating system: file system, processes, pipes, programming in the Shell command language. Data structures: lists, trees, recursion. Sorting: some basic algorithms for sorting arrays. Engineering applications of computers.

### 6.021E Digital Logic and Systems S1 or S2 L2T2

*Prerequisite:* 10.001.

Combinational circuits. Karnaugh maps. Sequential circuits. Register design. MOSFET circuits. Logic families. Memory elements. Computer magnetic storage devices. MSI/LSI functions. Computer operation. Numbers, codes, arithmetic, standards. Design for testability.

### 6.0311 Circuit Theory 2 S1 or S2 L2T2

*Prerequisites:* 6.021A, 10.111A (10.111A if attempted at an acceptable level may be taken as a co-requisite), 10.1113, 10.1114, 10.2111, 10.2112 (two of these may be taken as co-requisites), 6.021B, 6.021C (one of 6.021B or 6.021C may be taken as a co-requisite).

Basic circuit concepts followed by basic system ideas such as order, state, linearity and typical system waveforms. Typical linear time invariant systems modelled and described by differential equations leading to use of Laplace transforms. Partial fractions, poles, zeros and stability. Transfer functions and circuit responses both in time and frequency domain. Basic signal analysis. Fourier series. Fourier Transform. Modern filter design, Butterworth and Chebyshev filters. Transformation of low pass filter to high pass, bandpass and band stop filters.

### 6.0312 Utilization of Electric Energy S1 or S2 L2T2

*Prerequisites:* 6.021A, 6.021B. *Co-requisite:* 6.0311.

A continuation of study in the utilization of electrical energy commenced in 6.021B Power. Topics include: DC machines, synchronous machines, single- and three-phase induction motors, fractional horsepower motors, motor speed control, performance characteristics and applications, the thermal behaviour and rating of machines, harmonics in three-phase transformers.

### 6.0313 Electronics 2 S1 or S2 L2T2

*Prerequisites:* 6.021A, 6.021C. *Co-requisite:* 6.0311.

Linear signal-processing techniques. Short review of basic tran-

sistor theory and properties. Design and analysis of small signal amplifiers incorporating bipolar junction transistors. Applications of negative feedback. Differential amplifiers. Structure, properties and use of operational amplifiers.

### 6.0314 Systems and Control 1 S1 or S2 L2T2

*Prerequisite:* 6.0311.

Basic concepts of systems and automatic control with a general overview. Includes dynamic systems modelling, block diagrams, signal flow graphs, frequency and time domain relationships, stability criteria, Nyquist diagrams and root locus methods. Also includes introductory state space analysis.

### 6.0315 Electrical Energy S2 L2T2

*Prerequisite:* 1.972; 6.0312 attempted at an acceptable level.

Aspects of the supply, control and utilization of electrical energy. Choice of voltage and supply configuration. Transmission line characteristics and calculations. Dielectric and thermal considerations of power equipment. Protection considerations for medium voltage (up to 600V) systems — circuit breakers, fuses, relays, earthing, surge suppression. Electrical methods of industrial heating: direct, induction, dielectric, etc. Light sources, their operation and efficacy. AC-DC conversion, power switching devices, their characteristics and uses. Energy management.

### 6.0316 Electronics 3 S1 or S2 L2T2

*Prerequisite:* 6.0313. *Co-requisites:* 6.0311, 6.021E.

Large-signal and nonlinear circuits and devices. Models of diodes and transistors for large-signal analysis. Basic nonlinear circuits: wave-shapers, multipliers and gain-control circuits. Astables and monostables, sinewave oscillators (RC, LC, crystal), tuned amplifiers and power amplifiers. Both discrete component and integrated circuit realizations are treated. The laboratory program involves the design and study of several large-signal functional circuits.

### 6.0317 Communication Systems 1 S2 L2T2

*Prerequisite:* 6.0311. *Co-requisite:* 10.361.

Overview of information acquisition, transmission and processing. Aims to enable students not specializing in this field to understand the communication problems they are likely to meet in their career, and to provide a background if they intend to specialize in communications. *Topics:* analogue to digital conversion (sampling, quantizing, aliasing, pulse code modulation, delta modulation, time and frequency division multi-plexing). Modulation and demodulation (amplitude, frequency and phase modulation, signal to noise ratio, noise figure, error probability, bandwidth, spectrum, intersymbol interference). Communication systems (radio wave propagation, antennas and arrays, modems, repeaters, equalizers, line and error coding).

### 6.0318 Microprocessor Systems and Applications S1 or S2 L2T2

*Prerequisites:* 6.021D or 6.621, 6.021E or 6.631. *Excluded:* 6.613.

Basic computer architecture: fetching and executing instructions; Motorola 6809 registers and instructions; assemblers,

addressing modes; bus waveforms; interfacing to a bus; parallel interfacing — the PIA; handshaking; interrupts; critical regions; buffered I/O; stack data frames; recursion; serial interfacing — the ACIA; direct memory access (DMA); dynamic memory; Microprocessor examples.

## 6.042 Digital and Analogue Signals

SS L2T3

*Prerequisites:* 6.0311, 10.0331, 10.361.

*Analysis and processing of continuous-time and discrete-time (digital) signals:* Generalized Fourier analysis; convolution, correlation, energy and power density spectra. Signal distortion (linear and nonlinear) Hilbert transforms; analytic signals, signals in systems. Sampling and digital processing of analogue signals; the discrete Fourier transform (DFT), the fast Fourier transform (FFT), algorithm. Design of finite and infinite impulse response (FIR and IIR) digital filters. Analysis of random signals and noise; transmission through linear systems and nonlinear devices, signal-to-noise ratios, matched filters. Estimation and measurement of power density spectra.

## 6.046 Project Evaluation

S1 L2

*Exclusion:* 18.1212.

Material to be covered will be drawn from: opportunity costs, time flow of funds (including discounted cash flows, npv, internal rate of return, payback period), optimum replacement interval, optimal consumption and borrowing under various capital rationing conditions, aspects of risk and uncertainty, decision making under uncertainty, maximum expected utility and other approaches, pricing (including marginal cost pricing, joint costs, Ramsay pricing), industry pricing issues.

## 6.047 Reliability Engineering for Design and Development

S2 L2T2

*Prerequisite:* 10.361 Session 1 attempted.

*Co-requisite:* 10.361 Session 2. *Excluded:* 6.044.

*Part A:* Quantified reliability, maintainability, availability achievement in design and development. Prediction of RAM. Redundancy design. Fault tree analysis. FMECA. Life cycle cost. R&M programme management, including Design Review. Selection of components, materials and processes. Procurement specifications. *Part B:* Failure mechanisms. Environmental factors in design. Thermal design. Vibration and shock design. Developmental testing. Reliability growth programmes. Assessment of test results. Accelerated testing. Qualification testing.

## 6.202 Power Engineering — Systems 1

SS L2T3

*Prerequisites:* 6.0312, 6.0315.

An elective emphasizing parameters and performance of power system components; transmission lines and cables, transformers, synchronous machines; power system overvoltages; fault calculations; circuit interruption; protection; distribution systems; power system economics.

## 6.203 Power Engineering — Systems 2

SS L2T3

*Prerequisite:* 6.202.

Emphasis on interconnected system operation, performance and

control. Digital computer techniques for power system analysis. Review of topics in numerical analysis, simultaneous linear and non-linear equations, numerical integration, sparsity programming techniques. Load-flow. Short-circuit analysis. Steady-state and transient stability analysis. Harmonics.

## 6.212 Power Engineering — Utilization

SS L2T3

*Prerequisites:* 6.0312, 6.0315.

*Topics include:* Power electronics; scope of power electronics, commutation, filtering and harmonics, thyristor protection, AC phase control, integral cycle control, rectification, inversion, bridge converters, converter control, dual converter, cyclo-converter, DC switching and regulation. Electrical machines; application and control; unified machine theory; application of symmetrical component theory to the operation of induction motors. Electrical equipment for hazardous atmospheres. A program of experimental projects and design applications accompanies the lectures.

## 6.215 Industrial Electrical Systems

S2 L2 T3

*Prerequisite:* 6.0315.

The design, operation, maintenance and efficiency of large industrial electric power systems. Protection and detailed fault calculations. Choice and use of protective equipment, including circuit interrupters, surge diverters and personnel protection. Testing of equipment and relevance of Standards (including loading specifications, safety and general wiring procedures). Power factor correction, lighting system harmonics, rectifier harmonics, protection of electronic equipment. Uninterruptible power supply systems. Economic considerations of industrial electrical systems' including present and future energy use and its effect on the design of efficient power systems.

## 6.222 High Voltage Technology

SS L2T3

*Prerequisite:* 6.0315.

An elective concerned with the high voltage design and testing of electrical equipment used in the power industry. The practical applications of relevant materials, with emphasis on properties of insulation systems (gases, liquids and solids) and the interaction of the materials in non-uniform fields. Methods of testing under steady state — AC and DC — and surge conditions are incorporated in the laboratory work. Design examples are taken from insulator, bushing, cable, power capacitor, transformer, rotating machine and switchgear technologies.

## 6.303 Transmission Lines for Microwave and Optical Communication

SS L2T3

*Prerequisite:* 6.0317.

Transmission line equations. Smith chart and matching. Multi-mode optical fibre. Step-index and graded-index fibres, bandwidth of fibre, fibre connections, measurements and fabrication.

## 6.313 Signal Propagation at Microwave and Optical Frequencies

SS L2T3

*Prerequisite (or co-requisite):* 6.303.

Maxwell's equations, waveguide theory, single mode optical fibres, free space propagation, antennas. Microwave sources. Light emitting diodes, lasers and optical detectors.

**6.322 Electronics 4****S1 or S2 L2T3***Prerequisites: 6.0313, 6.0316.*

Theory and applications of electronic devices, circuits and systems employing microelectronics technology. Active filters, voltage-controlled oscillators, phase-locked loops, multipliers. Modulation and demodulation techniques. Additional topics chosen from: ICs using MOS devices, controlled-gain amplifiers, charge-coupled devices, voltage references, switching regulators. *Laboratory:* a series of projects to design, construct and study circuits based on the above topics.

**6.323 Communication Systems 2A****SS L2T3***Prerequisites: 6.0317, 10.0331, 10.361.*

Theory and practice of modern analogue and digital communication techniques. Topics selected from: digital communications: bandlimited signalling, Nyquist and partial response shaping, non-binary transmission, receiver optimization and matched filters, line coding, spectrum with line coding, adaptive equalization, error control coding information theory (entropy, discrete and continuous channel capacity); linear and nonlinear analogue modulation (AM, SSB, FM etc, signal to noise ratios, characterization and effect of nonlinearities on transmitters and receivers, comparison); aspects of transmission media relevant to telecommunication systems.

**6.333 Communication System 2B****SS L2T3***Prerequisites: 6.0316, 6.0317.*

Modern digital and analogue communications systems from a systems point of view. Topics selected from: television, teletext and viewdata; acoustic systems; broadcast systems covering AM, FM, stereo; radar, sonar, electronic navigation aids; satellite communication systems; point-to-point and mobile terrestrial communication systems.

**6.402 Introductory Physiology for Engineers S1 L2T2**

An introduction to biophysics and physiology for engineers. Cells, tissues and organ systems with emphasis on their functional and regulatory characteristics and their interaction. An introduction to computer models of physiological control systems demonstrating their value in understanding the dynamics of complex neural, hormonal and circulatory responses to changes in homeostasis.

**6.412 Systems and Control 2****SS L2T3***Prerequisites: 6.0311, 6.0314.*

The design of feedback controllers for single and multivariable systems typically encountered in electrical engineering. Emphasis on satisfying steady-state, transient and sensitivity specifications by both frequency domain and time domain techniques. Treatment of identification methods and nonlinearities via the describing function. Extensive use of interactive computer-aided design programs.

**6.413 Digital Control****SS L2T3***Prerequisites: 6.0314, 10.0331, 10.0332, 10.361.*

The design and analysis of digital control systems. Sampling, aliasing, pulse transfer function, discrete state-space, z-transform, transform methods of control design, digital PID, analog redesign. On-line digital identification and adaptive control techniques as illustrated by the self-tuning regulator, minimum variance and dead beat control structures. Linear quadratic regulator and observers.

**6.432 Computer Control and Instrumentation SS L2T3***Prerequisites: 6.0314, 6.0316, 6.0318.*

Current practice in hardware and introduction to software techniques as applied to the implementation of control and instrumentation systems. Analog computers and associated circuit techniques. Transducers, actuators, controllers and special electromechanical devices as used in industrial instrumentation. Digital instrumentation. Hybrid devices and analog conversion. Sampling. Computer control organization and interfacing concepts. Microprocessor peripherals, including display systems, and magnetic data storage devices. Bus communication system for instrumentation. Programmable logic controllers. Standard process control configurations. Introduction to software systems for digital control applications. Computer control of processes via on-line languages. Includes a significant laboratory program aimed both at illustrating the lecture material and introducing new concepts.

**6.483 Biomedical Engineering****SS L2T3***Prerequisites: 6.0314, 6.0316, 6.402.*

Electromedical instrumentation and electronic aspects of its design. Electrodes, transducers, amplifiers, filters, and specific instrumentation for blood pressure, blood flow, imaging systems, etc. Also a dynamic systems approach to physiological systems analysis, with considerations for design of related equipment.

**6.512 Semiconductor Devices****SS L2T3***Prerequisite: 6.0313.*

Principles of operation and circuit characteristics of a range of semiconductor devices including bipolar diodes and transistors, MOS devices and circuits, charge-coupled devices, solar cells, light-emitting diodes, and semiconductor lasers. The lectures are supplemented by experimental work with a selection of these devices.

**6.522 Transistor and Integrated Circuit Design SS L2T3***Prerequisites: 6.0313, 6.0316.*

Review of technology for bipolar and MOS integrated circuits. Device models, layout rules, the relationship of parameters to processes. Analog circuit modules: current mirrors, compound transistors, differential pairs and multipliers. Operational amplifiers and voltage regulators. Bipolar logic: STTL and compound functions. MOS and CMOS logic. Analog MOS circuits, switched capacitor filters and other selected topics. The use of SPICE in circuit simulation. The laboratory program is aimed at understanding the internal design of some standard IC functions.

**6.532 Integrated Digital Systems****SS L2T3***Prerequisites: 6.021E, 6.0316.*

Integrated circuit logic families with emphasis on MOS technol-

ogies, structured chip design, custom and semi-custom approaches, system architecture, computer aided design, layout considerations, timing estimates, circuit failures, faults, fault modelling, testing, design for testability.

## 6.606 Computing Science Honours

### 6.612 Computer Organization and Digital Systems Design **SS L3T2**

*Prerequisite:* 6.0318 or 6.613. *Excluded:* 6.654G

The structural organization and hardware design of digital computer systems, basic computer organization, control and micro-programming, arithmetic algorithms and processor design, memory management and organization, input-output systems, parallel processing and multiprocessor systems. use of algorithmic state machines for digital system description, specification and design.

### 6.613 Computer Organization and Design **SS L3T2**

*Prerequisites:* 6.631 or 6.021E, 6.021E, 6.021D or 6.620 or 6.621 (Pass Conceded (PC) awarded prior to Session 2, 1983, is not acceptable for these subjects). *Excluded:* 6.0318.

Bussing structures (asynchronous and synchronous); input/output organization; polling, interrupt and DMA control; parallel and serial device and processor communication and interfacing. Memory organization; CPU and control unit design. Microprocessor case studies.

### 6.621 Computing 2A **S1 L3T2**

*Prerequisites:* 6.611, 10.001 or 10.011. *Excluded:* 6.620, 6.021D.

For those students who intend to take further subjects in computer science.

Expansion and development of material introduced in 6.611 Computing 1. Systematic program development: introduction to programming language semantics, reasoning about programs, program derivation, abstract programs, realization of abstract programs (conversion from abstract to concrete). Practice in programming in a high-level programming language. Data-structures arrays, lists, sets, trees; recursive programming. Introduction to computer organization: a simple machine architecture. Introduction to operating systems.

### 6.622 Computer Applications **SS L3T2**

*Prerequisite:* 6.641. *Excluded:* 6.646, 6.63.

Simulation: discrete even simulation, pseudo-random number generation, simple queueing theory. Non-numeric programming: artificial intelligence, symbolic computing. Database systems: data base models: relational, hierarchical and network structures; query languages; case study of ingres; data base security.

### 6.631 Computing 2B **S1 or S2 L3T2**

*Prerequisite:* 6.620 or 6.621 or 6.021D, *Excluded:* 6.021E.

*Assembler programming:* programming in a low level machine oriented language in order to illustrate the mapping of higher level language constructs onto a typical machine and the inter-

action between operating systems and devices. *Digital Logic Design:* Boolean algebra and logic gates, simplification of Boolean functions, combinational logic, medium scale integration building blocks, clocked sequential circuits, registers and memory, computer arithmetic.

### 6.632 Operating Systems **SS L2T3**

*Prerequisites:* 6.631 or 6.021E, 6.641. *Excluded:* 6.672.

Introduction to operating systems via a case study of a particular system, namely the UNIX Time-sharing systems. Includes system initialization, memory management, process management, handling of interrupts, basic input/output and file systems. A comparison of UNIX with other operating systems. General principles for operating systems design.

### 6.633 Data Bases and Networks **SS L3T2**

*Prerequisite:* 6.641. *Excluded:* 6.622, 14.608, 14.607.

*Data base management systems:* data models; relational and network structures; data description languages; data manipulation languages; multi-schema structures. Data distribution integrity and security; recovery; privacy. *Computer networks:* economic and technological considerations; digital data transmission; error detection and recovery; network configurations; circuit switching, packet switching; communication protocols, current international standards; data compression; encryption and decryption.

### 6.641 Computing 2C **S1 or S2 L3T2**

*Prerequisites:* 6.620 or 6.021D or 6.621.

*Design of data structures:* abstraction, representation, manipulation and axiomatization. Key transformations (hashing), balanced and multiway trees, introduction to graphs. *Files:* sequential access, random access, merging, sorting and updating. File organizations and introduction to data base systems. *Programming in logic:* descriptive programming languages, symbolic manipulation, pattern matching and associative programming. *Software engineering:* a survey of some current techniques in problem specification and program design.

### 6.642 Design and Analysis of Algorithms **SS L3T2**

*Prerequisite:* 6.641.

Techniques for the design and performance analysis of algorithms for a number of classes of problems. Analysis of algorithms: order notation, recurrence equations, worst case and expected order statics. Design of efficient algorithms: recursion, divide and conquer, balancing; backtracking algorithms, branch and bound, dynamic programming: set manipulation problems; fast search algorithms, balance optimal and multiway trees; graph representations and algorithms; pattern matching algorithms. NP— complete problems. Design and specification of programs: modularization, interface design, introduction to formal specification techniques.

### 6.643 Compiling Techniques and Programming Languages **SS L3T2**

*Prerequisite:* 6.641. *Excluded:* 6.672.

1. Language description: phrase structure grammars, Chrom-

sky classification, context-free grammars, finite state grammars, Backus Naur Form, syntax graphs LL(k), LR(k), LAL(k). 2. Lexical analysis: translation of an input (source) string into a (machine independent) quasi-terminal symbol string. Finite state recognizers. 3. Syntax analysis: top-down compilation for LL(1) grammars using syntax graph driven analysers or recursive descent. Bottom-up compilation for simple- and weak-precedence and LR(k) grammars. 4. Semantic analysis: program translation and code generation; attributed grammars. 5. Compilers generators: automatic generation of compilers for LALR(1) grammars. 6. Code optimization by systematic program transformation. 7. Run-time organization: activation record stacks, heap management.

### 6.646 Computer Applications

SS L3T2

*Prerequisites:* 6.021D or 6.621, 10.311 or both of 10.311A and 10.311B, 10.331, or equivalent. *Excluded:* 6.622.

The use of computers for solving problems with a substantial mathematical and operational research content: includes use of some standard software packages. Topic selected from: discrete event simulation; a simulation language; pseudo random number generation; simple queueing theory, applications of mathematical programming; dynamic programming; statistical calculations; critical path methods; computer graphics, artificial intelligence.

### 6.647 Business Information Systems

SS L3T2

*Prerequisites:* 6.641, 14.001 or 14.501.

Introduction to accounting systems: general ledger, debtors and creditors; models of business information systems; integrated business systems. System specification, system analysis, system design and implementation; testing and debugging. Managing a project team, project control. The COBOL programming language. File organization and design; sequential, indexed sequential, random, inverted, B-tree file organizations; data dictionaries, program generators, automatic system generators. A major project, written in COBOL, is undertaken as a team exercise.

### 6.652 Data Communication and Computer Networks

SS L2T3

*Prerequisites:* 6.0318 or 6.613, 6.0317, 6.632 or 6.672.

Principles of data networks. *Data communications:* Data transmission on telephone networks, national data networks. Local area networks and their interconnection. Contention and token passing systems. Channel capacity, queuing problems, noise and handling errors. Data in mixed traffic environment. Services. Arbitration and synchronization. Hardware/software communication models. *Computer networks:* analysis of protocols for data link layer, network layer, and transport layer; TCP/IP and XNS protocols. Operating systems views of communications; network protocol drivers, network servers. Case studies: ARPAnet and ACSnet. Laboratory work covers experiments on data link and network layer protocols in a practical network.

### 6.672 Operating Systems and Compilers

SS L3T2

*Prerequisites:* 6.0318 or 6.613. *Excluded:* 6.643, 6.632.

*Operating systems:* principles of operating systems; multiprocessing; resource sharing and deadlock; interprocess commu-

nication; CPU scheduling; memory management including segmentation and virtual memory; file systems. Laboratory component covers C programming, polled input/output, interrupt driven input/output, multiprocessing, and real-time control of a simple system. Compilers: language description; Backus-Naur form, lexical analysis, semantic analysis, code generation. There is a project which involves modification of a simple compiler.

### 6.710 Introduction to Computer Engineering

F L1T½

*Prerequisite:* HSC Exam Score Range Required  
2 unit English (General) or 53-100  
2 unit English or 49-100  
3 unit English 1-50

Introduction to the nature, history and scope of computer engineering (including computer architecture, digital systems, software engineering, information processing, electronics, and communications). The roles of computer engineering in industry, government and public utilities. Development of organisation, communication and research skills in engineering.

### 6.711 Computing 1A

S1 or S2 L3T3

*Prerequisite:* as for 10.001. *Co-requisite:* 10.001 *Excluded:* 6.600, 6.611, 6.620, 6.021D

Introduction to the basic concepts of computing: Logic, Hierarchies, Abstraction, Specification, Refinement, Implementation, Algorithm, Programming language, Recursion, Non-determinism, Fundamental structures: sets, relations, functions, sequences, bags, trees, graphs. Exposure to a functional programming language for practical experience with the conceptual material in the subject. Machines for interpreting functional programs.

### 6.712 Computing 1B

S1 or S2 L3T3

*Prerequisite:* 6.711 *Excluded:* 6.620, 6.621, 6.021D

Expansion of the functional approach to computing in 6.711. Introduction to procedural and logic programming styles. Data structure implementation. Control structures: recursion and iteration. The software development process. Program efficiency and complexity — time and space analysis. Practical experience in using a procedural language. The basic structure of a computer, the layered model of a computer, instruction execution, assembly language, computer building blocks, the function of the operation system.

### 6.821 Circuit Theory

S1 L2 T½

*Prerequisites:* 1.961, 6.010, 10.001. *Co-requisite:* 10.1214 or 10.1114.

Dynamic response of linear circuits: 1st and 2nd order circuits with DC sources, introduction to higher order circuits. Sinusoidal steady state operation: phasors, impedance and admittance; dynamic response of circuits driven by sinusoidal sources, concepts of power electronics; linearity, network theorems; resonance, bandwidth, and quality factor. Two-port networks: parameters, circuits as filters. Power in steady-state circuits; average and reactive power, power factor, power factor correction. Three-phase circuits: balanced and unbalanced steady-state operation; real and reactive power in balanced circuits, transient analysis.

## 6.822 Systems Theory

S2 L2 T½

*Prerequisites:* 6.821, 10.1213 or 10.1113, 10.1214 or 10.1114. *Co-requisites:* 10.0331.

Continuous and discrete signals and their transformations. Properties of continuous and discrete systems. Linear time invariant systems. Low order differential and difference equations. Diagrammatic representations of systems. Fourier analysis, filtering, Laplace transforms, z-transforms. Examples of systems will be taken from areas of circuits, analog and digital electronics, power and mechanical engineering.

## 6.823 Analog Electronics

S2 L2 T½

*Prerequisites:* 6.821, 1.982

Operating principles and terminal characteristics of PN diodes, bipolar and field effect transistors, and thyristors. Small signal models of devices, including h-parameter model. Analysis and design of low-frequency Class-A amplifiers, including choice of biasing method.

## 6.824 Digital Circuits

S2 L2 T½

*Prerequisite:* 6.010

Logic functions: truth tables, Boolean expressions. Boolean algebra: laws, standard forms, algebraic simplification. Logic Gates: symbols, timing diagrams, interconnections. Gate circuits: realisations of Boolean expressions. Gate-level design: prime implicants and covers, Karnaugh maps. MSI-level design: decoders, multiplexers, ROMs, PLAs. Introduction to sequential circuits: stop-watch, traffic light sequencer examples. Astable/Bistable elements: clock circuits, RS, JK, D-type flip-flops. State machines: Moore/ Mealy models, state diagram from circuit analysis. Synchronous sequential circuit design: state diagram, state transition table, excitation/output specification, gate/flip-flop design. Registers and memories: parallel and shift registers, multifunction registers, addressable register arrays. High-level design: register transfer language, control/data paths, design examples.

## 6.825 Electromagnetic Theory and Applications F L2 T½

*Prerequisites:* 6.010, 1.961. *Co-requisites:* 10.2111, 6.821

Electrostatics in vacuum and in dielectric materials. Electric current. Magnetostatics in Vacuum and magnetic media, magnetic materials and magnetic circuits. Time-varying fields. Capacitance and inductance calculations. General filed concepts. Rotating magnetic fields, and electromagnetic principles of machines. Transformers. Superconductivity. Maxwell's equations. Transmission lines from circuit and electromagnetic viewpoints. Electromagnetic radiation and electromagnetic interference. This subject is taught jointly by staff from the schools of Physics and Electrical Engineering and Computer Science.

## 6.827 Electrical Engineering Laboratory 2A S1 T1½

*Prerequisite:* 1.961, 6.010. *Co-requisite:* 6.821, 6.825

Experiments in electric circuits and electromagnetic fields and applications. Laboratory technique.

## 6.828 Electrical Engineering Laboratory 2B S2 T3

*Prerequisites:* 6.827, 6.821. *Co-requisites:* 8.822, 6.823, 6.824, 6.825.

Experimental work on digital and analog devices and circuits, electromagnetic fields and electrical systems.

## 6.829 Electrical Design

S2 L1 T2

*Prerequisites:* 5.0016, 6.010, 6.011, 6.821. *Co-requisites:* 6.823, 6.824

Concepts of product design: specification, design methodology, project management, costing for prototype production, testing. Electronic circuit design — device specifications, thermal dissipation, passive component choices, tolerances. Electronic circuit analysis and design using computer aids. Electronic circuit prototyping techniques: wire-wrapping, PCB layouts (using computer aids), interconnection technologies, earthing. Group Project Work: including initial design, PCB production and testing, and preparation of a report on an electrical project.

## 6.854 Electrical Power Engineering

S2 L/T3

*Prerequisite:* 1.001 or equivalent (1.9222 or 6.851 for students in Course 3140)

Extensive introduction to the theory and application of heavy current electrical engineering. Commences with the requisite circuit theory and then proceeds to consideration of the distribution of electrical power and the characteristics and selection of electrical machinery. DC power supplies, three-phase AC supply, voltage regulation, transformers, AC and DC machines and their rating; a project illustrating the application of electrical engineering to various aspects of industry. Consists of one 2-hour tutorial or laboratory sessions per week each commencing with a structured mini-lecture. Detailed lecture notes are provided.

## 6.856 Electronics for Measurement and Control S1 L2 T1

The use of electronics in mechanical systems and the processing of signals by analog and digital techniques. Revision of basic circuit theory, operational amplifier circuits and filtering. Digital logic using integrated circuits. Microcomputers and Microprocessors. Techniques for A/D and D/A conversion, measurement system interfacing to microprocessors.

## 6.902 Industrial Experience

A minimum of three years of appropriate industrial experience must be obtained concurrently with attendance in Course 3650. Students are required to submit to the School evidence from their employers confirming completion of the prescribed period of industrial training.

## 6.903 Industrial Training

Students enrolled in courses 3640, 3725 and 3720 must complete a minimum of 60 days' industrial training. At least some of this must be obtained in Australia. Overseas employment must have prior approval. Students are required to submit to the School evidence from their employers confirming completion of the prescribed training and a report, typically 500 words long, summarising the work done and training received. Experience claimed as an industrial elective covers requirements for this subject.

**6.911 Thesis**

This is done in the last two sessions of the BE degree course. For full-time students, three hours per week in the first session, and twenty one hours per week in the second session are devoted to directed laboratory and research work on an approved subject under guidance of members of the lecturing staff. Part-time students may need to attend the University full-time in their final session or attend for one further part-time session, if facilities are not available for the thesis to be done at work. Generally, the thesis involves the design and construction of experimental apparatus together with laboratory tests. Each student is required to present a seminar, and a written thesis must be submitted on each project by the Tuesday of the fourteenth week of Session 1 or Session 2.

**6.921 Project**

The project is done in the final stages of the BSc(Eng) course. It involves the design and construction of experimental apparatus together with laboratory tests. Each student is required to present a seminar and submit a written report. The project should represent the equivalent of a minimum 100 hours of directed laboratory work. If facilities are not available for this to be done largely at work, students may need to attend the University full-time in final session, or attend for one further part-time session.

**6.931 Industrial Elective****6.932 Industrial Elective****6.933 Industrial Elective**

*Prerequisites for 6.931, 6.932, 6.933: Students must be in at least the third stage of part-time BE degree course and be in full-time approved employment or be pursuing an approved sandwich course.*

Each Industrial Elective represents one year of appropriate quality concurrent industrial experience for students in approved full-time employment. Students must submit evidence and a written report to the satisfaction of the Head of School. Some attendance at the University for verbal reporting may also be required.

A maximum of three such electives can be taken and they may be substituted for certain subjects in course 3640 requirements. The substitution is not available for work done during the first year of employment if this coincides with the first year of part-time enrolment. The period of employment claimed must precede the completion of the thesis 6.911. An Industrial Elective cannot be claimed for work submitted for credit as 6.911 Thesis. Details of the procedure for registering and the requirements to be met can be obtained from the School of Electrical Engineering and Computer Science.

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**Civil Engineering**


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**8.110 Computing and Graphics****S1 L2T1****S2 L1T2**

Introduction to programming and development of skills for solving problems and rapid calculation. Computing elements, input-output, data and program structures. Useful and correct algorithms. The use of Pascal and control languages. Introduction to higher level languages and graphics.

Australian Drawing Standards. Descriptive geometry and orthographic projections. Perspective drawing. Introduction to computer aided drafting. Introduction to graphics — primitives, attributes, windows, layers, etc. Elementary graphics programming. Tutorials include supervised and free practice at computing, testing algorithms, data manipulation. Drawing practice includes graphs, systems diagrams; road, concrete and steel work; perspective drawing; pseudo computer aided drafting and a graphics plot.

**8.120 Engineering Mechanics****FL2T2**

*Co-requisite: 10.001*

Two-dimensional concurrent and non-concurrent force systems. Equilibrium of particles and rigid bodies. Distributed forces: centre of gravity and centroid. Internal forces in structural members: shear and bending moment diagrams. Analysis of structures: trusses, frames and machines. Determinacy and constraints. Compatibility. Forces in cables. Properties of cross-sections. Concepts of stress and strain.

Dynamics of particles. Laws governing conservation of energy and momentum. Curvilinear motion and angular momentum. Derivation and solution of equations of motion for simple spring-mass systems responding to forces of simple form. Applications to civil engineering problems.

**8.130 Civil Engineering Practice****S1 L2T1****S2L1½T½**

<i>Prerequisite:</i>	<i>HSC Exam Score Range Required</i>
2 unit English (General) or	53-100
2 unit English	49-100
or	
3 unit English	1-50

Introduction to the structure, nature and scope of civil engineering work and the problems resolved by practitioners. History of civil engineering. Branches of engineering; organization of the profession. Methodologies employed by engineers in their work. Communication methods and skills. Report preparation. An examination of some leading Australian and world engineering projects.

Construction Practice: Construction of concrete structures. Concrete materials. Batching of concrete materials. Mixing, transporting, placement and finishing of concrete. Construction of earthworks. Earthworks plant. Construction of rockworks. Rock drilling plant. Blasting practice.

Management of Civil Engineering Practice: The nature of civil engineering projects. Management overview. Legal, political and environmental aspects. Technical and economic investigations. Design. Contractual aspects. Construction practice. Handover; Operation and management; Demolition.

## 8.2110 Systems Engineering 1 S1 L1½T½

*Prerequisite:* 10.001.

Systems concepts: general systems theory, classification and representation of systems, dynamic behaviour. Modelling concepts, simulation and optimization. Formulation and analysis of problems. Models of the design process. Evaluation and selection concepts. Case studies in the formulation, modelling and resolution of civil engineering problems.

## 8.2120 Systems Engineering 2 S2 L1T1

*Prerequisites:* 8.1120, 8.2110, 10.381.

Techniques for numerical analysis and decision-making: simulation, dynamic programming, network models, decision theory. Economic models. Benefit-cost techniques. Case studies in the application of modelling techniques to the solution of civil engineering problems.

## 8.2210 Engineering Construction 2 S1 L1½T½

*Prerequisite:* 8.1210.

Construction power systems. Heavy lifting and movement machinery. Specialised and general purpose cranes and hoists. Analysis of motion resistance and elemental movement machines. Theory of placement and compaction processes. Specialised techniques and equipment for soil, rock, concrete and bituminous materials. Construction ergonomics, worker physiology, work task analysis, health hazards in engineering construction.

## 8.2220 Engineering Construction 3 S2 L1½T½

*Prerequisite:* 8.2210

Vehicle mobility science, grade resistance and rimpull cycle time and productivity. Drilling processes in rock, concrete and soil. Compressed air science, gas flow in pipes, design of compressed air pipeline systems. Fragmentation science, crushing and screening, blasting and demolition.

## 8.2310 Materials Technology S2 L2T2

*Co-requisite:* 8.2420.

*Behaviour of materials:* response to forces in tension, compression, bending, shear and torsion; elastic and plastic deformation. Concepts of elastic modulus, strength, brittleness, hardness etc. Effects of stress concentrations, temperature and strain rate; static and dynamic loading; fatigue, brittle fracture and creep failures. *Metals technology:* relationship of properties to micro-structure, dislocation mechanism of plastic deformation; micro-

mechanisms of creep and of fracture. Property control by strain hardening, alloying and heat treatment of steels and aluminium alloys.

## 8.2320 Concrete Technology 1 S1 L2T2

Use of concrete in modern civil engineering practice. Composition and function of constituents, admixtures, cements. Portland and other classes of cement, composition and properties. Aggregates: types, grading, quality requirements, alkali-aggregate reaction. Properties of fresh and hardened concrete. Specification, control and code requirements. Mix design and proportioning methods.

## 8.2410 Mechanics of Solids 1 S1 L2T1

*Prerequisite:* 8.1410.

Stress resultants and stress. Deformation and strain. Bars under axial forces: homogeneous and non-homogeneous bars, linear and non-linear behaviour, concept of strain energy. Bars in bending: homogeneous and non-homogeneous bars, linear and non-linear behaviour, strain energy, moment area methods, concepts of stiffness and flexibility. Solid and thin-walled sections: shear stresses and deformations, shear centre.

## 8.2420 Mechanics of Solids 2 S2 L2T1

*Prerequisite:* 8.2410.

Torsion: stresses, deformation and strain energy. Principal stresses and strains: Mohr's circle, equilibrium and compatibility equations. Combined stresses: yield criteria. Structural stability. Dynamic loading: free and forced vibration, response to impulse loading.

## 8.2430 Structural Design 1 S2 L3T1

*Prerequisite:* 8.2410. *Co-requisite:* 8.2420.

Design objectives and criteria: concept of limit states. Types of structural members and structures: relation of materials to behaviour. Loads on structures. Design of tension members, flexural members, stocky and slender compression members. Bolted and welded connections.

## 8.2610 Hydraulics 1 S1 L1T1

*Prerequisites:* 8.1410, 8.1610, 10.001.

The momentum equation and its applications. Applications of the energy equation. Elements of hydrodynamics: stream functions, velocity potential functions, flow nets. Porous-media flow: Darcy equation, boundary value problems.

## 8.3110 Engineering Computations S1 L2T1

*Prerequisites:* 8.1120, 10.022.

Solution of linear and non-linear equations. Numerical differentiation. Interpolation. Numerical integration. Solution of ordinary and partial differential equations: application to beams, groundwater flow, heat conduction and plate bending. Eigenvalue methods: application to buckling and vibration.

**8.3210 Engineering Management 1****S2 L1½T½***Prerequisite: 8.2220.*

Construction methods determination. Concept design, sizing and matching problems. Applications of simulation techniques in construction design. Resource balancing techniques. Scheduling and co-ordination techniques, network methods, multiple activity charts, cost and time estimation, data gathering processes, work task approach, work conditions and human behaviour. Comparison with current practice. Methods improvement practice.

**8.3220 Engineering Management 2****S2 L3T1***Prerequisite: 8.3210.*

Organisational and management theory. Co-operative systems and decision processes. Special forms of organisations, measures of effectiveness. Management control systems, comparative management. Human resources management styles. Small group behaviour, learning curves, management of work groups in construction practice. Information systems and their management. Information flows, document design, case studies.

**8.3230 Engineering Construction 4****S2 L1½T½***Prerequisite: 8.2220.*

Specialised construction processes. Grouting, piles and pile driving, coffer dams and caissons, paving and surfacing, tunnelling and formwork design.

**8.3310 Soil Mechanics****S1 L1½T½***Prerequisite: 8.2610.*

Soil classification: particle size distribution, Atterberg limits, classification systems. Water in soils: soil suction and moisture content, effective stress, determination of pore pressure and hydraulic conductivity, consolidation theory and tests, one-dimensional settlement analysis. Strength and deformation of soils: Mohr-Coulomb theory of shear strength, laboratory tests of direct and triaxial shear. Control of soil properties: mechanical compaction and stabilization.

**8.3320 Geotechnical Engineering****S2 L2T1***Prerequisite: 8.3310.*

Site investigation: drilling and sampling, field tests. Lateral earth pressure: design of retaining walls. Isolated surface foundations: design for stability and settlement. Deep foundations: stability and settlement of single piles. Slope stability: types of failure in soil and rock slopes, influence of detailed geology, stability analysis. Underground openings and buried structures: analysis and design. Expansive soils and footing design.

**8.3330 Concrete Technology 2****S2 L1T1***Prerequisite: 8.2320. Co-requisite: 8.3430.*

Resume of important properties of concrete. Stress-strain behaviour. Time dependent behaviour. Permeability and durability. Protection of steel reinforcement. Non-destructive testing. Special concretes and techniques: accelerated strength testing, steam curing, pumped and prepacked concrete. Special aggregates and cements. Special admixtures.

**8.3410 Structural Analysis 1****S1 L2T1***Prerequisite: 8.2420.*

Pin-jointed trusses: principle of work, virtual forces and displacements, truss flexibility coefficients. Statically indeterminate trusses: force and displacement methods. Space trusses. Work theorems. Non-linear analysis of trusses.

**8.3420 Structural Analysis 2****S2 L2T1***Prerequisite: 8.3410.*

Force and displacement transformations. Rigid jointed frames: force and displacement methods, principle of virtual work. Forces in, and deformation of, statically determinate frames. Statically indeterminate frames: moment distribution analysis. Moving loads: influence lines.

**8.3430 Structural Design 2****S1 L3T1***Prerequisites: 8.2420, 8.2430.*

Behaviour analysis and design of reinforced concrete beams from first cracking up to ultimate moment capacity: ultimate strength theory, design for shear, bond and anchorage, modular ratio theory, reinforced concrete columns, continuous beams and frames, composite beams, detailing, concrete codes.

**8.3440 Structural Design 3****S2 L3T1***Prerequisite: 8.3430.*

Behaviour, analysis and design of prestressed concrete beams: pre- and post-tensioning, elastic stress calculations, ultimate strength, design for shear, end block design. Behaviour and design of steel beams: internal stability, modes of failure, local buckling. Design of steel compression members and beam-columns. Plastic analysis and design of continuous steel beams.

**8.3510 Traffic Flow Theory****S1 L2T1***Prerequisite: 10.381.*

Traffic measurements and traffic stream parameters: flow, concentration, speed, spacing and headway. Fundamental diagram of traffic. Overtaking models. Car following theory. Highway and intersection capacity. Data collection and estimation of parameters.

**8.3610 Hydraulics 2****S1 L1½T½***Prerequisite: 8.2610.*

Flow of real fluids: laminar and turbulent flow, shear stresses, boundary layers, separation and wakes, shear drag, pressure drag. Pumps: pump types, characteristics, selection, pumping systems. Closed-conduit flow: resistance to flow, Darcy-Weisbach equation, friction-factor charts, pipe networks. Dimensional analysis and hydraulic modelling: similarity criteria, scale effects, hydraulic models.

**8.3620 Hydraulics 3****S2 L1½T1½***Prerequisite: 8.3610.*

Unsteady flow in pipes: surge, water hammer. Sediment trans-

port: modes of motion, bed forms, sediment load equations, channel stability. Free surface flow: uniform flow, specific energy, controls, gradually varied flow, hydraulic jump.

## **8.3630 Water Supply and Wastewater Disposal S1 L2T1**

*Prerequisite:* 8.2610.

Water demand and sources of supply, transmission and distribution. Wastewater collection and disposal. Water pollution and quality criteria, water analysis. Water treatment: screening and sedimentation, filtration, coagulation and flocculation, disinfection and fluoridation, water softening and desalination. Wastewater treatment: preliminary and primary treatment, biological treatment, sludge digestion, tertiary treatment.

## **8.3640 Engineering Hydrology S2 L2T1**

*Prerequisite:* 10.381.

The hydrologic cycle. Australian climate and water resources. Atmospheric moisture. Precipitation: measurement, types, intensity-frequency-duration analysis. Runoff cycle: evapotranspiration, infiltration, soil moisture and runoff. Stream gauging. Flood estimation: design storms, loss rates; empirical, rational, unit hydrograph and flood frequency methods.

## **8.4110 Industrial Training**

*Requirement for the Bachelor of Engineering Degree.*

Students are required to complete a minimum of 60 working days of approved industrial training and submit a report on this training before the fourth week of Session 1.

## **8.4210 Construction Major S2 L/T11**

*Prerequisites:* 8.3230, 8.4220.

Construction camp: a one week field camp involving several construction procedures and associated performance measurements. Construction planning and design: organisation, management, and control to support the conduct of the construction camp. Either construction technology or construction management. Construction and/or management project.

## **8.4220 Engineering Management 3 S1 L1½T½**

*Prerequisite:* 8.3220.

Human resources: conflict management, industrial relations, work groups in construction practice. Legal systems: contracts and their administration, professional liabilities and duties. Financial management: corporate entities and legal forms of enterprises, financial reporting, accounting systems, project finance, cash flow, taxation, depreciation of fixed assets.

## **8.4310 Geotechnical Major S2 L/T11**

*Prerequisites:* 8.3320, 8.3330, 8.4330.

Six topics selected from: Soil engineering. Rock engineering. Foundation engineering. Geotechnical engineering. Advanced pavement design. Theoretical advanced soil mechanics. Concrete technology. A project consisting of analytical or experimental work.

## **8.4320 Metals Engineering S1 L2**

*Prerequisite:* 8.2310. *Co-requisite:* 8.3440.

Metals used in structures: types, applications and developments in steels, aluminum alloys etc. Corrosion: causes, prevention and control in structural, reinforcing and piling steels. Fatigue and brittle fracture: factors leading to increased risk, significance of welding; empirical and fracture mechanics approaches to design against failures in service.

## **8.4330 Pavement Engineering S1 L1½T½**

*Prerequisite:* 8.3310.

Pavement materials: subgrades, gravels, crushed rock, mechanical and chemical stabilisation, concrete, interlocking blocks, bituminous concrete, sprayed seals. Pavement design: traffic and environmental effects, loading spectra, design of flexible, rigid and block pavements. Pavement construction: construction processes and control.

## **8.4410 Structures Major S2 L/T11**

*Prerequisites:* 8.4420, 8.4430, 8.4440.

A design or research project and the following strands: bridge engineering, concrete structures, and structural behaviour which will include computer methods, stability and dynamic analysis, and classical methods.

## **8.4420 Structural Analysis 3 S1 L1T1**

*Prerequisite:* 8.3420.

Approximate analysis and structural form. Brief discussions of cable structures, arches, plates and shells.

## **8.4430 Structural Design 4 S1 L1T1**

*Prerequisite:* 8.3440.

Slab design: two-way edge supported slabs, idealized frame and simple design methods, punching shear, moment transfer at column connections, serviceability approach, detailing. Design of reinforced concrete footings and retaining walls. Plastic design of steel frames.

## **8.4440 Timber Engineering S1 L2**

*Prerequisite:* 8.2420.

Timber properties: structure, mechanical properties, creep and shrinkage. Timber grading. Defects in timber. Properties of laminated timber. Design of tension members, columns, and solid rectangular beams. Timber connections. Timber framing in domestic construction. Pre-fabricated structural members. Design of a glue laminated beam.

## **8.4510 Transport Major S2 L/T11**

*Prerequisites:* 8.3510, 8.4520.

Geometric design of transport elements: road location and form design, subdividing and simple intersections, application of computer aided design methods. Design for traffic management and control: efficiency, safety, environmental factors, information sys-

tems, lighting. Environmental and social impact of transport design. Transport operations: public transport system design. Project involving transport analysis or design.

#### 8.4520 Transport System Analysis S1 L2T1

*Prerequisite:* 8.2120.

Description and analysis of transport system interactions: feedback, steady state performance, sensitivity analyses. Travel demand: traffic generation, distribution and assignment. Transport supply: capacity and operational measures of different transport modes. Land use and transport planning: economic, social and environmental evaluation. Optimization methods.

#### 8.4610 Water Major S2 L/T11

*Prerequisites:* 8.3620, 8.3630, 8.4620.

**Either:** a design project and six of the following topics (only six topics are offered in each year): Water resources. Hydrology. Advanced hydraulics. Coastal engineering. Public health engineering. Environmental and social issues. Special topic. Or a research project and four of the above topics, specified by the supervisor.

#### 8.4620 Water Resources Engineering S1 L1½T½

*Prerequisites:* 8.3640. *Co-requisite:* 8.3620.

Water resource systems: objectives and constraints, modelling, stochastic behaviour, optimisation. Urban hydrology: drainage layout and design, runoff and flood routing, retarding basins. Groundwater hydrology: recharge and discharge processes, water extraction, aquifer modelling, unsaturated flow systems.

#### 8.6120 Civil Engineering for Electrical Engineers SS L2T2

Includes an introduction to the various branches of civil engineering, the nature and organization of the profession. Relationship between clients and design consultants. The historical development of civil engineering. Theory of beams and trusses, resultant forces, structural action, stress and strain. Relation between load, shear force and bending moments, geometric properties of sections, deflection of beams. Properties of materials used in structures; various steels, concrete (plain, reinforced and prestressed), aluminium and timber. Brittle fracture. Introduction to buckling. Engineering failures. Introduction to design of transmission lines and towers.

#### 8.6140 Engineering for Surveyors 1 SS L1½T1½

*Aspects of hydraulics:* Fluid properties, hydrostatics, motion of fluids, continuity, energy and momentum aspects, closed conduit flow and open channel flow. *Aspects of hydrology:* Scope and applications. Hydrologic measurements, rainfall analysis, storm rainfall-runoff relations, flood estimation. Urban drainage design:

#### 8.6150 Engineering for Surveyors 2 SS L3

*Municipal engineering. Soil mechanics:* Soil forming processes; pedological classification; engineering classification of soils; pavement design based on engineering classification; effective stress

concept for saturated and unsaturated soils, shear strength, flow of water through soils, consolidation; slope stability and earth pressures. *Public utilities:* Relationship between urban development and each of water supply, wastewater and stormwater drainage, transport.

### Servicing Subjects

These are subjects taught within courses offered by other faculties.

For further information regarding the following subjects see the Faculty of Applied Science Handbook.

#### 8.6110 Structures S1 L1T2

*Theory of structures:* Moduli of elasticity, simple stress and strain. Compound bars, temperature stresses. Thin shells. Stress at a point. Strain at a point. Principal stresses and strains. Relationship between load, shear force and bending moment. Moments of inertia, principal moments of inertia. Stresses due to axial force, bending moment, shear force, and torsion. Differential equations of simple beam theory. Deflection of beams. Statically indeterminate beams. Strain energy. Deflections at a single load. Shock loads. Theory of centrally loaded column and eccentrically loaded columns.

#### 8.6130 Properties of Materials F L1T1

Mechanical behaviour of materials. Response to static loading in tension, compression, shear and bending. Use of static test data in analysis and design; variability of material properties; factors of safety. Hardness tests. Creep in solid materials. Response to dynamic loading; fatigue; impact. Deterioration of engineering materials. Rheological classification of materials.

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## Mathematics

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#### 10.001 Mathematics 1 F L4T2

*Prerequisite:*

	<i>HSC Exam</i>
	<i>Score Range</i>
	<i>Required</i>
2 unit Mathematics* or	67-100
3 unit Mathematics or	1-50
4 unit Mathematics	1-100
or	
10.021B.	

*Excluded:* 10.011, 10.021B, 10.021C.

\*This refers to the 2 Unit Mathematics subject which is related to the 3 Unit Mathematics subject. It does not refer to the subject 2 Unit Mathematics (Mathematics in Society).

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

**10.011 Higher Mathematics 1****F L4T2***Prerequisite:*

HSC Exam  
Score Range  
Required  
120-150

3 unit Mathematics

or

4 unit Mathematics

1-100

*Excluded: 10.001, 10.021B, 10.021C.*

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

**10.021B General Mathematics 1B****S1 L4T2***Prerequisite:*

HSC Exam  
Score Range  
Required  
60-100

2 unit Mathematics\* or

3 unit Mathematics or

4 unit Mathematics

1-50

or

10.021A

1-100

*Excluded: 10.011, 10.001.*

\*This refers to the 2 Unit Mathematics subject which is related to the 3 Unit Mathematics subject. It does not refer to the subject 2 Unit Mathematics (Mathematics in Society)

Functions (and their inverses), limits, asymptotes, continuity; differentiation and applications; integration, the definite integral and applications; inverse trigonometric functions; the logarithmic and exponential functions and applications; sequences and series; mathematical induction; the binomial theorem and applications; introduction to probability theory; introduction to 3-dimensional geometry; introduction to linear algebra.

**10.021C General Mathematics 1C****S2 L4T2***Prerequisite: 10.021B. Excluded: 10.001, 10.011.*

Techniques for integration, improper integrals; Taylor's theorem; first order differential equations and applications; introduction to multivariable calculus; conics; finite sets; probability; vectors, matrices and linear equations.

**10.022 Engineering Mathematics 2****F L2T2***Prerequisite: 10.001.*

Differential equations, use of Laplace transforms, solutions by series; partial differential equations and their solution for selected physical problems, use of Fourier series; introduction to numerical methods; matrices and their application to theory of linear equations, eigenvalues and their numerical evaluation; vector algebra and solid geometry; multiple integrals; introduction to vector field theory.

**10.031 Mathematics****FL1T1***Prerequisite: 10.001 or 10.011 or 10.021C(CR).*

**Note A:** A unit, together with 10.032, which is available to Faculty of Science students as one of a sequence of two units constituting a terminating service course in mathematics. As such it is mutually exclusive to any other Level II or Level III unit in Pure and/or Applied Mathematics except that 10.292A may be taken with 10.031 and 10.032.

**Note B:** Mathematics 10.031 is included for students desiring to attempt only one Level II Mathematics unit. If other Level II units in pure Mathematics or Applied Mathematics are taken, 10.031 Mathematics will not be counted.

Differential equations, use of Laplace transforms, solutions by series, partial differential equations and their solution for selected physical problems, use of Fourier series; multiple integrals, matrices and their application to theory of linear equations, eigen-values; introduction to numerical methods.

**10.0331 Electrical Engineering Mathematics 3 — Transform Methods****S1 L1½T½***Prerequisites: 10.111A, 10.1113, 10.1114, 10.2122. Exclusions: 10.412D, 10.422D and 10.4331.*

The mathematics of signals and linear systems. General Fourier series. Fourier, Laplace and related transforms Delta-distributions and others and their transforms. Discrete Fourier and Z-transforms. Applications to spectral analysis, autocorrelation, uncertainty and sampling, linear analog and digital filters, partial differential equations.

**10.0332 Electrical Engineering Mathematics 3 — Numerical Methods****S2 L1½T½***Prerequisites: 10.111A, 10.1114, 10.2111, 10.2112. Exclusions 10.212A, 10.222A.*

Numerical approximation of solutions to linear and non-linear equations. Interpolation and extrapolation. Approximation of definite integrals. Approximate solution of differential equations, Optimization. Approximate solution of matrix eigenvalue and eigenvector problems.

**10.111A Pure Mathematics 2 — Linear Algebra****F L1½T1***Prerequisite: 10.001 or 10.011. Excluded: 10.121A.*

Vector spaces, linear transformations and matrices, change of basis. Eigenvalues and eigenvectors, generalized eigenvectors. Functions of matrices. Linear systems of differential equations including the use of Laplace transform. Inner products, orthogonalization, projections. Unitary and self-adjoint transformations. Quadratic and Hermitian forms.

**10.1113 Pure Mathematics 2 — Multivariable Calculus****S1 or S2 L1½T1***Prerequisite: 10.001 or 10.011. Excluded: 10.1213.*

Multiple integrals, partial differentiation. Analysis of real valued functions of one and several variables.

**10.1114 Pure Mathematics 2 — Complex Analysis****S1 or S2 L1½T1***Prerequisite: 10.001 or 10.011. Excluded: 10.1214.*

Analytic functions, Taylor and Laurent series, integrals. Cauchy's theorem, residues, evaluation of certain real integrals.

**10.1115 Pure Mathematics 2 — Finite Mathematics A****S1 L1½T½***Prerequisite: 10.001.*

Positional number systems, floating-point arithmetic, rational arithmetic, congruences. Euclid's algorithm, continued fractions, Chinese remainder theorem, Fermat's theorem, applications to computer arithmetic. Polynomial arithmetic, division algorithm, factorization, interpolation, finite field. Codes, error-correcting codes, public-key cryptography.

**10.1116 Pure Mathematics 2 —  
Finite Mathematics B S2 L1½T½**

*Prerequisite:* 10.1115 (or any other Year 2 Mathematics half-unit).

Introduction to combinatorial computing, recurrence relations, examples of divide and conquer strategies, backtrack and branch and bound algorithms. Finite Fourier transforms, roots of unity, convolutions, application to fast multiplication and the analysis of pseudo-random numbers. Boolean algebra, switching circuits.

**10.121A Higher Pure Mathematics 2 —  
Algebra F L2T½**

*Prerequisite:* 10.011 or 10.001 (DN). *Excluded:* 10.111A, 10.1111.

Linear algebra: vector spaces, commutative rings, polynomials, modules, linear transformations, eigenvectors, invariant subspaces, canonical forms, linear functions, bilinear and multi-linear algebra. Group theory; subgroups, quotient groups, isomorphisms. Lagrange's theorem, Sylow's theorem.

**10.1213 Higher Pure Mathematics 2 —  
Multivariable Calculus S1 L2T½**

*Prerequisite:* 10.011 or 10.001 (DN). *Excluded:* 10.1113.

As for 10.1113 Pure Mathematics 2 — Multivariable Calculus but in greater depth.

**10.1214 Higher Pure Mathematics 2 —  
Complex Analysis S2 L2T½**

*Prerequisite:* 10.1213. *Excluded:* 10.1114.

As for 10.1114 Pure Mathematics 2 — Complex Analysis, but in greater depth.

**10.2111 Applied Mathematics 2 —  
Vector Calculus S1 or S2 L1½T½**

*Prerequisite:* 10.001. *Excluded:* 10.2211.

*Properties of vectors and vector fields; divergence, gradient, curl of a vector; line, surface, and volume integrals. Gauss' and Stokes' theorems. Curvilinear co-ordinates.*

**10.2112 Applied Mathematics 2 —  
Mathematical Methods for  
Differential Equations S1 or S2 L1½T½**

*Prerequisite:* 10.001. *Excluded:* 10.2212.

*Mathematical methods for ordinary and partial differential equations. Series solutions, numerical methods, separation of variables. Fourier series. Bessel functions.*

**10.2113 Applied Mathematics 2 —  
Linear Programming S1 or S2 L1½T½**

*Prerequisite:* 10.001. *Co-requisite:* 10.111A. *Excluded:* 10.2213.

*Mathematical modelling and solution techniques for linear optimization problems. Feasible regions, graphical methods, the standard problem, basic solutions, fundamental theorem, simplex and revised simplex methods, duality and the dual simplex method, sensitivity analysis, the transportation problem.*

**10.2115 Applied Mathematics 2 —  
Discrete-Time Systems S1 or S2 L1½T½**

*Prerequisite:* 10.001. *Co-requisite:* 10.111A, *Excluded:* 10.2215.

*The study of dynamical systems whose states change at discrete points in time. Difference equations: existence and uniqueness of solutions, general solution of linear equations. Linear systems: dynamics, stability, and oscillations, z-transforms, state-space methods. Nonlinear systems; equilibrium points, limit cycles.*

Applications selected from problems of importance in engineering, biological, social, management, and economic systems.

**10.2211 Higher Applied Mathematics 2 —  
Vector Analysis S1 L2T½**

*Prerequisite:* 10.011 or 10.001 (CR). *Excluded:* 10.2111.

As for 10.2111 but in greater depth.

**10.2212 Higher Applied Mathematics 2 —  
Mathematical Methods for  
Differential Equations S2 L2T½**

*Prerequisite:* 10.011 or 10.001 (CR) *Excluded:* 10.2112.

As for 10.2112 but in greater depth.

**10.2213 Higher Applied Mathematics 2 —  
Linear Programming S1 or S2 L1½T½**

*Prerequisite:* 10.011 or 10.001 (CR) *Co-requisite:* 10.111A. *Excluded:* 10.2113.

As for 10.2113 but in greater depth.

**10.2215 Higher Applied Mathematics 2 —  
Discrete-Time Systems S2 L1½T½**

*Prerequisite:* 10.011 or 10.001 (DN). *Co-requisite:* 10.111A *Excluded:* 10.2215.

As for 10.2115, but in greater depth.

**10.2922 Applied Mathematics 3 —  
Applied Time Series Analysis S2 L1½T½**

*Prerequisites:* 10.2112 or 10.031 or 10.022. *Co-requisites:* 10.331 or equivalent, 10.2921 or 10.212D or equivalent. *Excluded:* 10.4129.

*Techniques for analyzing time-varying data. Classification of random processes, sampling for discrete analysis, Fourier analysis, spectra, filtering. Cross-spectra, estimation and hypothesis testing, confidence limits, application to experiment planning. Emphasis on computer analysis of actual data.*

**10.311A Theory of Statistics 2 —  
Probability and Random Variables S1 L3T1**

*Prerequisite:* 10.001 or 10.011 or 10.021C (CR). *Excluded:* 10.321A, 10.301, 10.331, 45.101.

Probability, random variables, standard discrete and continuous distributions, multivariate distributions, transformations, random sampling, sampling distributions, limit theorems.

**10.311B Theory of Statistics 2 —  
Basic Inference S2 L3T1**

*Prerequisite:* 10.311A. *Excluded:* 10.321B, 10.301, 10.331, 45.101.

Point estimation: general theory, estimation by moments, maximum likelihood, interval estimation with general theory and application, hypothesis testing using Neyman Pearson theory, linear regression and prediction, analysis of variance.

**10.3111 Theory of Statistics 2 — Statistical  
Computing and Simulation S1 L1½T½**

*Prerequisite:* 10.001 or 10.011 or 10.021C(CR). *Co-requisite:* 10.311A.

Introduction to APL, random variables, univariate transformation, simulation of random variables, APL programming, integer value random variables, random walks — theory and simulation, introduction to Markov chains.

**10.3211 Higher Theory of Statistics 2 —  
Statistical Computing and  
Simulation S1 L1½T½**

*Prerequisite:* 10.001 or 10.011. *Co-requisite:* 10.321A.

As for 10.3111 but in greater depth.

**10.3112 Theory of Statistics 2 —  
Nonparametric Statistical  
Inference S2 L1½T½**

*Prerequisite:* 10.311A. *Co-requisite:* 10.311B.

Order statistics, exact and approximate distributions, multinomial distributions, goodness of fit, contingency tables, one-sample and two-sample estimation and inference problems.

**10.3212 Higher Theory of Statistics 2 —  
Nonparametric Statistical  
Inference S2 L1½T½**

*Prerequisite:* 10.321A. *Co-requisite:* 10.321B.

As for 10.3112 but in greater depth.

**10.321A Higher Theory of Statistics 2 —  
Probability and Random Variables S1 L3T1**

*Prerequisite:* 10.001 or 10.011. *Excluded:* 10.311A, 10.301, 10.331, 45.101.

As for 10.311A but in greater depth.

**10.321B Higher Theory of Statistics 2 —  
Basic Inference S2 L3T1**

*Prerequisite:* 10.321A. *Excluded:* 10.311B, 10.301, 10.331, 45.101.

As for 10.311B but in greater depth.

**10.331 Statistics SS F L1½T½**

*Prerequisite:* 10.001 or 10.021C (CR). *Excluded:* 10.311A, 10.311B, 10.321A, 10.321B, 10.301, 45.101.

An introduction to the theory of probability, with finite, discrete and continuous sample spaces. The standard elementary univariate distributions; binomial, Poisson and normal, an introduction to multivariate distributions. Standard sampling distributions, including those of  $\chi^2$ ,  $t$  and  $F$ , Estimation by moments and maximum likelihood (including sampling variance formulae, and

regression); confidence interval estimation. The standard tests of significance based on the above distributions, with a discussion of power where appropriate. An introduction to experimental design; fixed, random and mixed models, involving multiple comparisons and estimation of variance components.

**10.341 Statistics SU S1 L2½ T½**

*Prerequisite:* 10.001 or 10.011.

For students in the School of Surveying.

Revision of plane trigonometry and co-ordinate systems. Join, polar, area calculations using hand calculators. Spherical trigonometry. Principles of calculation; representation of numbers, round-off errors, significant figures, orders of magnitude. Introduction to computers; computer hardware, computer software, operating systems, programs. Program design and documentation. Introduction to FORTRAN; constant types, data elements, selection control, loop control, input and output, program modules.

**10.351 Statistics SM F L1½T½**

*Prerequisite:* 10.001 or 10.011.

For students in Aeronautical, Industrial and Mechanical Engineering and Naval Architecture.

Introduction to probability theory, with finite, discrete and continuous sample spaces. Random variables: the standard elementary distributions including the binomial, Poisson and normal distributions. Sampling distributions: with emphasis on those derived from the normal distribution:  $t$ ,  $\chi^2$  and  $F$ . Estimation of parameters: the methods of moments and maximum likelihood and confidence interval estimation. The standard test of statistical hypotheses, and, where appropriate, the powers of such tests. An introduction to regression and the bivariate normal distribution.

**10.361 Statistics SE F L1½T½**

*Prerequisite:* 10.001 or 10.011.

For students in the School of Electrical Engineering.

Introduction to probability theory, random variables and distribution functions; the binomial, Poisson and normal distributions in particular. Standard sampling distributions, including those of  $\chi^2$  and  $t$ . Estimation by moments and maximum likelihood; confidence interval estimation. The Standard tests of significance based on the above distribution with a discussion of power where appropriate.

An introduction to linear regression, auto-regression. Probability limit, law of large numbers and central limit theorem. Multivariate normal distribution. Stochastic processes in discrete and continuous time: Poisson and Gaussian processes.

**10.361 Statistics SC S1 or S2 L1½T½**

For students in the School of Civil Engineering.

Introduction to probability. Random variables. Elementary distribution. Statistical inference. Point estimation. Confidence intervals.

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## Accounting

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### 14.001 Introduction to Accounting A S1 L1½

*Architecture: 2 credit points compulsory for BBuild degree course students.*

*Prerequisite: Nil.*

An introduction for non-commerce students to the nature, purpose and conceptual foundation of accounting. Information systems including accounting applications. Analysis and use of accounting reports.

### 14.002 Introduction to Accounting B S2 L1½

*Architecture: 2 credit points; compulsory for BBuild degree course students.*

*Prerequisite: 14.001.*

An introduction for non-commerce students to managerial accounting. Long-range planning, budgeting and responsibility accounting: cost determination, cost control and relevant cost analyses.

### 14.501 Accounting and Financial Management 1A S1 or S2 L2T½

*Prerequisite: Nil.*

The basic concepts of financial model building and information systems, including the double-entry recording system, the accounting cycle, income measurement and financial reporting, and an introduction to basic elements of auditing.

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## Industrial Relations and Organizational Behaviour

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### 19.605 Information Systems Implementation S2 L2T1

*Prerequisite: 19.603.*

Supervised implementation of an information systems project in a commercial programming language. Advanced program design and structured techniques, interface with systems software at application implementation level, comparison of a range of programming languages, test data specification, implementation procedures.

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## Health Administration

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### 16.711 Quantitative Methods 1

*Prerequisite: 16.540.*

Sources of statistical data; errors and pitfalls in the use of statistics. Measures of central tendency, dispersion and skewness. Elementary treatment of probability. Introduction to statistical inference; estimation and hypothesis testing, elements of sampling and sample survey design. correlation and regression. Index number. Time series analysis. Introduction to demography and vital statistics; measures of mortality, fertility and population replacement. Statistics of the Australian health care system including the measurement of morbidity and health service utilization, and statistics for quality assurance, planning and evaluation.

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## Industrial Engineering

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Industrial Engineering is a Department within the School of Mechanical and Industrial Engineering.

### 18.003 Numerical Methods/Industrial Experimentation S1 L1T½ S2 L1½T½

*Prerequisites: 5.0721, 10.022, 10.351.*

*Numerical methods:* numerical solution of systems of linear and non-linear equations. Numerical interpolation, differentiation and integration. *Industrial experimentation:* planning experiments. Common probability distribution. Experiments of comparison. Accelerated life testing. Analysis of variance. Correlation and regression.

### 18.004 Manufacturing Management S1 L2T2

*Prerequisites: 14.001, 14.002, 18.503, 18.603.*

*Production control:* modes of manufacture; information flow in multi-stage production systems; classical production and inventory models and control techniques; material requirements planning; just-in-time production; flexible manufacturing systems and their control. *Quality control:* sampling inspection, economic aspects, control charts, management of QC. *Project control:* critical path scheduling, PERT. Computers in manufacturing management: systems design.

### 18.091 Industrial Management S1 LT5

*Prerequisites: 10.2112, 10.361.*

*Engineering economy:* economic objectives of the firm. Economic measures of performance: net present value, annual equivalent value and the DCF rate of return (including the incremental rate of return) and their application in the selection and replacement of processes and equipment. *Introduction to operational research:* The formation and optimization of mathematical models of industrial processes. The development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queueing theory, inventory models, simulation, critical path networks. *The use of human and physical resources:* Methods engineering, ergonomics, motion and time study, financial incentives, applications to machine controlled processes, work sampling and data collection. Plant location, factory layout. *Production and quality control:* Control of jobbing, repetitive batch and continuous production. Manufacturing organizations, functions, inter-relationships and information flow. Sampling techniques in quality control, control charts. *Introduction to inventory control:* Analysis of some engineering planning decisions.

### 18.224 Numerical Control of Machine Tools S1 L2T1

*Prerequisite: 5.0721. Excluded: 18.260G.*

Overview of numerical control systems; machine specification and selection; manual part programming; process planning and sequencing; selection of operating conditions; work holding devices and tooling; introduction to computer assisted part programming.

**18.303 Methods Engineering****F L1T1***Prerequisite:* 10.351.

*Aims:* Historical development, measurement of productivity. *Methods study:* motion economy, ergonomics, man-machine relationships. *Factory environment:* layout, conditions, safety. *Work measurement:* purposes, time study, fatigue, human work capacity, predetermined motion time systems, regression methods; work sampling. *Human factors:* motivation to work, job satisfaction, socio-technical systems, incentive plans. *Laboratory:* exercises in work measurement, workplace design, ergonomics.

**18.403 Production Design and Technology****F L2T2***Prerequisites:* 5.4220, 5.4222, 10.351.

Basic metrology and tolerancing, introduction to plasticity theory and its application to theories for machining and forming, economics of production processes; interaction of machines and tools; principles of process selection; review of major processes, interaction of design, production quantity, materials and processes; value analysis.

**18.404 Design for Production****F L1T1***Prerequisite:* 5.123 or 18.413.

Product design, development and manufacture important in the manufacturing industry. Includes industrial design, patents law, product liability, product reliability, safety standards and regulations, process and operation planning, advanced production aids and jig and fixture design, advanced measuring inspection and gauging methods, quality control methods and systems.

**18.413 Design for Industrial Engineers****S1 L1T1 S2 L1T2***Prerequisites:* 5.122, 5.4220, 5.4222.

Tooling design. Production aids. Fluid power systems. Introduction to fatigue in design. Design analysis for manufacture; component design and drawing with individual and group projects of an interdisciplinary nature. (Some material taken with 5.123 Mechanical Engineering Design 3.)

**18.503 Operations Research A****F L2T1***Prerequisites:* 5.0721, 10.022, 10.351. *Co-requisite:* 18.803. *Excluded:* 6.646.

History and overview of operations research. Decision theory. Methodology; identification and formulation of the problem; construction of a model, obtaining solutions; testing the model and implementing the solution. Case study.

**18.551 Operations Research****F L2T1***Prerequisites:* 5.0721, 10.022, 10.351. *Excluded:* 6.646.

The formulating and optimization of mathematical models. The development of decision rules. Some techniques of operations research such as mathematical programming, queueing theory, inventory models, replacement and reliability models; simulation. These techniques applied to situations drawn from industrial fields, eg production planning and inventory control. Practical problems of data collection, problem formulation and analysis.

**18.603 Management/Economics****F L/T2***Prerequisite:* 5.0721.

*Introduction:* objectives of a company, measures of performance, need for economic decisions. *Cost information:* sources of costs, fixed and variable, overheads, break-even analysis. *Engineering economics:* time value of money. Derivation and use of interest formulae. Evaluation of alternatives, annual and present equivalents. D.C.F. rate of return. The minimum acceptable rate of return. Capital budgeting. Replacement studies. Risk and uncertainty. *Management:* objectives of an organization; definition and functions of management. Development of management thought; interactions between organizations and their environment. The management functions of planning, organizing, leading and controlling; management and computers.

**18.803 Optimization****S1 L2T1***Prerequisite:* 10.022. *Excluded:* 5.1245.

Optimization in one dimension. Conditions for optimality in  $n$  dimensions. *Linear programming:* problem formulation, solution by the simplex method, duality and post optimality analysis. The transportation algorithm. Dynamic programming. Unconstrained and linearly constrained non-linear programming. Geometric programming.

**Servicing Subjects**

These are subjects taught within courses offered by other faculties.

For further information regarding the following subjects see the Faculty of Applied Science Handbook.

**18.121 Production Management****F L2T1***Prerequisites:* 10.031, 10.331.

*Engineering economy:* Economic objectives of the firm. Economic measure of performance: net present value, annual equivalent value and the DCF rate of return (including the incremental rate of return) and their application in the selection and replacement of processes and equipment. *The use of human and physical resources:* Methods engineering, ergonomics, motion and time study, financial incentives, applications to machine controlled processes, work sampling and data collection. Plant location, factory layout. *Production and quality control:* Control of jobbing, repetitive batch and continuous production. Manufacturing organizations, functions, inter-relationships and information flow. Sampling techniques in quality control, control charts. *Introduction to inventory control:* Analysis of some engineering planning decisions. *Introduction to operational research:* The formation and optimization of mathematical models of industrial processes. The development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queueing theory, inventory models, simulation.

**18.1211 Production Management A****S1 L3***Prerequisites:* 10.031, 10.331 or 10.021B, 10.021 C, 13.200.

*Use of human and physical resources:* Methods engineering, ergonomics, motion and time study, financial incentives, appli-

cations to machine controlled processes, work sampling and data collection. Plant location, factory layout. *Production and quality control*: Control of jobbing, repetitive batch and continuous production. Manufacturing organisations, functions, inter-relationships and information flow. Sampling techniques in quality control, control charts. *Introduction to inventory control*: Analysis of some engineering planning decisions.

### 18.1212 Production Management B

S2 L3

*Prerequisites*: 18.1211.

*Engineering economy*: Economic objectives of the firm. Economic measure of performance: net present value, annual equivalent value and the DCF rate of return (including the incremental rate of return) and their application in the selection and replacement of processes and equipment. *Introduction to operational research*: Formation and optimization of mathematical models of industrial processes. Development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queueing theory, inventory models, simulation.

### 18.131 Operations Research

*Introduction to operational research*: The formation and optimization of mathematical models of industrial processes. The development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queueing theory, inventory models, simulation.

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## Applied Geology

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### 25.5112 Geology for Civil Engineers

S1 L2T1

An introduction to mineralogy, petrology, structural geology, stratigraphy and geomorphology. Weathering of rocks and development of soils. The role of the geologist in civil engineering.

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## Geography

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### 27.010 Land Studies

S1 L2T2

Concepts, significance and problems of land. Land as territory and land as resource in Australia. Constraints imposed by the physical environment on human occupancy and settlement patterns, the variety of conflicts that result and management strategies. Practical work involves study of the ways in which the attributes and characteristics of land are displayed on maps, air photos and satellite imagery, and introduces these as basic

information sources and research tools in applied geography.

### 27.030 Environmental Processes

S2 L2T2

Essential and continuing links between components of the physical environment. Movement of energy and matter in the physical environment, including consideration of Earth's energy balance, the hydrological cycle, nutrient cycles in vegetation and soil, imbalances leading to land degradation and instability, alternatives to and movement of materials.

### 27.133 Pedology

S2 L2T3

*Prerequisites*: 27.010 and 27.030 or 27.111 or any two units from 2.111, 2.121, 2.131, 2.141, and 27.811, 27.828 or 27.311 or 25.012 or 25.022.

Methodology of pedogenic studies and the application of these studies to the understanding of soil-landform relationships. Soil physical and chemical properties and their interrelationships, emphasizing clay-mineral structure and behaviour, soil solution chemistry, soil water movement and the application of these properties to elements of soil mechanics. Soil properties in natural, rural and urban landscapes, including assessment of soil fertility, swelling characteristics, dispersibility, erodibility and aggregate stability. Laboratory analysis of soil physical and chemical characteristics with emphasis on properties associated with land capability assessment. Statistical analysis of soil data and its application to mapping. The use of soil micromorphological and mineralogical studies in pedology.

### 27.143 Biogeography

S1 L2T3

*Prerequisites*: 27.010 and 27.030 or 27.811 or 27.828 or 17.031 and 17.041 or 27.111 or 27.172.

Distribution of taxa. Floras of the Southern Hemisphere with particular reference to Australia. Endemic, discontinuous and relict taxa. Dispersal and migration of species. Origin, evolution and geological history of Angiosperms. The development of the Australian biogeographic element. Study of the recent past to understand present distributions of taxa. The role of man and climatic change on Australian vegetation. Detection of pattern and association and their causes. Classification, ordination and mapping of vegetation. Ecology of selected Australian vegetation types. Composition, structure, productivity and environmental control of heathland, woodland, grassland and rainforest communities. Management of vegetation in different climate regimes. *Field work* of up to five days is a compulsory part of the subject.

### 27.153 Climatology

S1 L2T3

*Prerequisites*: 1.001 or 27.811 or 27.828 or 25.110 and 25.120 or 17.031 and 17.041 or 27.111.

Physical bases for understanding microclimate. Processes of energy exchange at the earth's surface, and the atmospheric and terrestrial surface controls of the heat and mass budgets. Atmospheric diffusion. Wind profiles and atmospheric turbulence as affected by stability and surface properties. Determinants of the local and site-specific climatic environment, particularly topographic, surface cover and substrate conditions. Urban climate and climate in relation to human comfort and health. Building construction design aspects of climate and applications of climatology in urban and regional planning. Climatic aspects of the development and regional planning. Climatic aspects of the development and utilization of solar and wind energy sources.

## **27.175 Introduction to Remote Sensing S1 L2T2**

*Prerequisite: Successful completion of a Year 1 program in Applied Science, Science or Arts (or equivalent) as approved by the Head of School.*

Principles and technical aspects of remote sensing. Forms of available imagery, their utility and facilities for interpretation. Basic air-photo interpretation techniques relevant to environmental assessment. Introduction to principles of the electromagnetic spectrum, photometry and radiometry. Sensor types, image formation and end products associated with selected satellite programs, including Landsat. Land-cover and land-use interpretation procedures in visual image analysis. Basic procedures in machine-assisted image enhancement.

## **27.176 Remote Sensing Applications S2 L2T2**

*Prerequisite: 27.175 or 27.1711, 29.514 or 29.511 and 29.631. Excluded: 27.1712*

Spectral characteristics of natural phenomena and image formation. Ground truthing, collection and calibration. Introduction to computer classification procedures. Multitemporal sampling procedures, image to image registration and map to image registration. Major applications of remote sensing in the investigation of renewable and non-renewable resources to include: soils, geology, hydrology, vegetation, agriculture, rangelands, urban analysis, regional planning, transportation and route location and hazard monitoring.

## **27.183 Geomorphology S2 L2T3**

*Prerequisites: 25.110 and 25.120 or 27.010 and 27.030 or 27.811 or 27.828 or 27.111 or 27.172. Excluded: 27.860.*

Beaches and their response to waves, currents and sediment movement. Barrier systems, lagoons and estuaries. Rock platforms. Quaternary sea level changes. Hydraulic geometry of stream channels, including effects of sediment transport and human activities. Hillslope form, process and associated slope materials. Methods of slope measurement, analysis and survey. Hillslope models. Systems approach, equilibrium concepts and modelling in landform studies. Field projects in coastal and fluvial geomorphology, and laboratory time is devoted to statistical exercises using data collected from maps, airphotographs and in the field.

## **27.193 Environment Impact Assessment S1 L2T2**

Rationale and basic objectives; standardized types of environmental impact assessment (EIA), including matrix approach, adopted methods of EIA in Australia. Frequently used assessment and predictive techniques for meteorological, hydrological, biological, socio-economic impacts. Techniques of impact evaluation in terms of socio-economic criteria. Environmental decision making and planning under conditions of uncertainty. Case studies exemplifying procedures, techniques and issues. Trends, changes and possible future developments in EIA. Practical exercises representing components of typical EIAs.

## **27.862 Australian Environment and Natural Resources S1 L2T2**

*Prerequisite: 27.010 and 27.030 or 27.811 or 27.812 or 27.828 or 27.829. Excluded: 27.872.*

Continental and regional patterns of land, water and energy resources in Australia and its territorial waters, and natural factors affecting their development, including climate, soils and terrain; problems of limited surface and 'underground' water resources and of conflicting demands, exemplified through particular basin studies; comparable reviews of energy, minerals and forest resources, human resources and development.

## **27.863 Ecosystems and Man S2 L2T2**

*Prerequisite: 27.010 and 27.030, or 27.111 or 27.311/811 or 27.312/812 or 27.828 or 27.829. Excluded: 27.873, 27.363.*

The structure and functioning of ecosystems, human interaction with ecosystems; Australian case studies of ecosystem management, including pastoral, cropping, forestry, coastal and urban ecosystems.

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## **Surveying**

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### **Note: Electronic Calculators.**

Students enrolled in the surveying courses are required to equip themselves with an electronic calculator. Advice on the purchase of this equipment is given to students at the commencement of their course.

## **29.1111 Introduction to Computing S1 L2 T2**

Revision of plane trigonometry and co-ordinate systems. Join, polar, area calculations using hand calculators. Spherical trigonometry. Principles of calculation; representation of numbers, round-off errors, significant figures, orders of magnitude. Introduction to computers; computer hardware, computer software, operating systems, programs. Program design and documentation. Introduction to FORTRAN; constant types, data elements, selection control, loop control, input and output, program modules.

## **29.1711 Introduction to Surveying F L1½T½**

Historical development of surveying. Principles of survey observations and the control of observation errors. Introduction to geodetic positioning, photogrammetry and remote sensing; cadastral surveying and land information management; engineering, mining, geophysical and hydrographic surveying; mapping. Discussion of the purpose, methods and products of these surveying disciplines. Survey data; structures, collection,

storage, processing and presentation. The key values of the surveying profession. The profile and role of a surveyor in practice; knowledge, skill management and professional ethics. Current and future challenges of the changing surveying profession.

### 29.2041 Survey Data Presentation S2L2T1

Basic principles of report writing. Writing aids and references. Structures of memos, letters, reports. Collecting data for reports; fieldnotes. Drafting and proofreading. Word processing. Use of graphic elements, figures and plans. Use of references. Production of reports. Fundamentals of survey drafting. Abbreviations, symbols, layout of drawing sheets, lines, letters, numerals, scales. Engineering and design drawings. Drawing practice in boundary surveying, state regulations.

### 29.2111 Principles of Computer Processing S2L2T2

*Co-requisite: 29.1111.*

Operating systems; VAX/VMS, MS-DOS, command languages. Third party software; word processing, spreadsheets, compilers. Program structure; subroutines, functions, control structures. Program libraries; creation, system libraries. Data structures; organization types, structures, arrays, stacks, lists, queues, trees. Data files; types and organizations. Sorting, searching, merging. Data bases; concepts, types, information access.

### 29.2221 Introduction to Geodetic Science S2L2½T½

Historical development of geodesy. Scope and goals of contemporary geodesy. The Earth's gravity field. The Earth's motions in space; the role of time in geodesy, co-ordinate systems and transformations. Near-earth satellite motion. Principles of terrestrial and space geodetic positioning. Integrated geodesy.

### 29.3011 Surveying Instruments S1L2½T1½

*Prerequisite: 29.1111.*

Survey tapes and bands; measurement, calibration, reductions. Levelling instruments; principles, construction, testing and adjustment, ancillary equipment. Optical and electronic theodolites; principles, construction, testing and adjustment.

### 29.3111 Survey Computations S1L2T1

*Prerequisite: 29.2111.*

Intersection, resection, trilateration, with and without redundant data, semigraphic solutions. Missing data problems, road intersections. Subdivision calculations. Transformations. Traverse computations, algorithm development of Bowditch's traverse adjustment. Computer communications, hardware and software standards, file transfer, protocols.

### 29.3231 Geodetic Computations S1L2T1

*Prerequisite: 29.2221. Co-requisite: 10.022*

Principles of map projections. Surveying and mapping projections; transverse Mercator projection. Geometry of the ellipsoid; ellipsoidal computations. Corrections to field observations; arc-to-chord, scale factor and grid convergence.

### 29.4011 Surveying Techniques S2L4½T1½

*Prerequisite: 29.2041. Co-requisite: 29.3011, 29.3111.*

Principles, reduction of observations and errors in survey techniques of levelling, horizontal and zenith angle measurement, trigonometric heighting, traversing, vertical staff tacheometry. Electronic distance measurement; principles, corrections, reductions, calibration, electro-optical distance meters.

### 29.4051 Survey Camp 1 S2T3

*Co-requisite: 29.3011*

Theodolite and steel band traverse between control points. Contour survey by stadia. Line levelling. Setting out with theodolite and steel band. Calibration of electronic distance meter.

### 29.4111 Data Analysis and Computing 1 S2L2T1

*Prerequisite: 29.2111. Co-requisite: 29.3111.*

Least squares theory; modelling of observations; general, parametric and condition methods. Solution of equations and inverses. Treatment of singular equations and datum problems. Law of propagation of variances. Statistical testing; confidence intervals, error ellipses. Applications in surveying, geodesy, photogrammetry and other sciences. Software design and coding for least squares analysis. Use of personal computers.

### 29.4221 Geodetic Positioning 1 S2L2T1

*Prerequisite: 29.2221. Co-requisite: 29.3231.*

Review of reference systems in classical positioning. Introduction to positional astronomy; determination of azimuth from sun and close circumpolar stars. Design, establishment and measurement of geodetic control networks. Latitude, longitude, azimuth, geoid determinations. Geodetic levelling; datum and methods. Geodetic data bases.

### 29.4721 Project Management 1 S2L1½T½

Types of business. Organisational and management principles. Goals, strategies and actions. Phases of a project: feasibility study, pilot project, contract work, final report, and control. Principles of project management: organisation, management, planning responsibilities, information, control. Communication: meeting, negotiation, conflict, dialectic for managers.

## 29.5010 Surveying 5

**S1 L2T½**

*Prerequisite: 29.3010.*

Precision theodolites; construction, errors and testing. Precise horizontal angle measurement. Electronic theodolites. Precise levelling; instruments, staves, errors. Field methods, marking and accuracy.

## 29.5110 Computations 3

**S1 L2T2**

*Prerequisite: 29.3110.*

Review of matrix algebra. General law of propagation of variances, variance factor, statistical testing, error ellipses for points and lines. Adjustment by least squares: 1. parametric method; 2. condition method. Solution and inversion of normal equations.

Includes a programming assignment.

## 29.5220 Geodetic Positioning

**S1 L2T½**

*Prerequisite: 29.4220. Co-requisite: 29.3110.*

Terrestrial positioning. Horizontal and vertical control networks. Inertial surveys. Satellite positioning. TRANSIT and NAVSTAR GPS systems.

## 29.5230 Map Projections

**S1 L2T½**

*Prerequisite: 29.4220. Co-requisite: 29.3110.*

Principles of map projections. Surveying projections and grids. Transverse mercator projections used in Australia. Scale-factor and arc-to-chord corrections on the transverse mercator projection.

## 29.5610 Cadastral Surveying and Land Law 1

**S1 L2½T1**

The legal system in Australia and NSW; the nature of land law including land tenure, estates in land, interests in land; title systems in land; land administration in Australia and NSW. Boundary surveying — controlling principles; cadastral mapping in NSW.

## 29.6010 Surveying 6

**S2 L2T2½**

*Prerequisite: 29.3010. Co-requisite: 29.5010.*

Electronic distance measurement; principles, light modulation, pulse techniques. Propagation of electromagnetic waves, refractive index. Effects of temperature, pressure and humidity on measurement. Geometrical corrections. Electro-optical and microwave distance metres. Calibration.

## 29.6220 Field Astronomy

**S2 L2T1**

*Prerequisite: 29.4220.*

Introduction to the determination of latitude and longitude from

meridian and prime vertical observations. Determination of azimuth from the sun and close circum-polar and circum-elongation stars. Simultaneous determination of latitude and longitude by position lines.

## 29.6510 Photogrammetry 1

**S2 L2T1**

Remote sensing data acquisition systems; photography, electro-optical, linear array and micro-wave systems. Photograph geometry. Interior orientation. Stereoscopic vision. Collinearity equations and deviations from collinearity encountered in practice. Space resection. Relative orientation; concept procedure, error effects. Ground control selection, absolute orientation. Analogue stereo-plotter principles.

## 29.6610 Cadastral Surveying and Land Law 2

**S2 L4T2**

*Co-requisite: 29.5610.*

Survey investigation for both artificial and natural boundaries; survey and title searching; field note preparation for cadastral surveying; survey marking; preparation of plans of survey; study of appropriate statutes and regulations; cadastral survey techniques for urban and rural properties; the role of co-ordinates in cadastral surveying.

The status of roads in NSW; identification surveys; consents for MHW, railways, rivers, kerbs in Sydney, strata plan surveys including plan preparation; the surveyor as a professional; contract, partnership and corporations, liability; surveyors and the law, limitation periods, insurance, loss prevention; software packages for cadastral surveying.

## 29.6810 Land Management and Development 2

**S2 L2T1**

*Co-requisite: 29.5610.*

Subdivision control in NSW; broad-acre subdivisions under Local Government and Planning and Environment Legislation; procedures and legal controls; review of subdivision design; engineering aspects.

## 29.7010 Surveying 7

**S1 L3½T1**

*Co-requisite: 29.6010.*

Introduction to hydrographic surveys. Echo sounding; theory and practice. Visual fixing by transits, theodolite and sextant. Electronic position fixing; hyperbolic, range-range and satellite systems. Theory of tides. Tidal streams and currents. Tidal datums. Sweeping and searching. Statistical testing of observations. Multi-sample variance analysis. Correlated observations. Linear regression and prediction.

## 29.7050 Survey Camp

**S1**

*Prerequisites: 29.5010, 29.6010, 29.5110, 29.5220, 29.5230, 29.6220, 29.6610.*

Cadastral surveying including astronomic observations for azimuth, land use survey including air photo and Landsat imagery interpretations. Photo control survey by traverse and resection,

precise traverse and heighting with EDM. Preparation of reports based on filed tasks completed.

**29.7120 Computer Graphics** **S1 L1T1**

*Prerequisite:* 29.3110.

Computer graphics, especially in relation to computer assisted mapping and draughting. Acquisition, processing and presentation of data; graphics programming using a high level language and a graphics language; use of interactive graphics display terminals and plotters.

**29.7220 Geodetic Computations** **S1 L2T1**

*Prerequisites:* 29.5110, 29.5230.

Elements of geodetic methodology; classes of mathematical models. Least squares solution of overdetermined models; assessment of results. Adjustment of control surveys. Solution of direct and inverse geodetic problems.

**29.7510 Photogrammetry 2** **S1 L2½T1½**

*Prerequisite:* 29.6510.

Analytical methods of relative and absolute orientation. Principles of analytical plotters. Map compilation by photogrammetric techniques. Map production. Differential rectification, orthophotos and mosaics. Map revision. Principles of aerial triangulation. Project planning; costs, scheduling, specifications, capabilities of photogrammetric production.

**29.7810 Land Management and Development 3** **S1 L1T1**

*Prerequisite:* 36.411.

Design and studio project for a residential neighbourhood development. Constraint and site analysis; preparation of maps of land use, vegetation, surface and soils, drainage and terrain, slopes, climate and aspect; composite overlay maps. Structure plan design: residential precincts, schools commercial areas, industrial areas, active and passive recreation, pedestrian ways and road hierarchy.

**29.8010 Surveying 8** **S2 L3T2**

*Prerequisite:* 29.5010.

Calibration of linear scales. Principles and practice of autocollimation. Theodolite attachments. Setting out of large structures. Gyro-theodolite. Underground surveys. Plumbing of shafts and high structures. Azimuth and height transfer.

**29.8220 Global Geodesy** **S2 L2T½**

*Co-requisite:* 29.7220.

Astro-geodetic methods. Gravimetric geodesy. Space geodetic methods. Combined methods. Variations of geodetic positions with time. Geophysical applications.

**29.8510 Photogrammetry 3** **S2 L2T1**

*Co-requisite:* 29.7510.

Analytical methods in photogrammetry. Aerial triangulation block adjustment by models and bundles. Control requirements, accuracies of aerial triangulation. Camera calibration. Application in non-topographic methods using metric and non-metric systems. Digital elevation models. Computer assisted mapping techniques in photogrammetry.

**29.8710 Seminar** **S2 L1T½**

*Prerequisite:* 29.4710.

Introduction to characteristics of effective speaking. Oral presentation by individual students on topics in selected areas of surveying. Participation in colloquia by invited speakers on current topics in surveying. Student assessment of degree course.

**29.8720 Management** **S2 L2**

Introduction to business management. Types of business. Financial accounting methods and interpretation of financial statements; finance and financial planning for small business. Principles of management and organization. Professional responsibilities. Management records. Managing people in small business.

**29.8810 Land Management and Development 4** **S2 L1T1**

*Prerequisites:* 8.6140, 8.6150. *Co-requisite:* 29.7810.

Continuation of design and studio project for a residential neighbourhood development. Plan of detailed lot layout: consideration of access, grades, drainage reserves, parks and pedestrian ways. Engineering design and plans: catchment details, road longitudinal and cross-sections, drainage layout, flow schedule, hydraulic grade line calculations, longitudinal sections of kerb profiles.

**29.9010 Advanced Surveying Instruments** **S1 or S2 L2T1**

*Prerequisites:* 29.5010, 29.6010.

Electronic tacheometers: types, construction, circle reading devices, on-line correction of instrument errors. Data storage mediums, data transfer between tacheometer and recorder and between recorder and computer. Electronic field books. High performance gyroscopic theodolites: construction, measuring process and accuracy. Two-colour and high precision electronic distance meters: principle, operation, calibration, accuracy. Microwave distance meters: new developments, ground-swing problem, measuring techniques, calibration. Long range EDM: measurement techniques, calibration of instruments.

**29.9020 Hydrographic Surveying** **S1 or S2 L1T2**

*Prerequisite:* 29.7010.

Practical training: a hydrographic survey requiring establishment of horizontal and vertical shore control, preparation of

# Engineering

plotting sheets, control marking, bathymetry, equipment calibration, tidal observations and reduction, inking in. Other navigational equipment. Nature of seabed, wind waves, the survey report. Discussion on practical surveying tasks or topics of current interest. Harmonic analysis of tidal data.

## 29.9030 Precise Engineering Surveying S1 or S2 L2T1

*Prerequisites:* 29.5010, 29.6010.

Review of survey problems in industry and engineering. Surveys for large structures — location, setting out and control during construction, monitoring of deformation and settlement: high precision mechanical, optical and electronic equipment for distance measurement, levelling, horizontal and vertical alignment, local deformation. Network design, station marking, observation techniques, data presentation, deformation and settlement analysis including free network solutions. Close-range surveys: optical tooling, laser interferometry. Positioning and alignment of machine components, optical positional constraints, scale and azimuth control.

## 29.9090 Project S1 or S2 T3

*Prerequisite:* High standard in the chosen topic area normally required; permission of project supervisor.

Theoretical or practical investigation of a selected topic under the guidance of a supervisor, with a report of a high academic standard required. Topic may be one suggested by the School or by the individual student based on his or her experiences.

## 29.9210 Adjustments of Control Networks S1 or S2 L1½T1½

*Prerequisite:* 29.7220.

Adjustment of control surveys on the ellipsoid. Statistical evaluation of the adjustment. Detection of outliers. Design and optimization of networks. Requires use of School computer program library.

## 29.9220 Advanced Geodetic Positioning S1 or S2 L2T1

*Prerequisite:* 29.5220.

Precise aspects of terrestrial and extraterrestrial reference frames; units, constants, coordinate systems and transformations used in satellite positioning; modelling of measurements. Orbit determination. Positioning with GPS; field procedures. Inertial surveying systems: inertial frame; sensors; mathematical and error models; filtering and smoothing processes; post-mission adjustment techniques; inertial positioning methods and applications.

## 29.9510 Computer Assisted Mapping S2 L2T1

*Co-requisite:* 29.7510.

Introduction to principles of Computer Assisted Mapping. Collection and editing of feature coded digital terrain data in vector and raster form. Digital elevation models. Automation of mapping procedures. Mapping systems based on computers.

## 29.9520 Remote Sensing Principles S1 or S2 L1½T1½

*Prerequisite:* 29.4520.

Definition and physics of basic electromagnetic quantities, atmospheric effects, photographic film images and sensors, thermal infra-red sensing, radar, radar sensing, electro-optical sensors. Choice of sensor and data processing. Remote sensing project.

## 29.9530 Land Information Systems S1 or S2 L2T1

Land information systems and computer-assisted mapping; land information as maps and records; computerization of land information; data acquisition from ground surveys, aircraft and satellite mounted sensors; data acquisition from maps and air photographs; data storage methods; data structures; data processing, transformations, searching, sorting; data base management systems; interactive graphical editing; data output including computer plotters and software packages; cartographic presentation; an examination of existing systems in Australia and overseas.

## 29.9610 Modern Cadastral Concepts S1 or S2 L2T1

*Prerequisite:* 29.6610.

An analysis of the operation and components of a modern cadastral survey system, especially the relationship between title, conveyancing, surveying and mapping. Components of land tenure and cadastral systems; statewide parcel based land information systems; cadastral models. Horizontal and vertical subdivision, trends in group housing in Australia and overseas, ownership alternatives including strata titles, management of strata schemes, the development process related to strata subdivision.

## 29.9910 Special Topic in Surveying A S1 or S2 L2T1

A special subject to be lectured on by visiting professors or other visiting staff. Details of syllabus and lecturer to be communicated to Faculty on each occasion when the subject runs.

## 29.9920 Special Topic in Surveying B S1 or S2 T3

A special subject taken by a group of students by private study in conjunction with tutorial sessions with the member(s) of staff in charge of the subject.

## Servicing Subjects

These are subjects taught within courses offered by other faculties.

For further information regarding the following subjects see the Faculty of Architecture Handbook.

## 29.411 Surveying for Architects and Builders S1 L1T1½ C2

*A compulsory subject. Prerequisites:* nil.

Introduction. Chaining, methods of measurement, corrections, chain surveys. Level, differential levelling, booking. Contours, volumes of earthworks. Theodolite, methods of reading angles, applications in building. Traversing, setting out.

**29.901 Introduction to Mapping****S1 L1T½**

*Mapping:* map types, map reading, scale, relief, depiction of features, cartography and photogrammetry. *Remote Sensing:* cameras and other sensors. Landsat images and applications. *Cadastral surveying:* land titles, surveys, easements and covenants.

**Town Planning****36.411 Town Planning****S1 L2**

*Architecture prerequisite:* 11.4308 and 100 credit points.

Introduction to the purpose, scope and application of planning. The urban planning process. Objectives and means of planning cities. Levels of planning and types of plans: state environmental policies, regional environmental plans, local environmental plans. Problems in planning: equitable distribution of resources. Environment and environmental impact statements. Planning law and administration. Future of cities.

**Chemical Engineering and Industrial Chemistry****48.302 Fuels and Energy****S2 L2T2**

A servicing subject for students in Electrical Engineering which deals with sources and properties of fuels (with particular emphasis on coal, crude oil and natural gas), principles of combustion including combustion calculation and the technology of boilers and other fuel plant. Other energy sources including solar energy and nuclear energy are discussed. The national and global situation is reviewed.

**48.403 Polymer Science****F L2T1**

*Prerequisites:* 2.102A, 2.102B, 10.031, 10.301. *Co- or prerequisites:* 48.001, 48.113.

Polymerization processes; step growth and chain growth (free radical and ionic), stereospecific catalysts. Methods of polymerization: bulk suspension, emulsion, solution, high pressure. Industrial examples. Principles of analysis of polymers using chemical and instrumental methods. Molecular weight applied to macromolecules: number-, weight-, viscosity- and z-average weights. Molecular weight distribution. Thermodynamics of polymer solutions, theta solvent. Measurement of molecular weight. Fractionation methods. Conformation of a polymer chain. The crystalline state. The amorphous state. Stress/strain behaviour. Creep. Impact. Rubber elasticity. Dynamic mechanical properties. Principles of operation of polymer processing equipment; safety procedures. Polymer compound design.

**Anatomy****70.011C Introductory Anatomy****S1 L2T4**

*Prerequisites:* 17.031, 17.041.

Introduction to gross anatomy, based on a study of prosected specimens. Musculoskeletal, cardiovascular, respiratory, gastrointestinal, genitourinary and nervous systems. General topographical and surface anatomy.

**Physiology and Pharmacology****73.111 Physiology 1****F L2T4**

*Prerequisites:* 17.031 & 17.041; 2.121 & 2.131, or 2.141; 10.001 or 10.011 or 10.021 B & C. *Excluded:* 73.121, 73.011. *Co-requisite:* 41.101.

Introduction to fundamental physiological principles, dealing first with basic cellular function in terms of chemical and physical principles, and, second, with the operation of the various specialized systems in the body, for example, the cardiovascular system, whose function it is to transport materials to and from the tissues of the body; the respiratory system which must maintain the exchange of oxygen and carbon dioxide between the atmosphere and the blood; the gastrointestinal system which enables food materials to be modified by digestion and absorbed into the circulation; the kidney which is involved in the regulation of body fluid and electrolyte balance and with the excretion of the waste products of metabolism; the endocrine system which releases chemical messengers, called hormones, that are carried in the blood stream to regulate a great variety of body functions, eg metabolism and reproductive activity; the nervous system which by means of very rapidly propagated electrical impulses is responsible for all our movements, sensations, memories, emotions and consciousness itself. A substantial series of practical class experiments on these different areas of physiology is included in the course. This subject is taken by students enrolled in any of the Physiology program.

**Law****90.502 Industrial Safety and Health Law****S1 S2 Hpw4 C3**

The law relating to compensation for work-related injuries and disabilities and to the regulation of safety standards in industry and of the processes and substances employed therein. *Topics include:* the employer's common law duty of care; the development and application of workers' compensation schemes; comprehensive no-fault compensation schemes and inquiries relating thereto in their application to industrial injuries and disabilities; existing protective legislation in Australia; a comparative survey of protective legislation in other countries and its effectiveness; proposals for amendment of protective legislation; individual rights under protective legislation; regulation of industrial safety and health under compulsory arbitration schemes; management and union initiatives in the fields of industrial safety and health; new problems in industrial safety and health.

## Graduate Study

# Course Outlines

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## Faculty of Engineering Enrolment Procedures

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All students re-enrolling in 1989 or enrolling in graduate courses should obtain a copy of the free booklet *Re-enrolment Procedures 1989* available from School Offices and the Admissions Office. This booklet provides detailed information on enrolment procedures and fees, enrolment timetables by Faculty and course, enrolment in miscellaneous subjects, locations and hours of Cashiers and late enrolments.

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## Graduate School of Engineering

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The Graduate School of Engineering is concerned with the co-ordination and development of the graduate activities of the Faculty and provides opportunities for well-qualified graduates to engage in advanced studies and research.

The Faculty consists of the Schools of Civil Engineering, Electrical Engineering and Computer Science, Mechanical and Industrial Engineering, Surveying and the Centres for Biomedical Engineering, Manufacturing and Automation, and Safety Science. The Faculty is also closely associated with the Centres for Groundwater Management and Hydrogeology, Remote Sensing, and Waste Management which are joint enterprises of the Faculties of Engineering and Applied Science. The Faculty is also closely associated with the Joint Microelectronics Research Centre.

The School of Civil Engineering consists of five departments: **Geotechnical Engineering** (foundation engineering, soil mechanics, rock mechanics, concrete technology, and pavement engineering); **Engineering Construction and Management**

(civil engineering systems, engineering economy, project planning and management and civil engineering construction); **Structural Engineering** (structural analysis and structural design); **Transport Engineering** (planning, design, and operation of transport systems, statistical analysis, land use and transport modelling, economic evaluations and environmental impact studies); **Water Engineering** (hydraulics, hydrology, water resources and public health engineering). In addition to extensive laboratory facilities on the Kensington campus, the School operates laboratories at King Street, Randwick and King Street, Manly Vale. The latter complex houses the School's Water Research Laboratory and the associated Water Reference Library. The School also uses the Fowlers Gap Arid Zone Research Station for construction camps and data collection for arid zone hydrology.

The School of Electrical Engineering and Computer Science comprises five departments: **Communications** (all aspects of theory, applied electronics and engineering relating to communication systems such as telephones, broadcasting and television); **Electric Power** (electrical machines and generation, distribution and utilization of electric energy); **Electronics** (electronic circuits, devices, micro-electronics and application of electronics to such areas as solar power generation); **Computer Science** (design of computer devices and the handling of information in all forms, e.g. numeric alphabetic, pictorial, verbal); **Systems and Control** (development of theories for the control of complex systems and the application of these theories including computer simulation). The School also houses the **Joint Microelectronics Research Centre**.

The School of Mechanical and Industrial Engineering consists of three departments: **Applied Mechanics** (agricultural engineering, automatic control, biomechanics, engineering design, engineering mechanics and mechanics of solids); **Fluid Mechanics and Thermodynamics** (energy utilisation and power generation, nuclear engineering, refrigeration and air conditioning, gas and liquid handling, aeronautical engineering and naval architecture); **Industrial Engineering** (economic analysis, production planning and control, product and process design, methods engineering and operations research). The **Centre for Manufacturing and Automation** is also located within the School.

The School of Surveying encompasses the following areas: **Cadastral Surveying** (knowledge of the laws and practices relating to property boundaries); **Geodetic Surveying** (the shape, size and mathematical model of the earth including small movements of the earth's crust); **Satellite Surveying** (the use of data from ground survey, air photography and satellite imagery to produce accurate maps); **Hydrographic Surveying** (the mapping of the seabed and waterways of navigation and offshore resource management); **Engineering Surveying** (the precise survey of large engineering constructions); **Land Management and Development** (environmental assessment for resource management and change of land use); **Land Information Management** (the use of computerised systems for accurate information of spatially related data); **Photogrammetry** (measurement of 3-dimensional positions from photographs and remotely sensed images).

The Centre for Biomedical Engineering is an interdisciplinary unit which promotes and co-ordinates biomedical engineering studies and research being conducted by a number of schools within the University and teaching hospitals. Biomedical engineering involves the application of engineering techniques to biomedical problems with particular emphasis on clinical medicine.

The Centre for Manufacturing and Automation promotes and co-ordinates teaching and research in the areas of manufacturing science and technology, machine control and automation, as well as computer integrated manufacturing and management.

The Centre for Safety Science promotes and co-ordinates teaching and research of a multidisciplinary range of scientific disciplines concerned with occupational health and safety. The major areas of study include occupational health control, safety engineering and management for safety with an emphasis being placed on the engineering of a safe working environment.

The Centre for Groundwater Management and Hydrogeology was established early in 1987 as a research and training unit within the Faculties of Applied Science and Engineering. Its general aims are to research the groundwater problems of strategic national importance and to co-ordinate and develop postgraduate courses and continuing education programs, and to liaise with industry.

The Centre for Remote Sensing is a joint enterprise of the Faculties of Applied Science, and Engineering which promotes and co-ordinates remote sensing studies and research being conducted by various schools within the University. Remote sensing is the science of obtaining information about the earth's surface (in particular) using electro-magnetic imaging systems mounted on aircraft and space platforms.

The Centre for Waste Management is a joint enterprise of the Faculties of Engineering and Applied Science, and co-ordinates and develops teaching and research in the multidisciplinary area of waste management. Waste management is concerned with the study of treating, controlling and disposing of industrial and domestic wastes as applied to the analysis of waste disposal technologies. Particular emphasis is placed on the safe treatment, disposal and resource recovery of solid and liquid wastes.

The Joint Microelectronics Research Centre was established in 1982 under the Commonwealth Special Research Centres Program. Its laboratories are located in the School of Electrical Engineering and Computer Science and at the Royal Melbourne Institute of Technology. The function of the Centre is to carry out research in semiconductor materials and processes, integrated circuit design, computer-aided design and computer-aided testing.

The Faculty awards seven higher degrees as follows: *Research* — Doctor of Philosophy, Master of Engineering and Master of Surveying; *Course Work Masters* — Master of Engineering Science (available in a number of areas of specialization), Master of Surveying Science, Master of Safety Science and Master of Biomedical Engineering. In addition, the degrees of Doctor of Science and Master of Science may be awarded for research conducted in, or in association with, the Faculty of Engineering.

The administration of the various awards including admission, progress and assessment of all higher degree and diploma candidates is conducted by the Higher Degree Committee of the Faculty under the general supervision of the Faculty of Engineering.

Conditions governing the award of higher degrees and graduate diplomas are set out later in this handbook in **Conditions for the Award of Higher Degrees**. However, conditions for the award of the degree of Doctor of Science may be found in the University Calendar.

### English Language Requirements

Applicants whose first language is not English or who have not undertaken a previous degree where English was the primary language of instruction are required to provide proof of their competence by presenting for one of the following tests or by satisfying the course authority as to their level of proficiency.

	Minimum Test Scores Required
Combined Universities Language Test (CULT)	75%
Test of English as a Foreign Language (TOEFL)	550
English Language Testing Service (ELTS)	6
Short Selection Test (SST)	Satisfactory

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## Research Degrees

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### Doctor of Philosophy PhD

This degree is awarded for a thesis considered to be a substantially original contribution to the subject concerned. The degree is becoming a prerequisite for research appointments in government and industrial research and development laboratories.

**Admission Guidelines** A candidate for registration for the degree of Doctor of Philosophy should hold an honours degree from the University of New South Wales or an honours degree of equivalent standing from another approved university. See also *English Language Requirements* as detailed earlier under **Graduate School of Engineering**. Applications for admission should be made to the Academic Registrar on the prescribed form at least one calendar month before the commencement of the session in which registration is to begin.

**Period of Candidature** The normal period is six academic sessions (full-time) and eight academic sessions (part-time) from the date of enrolment. In special cases the minimum period of registration may be reduced by up to two academic sessions. The maximum period of registration is ten academic sessions (full-time) and twelve academic sessions (part-time). In special cases an extension of these times may be granted.

Degree	School/Course	Course Code
	Mechanical and Industrial Engineering	2780
	Nuclear Engineering	2785
	Biomedical Engineering	2795

**Master of Engineering/Master of Science/  
Master of Surveying  
ME/MSc/MSurv**

These are research degrees in which a thesis embodies the result of an original investigation, or design, or engineering/surveying development. Candidates for the degree of ME and MSurv may be required to carry out a program of advanced study.

**Admission Guidelines** A candidate for registration for the degree of Master of Engineering, Master of Science or Master of Surveying should hold a Bachelor's degree from the University of New South Wales or from another approved university. See also *English Language Requirements* as detailed earlier under *Graduate School of Engineering*. Applications for admission should be made to the Academic Registrar on the prescribed form at least one calendar month before the commencement of the session in which registration is to begin.

**Period of Candidature** The normal period is four academic sessions (full-time) and six academic sessions (part-time) from the date of enrolment. In special cases the minimum period of registration may be reduced by up to two academic sessions. The maximum period of registration is six academic sessions (full-time) and ten academic sessions (part-time). In special cases extensions may be granted.

Research degrees may be undertaken in the Faculty of Engineering as follows:

Degree	School/Course	Course Code
PhD	Civil Engineering	1630
	Electrical Engineering and Computer Science	1641
	Mechanical and Industrial Engineering	1660
	Nuclear Engineering	1670
	Surveying	1680
ME	Biomedical Engineering	1710
	Civil Engineering	2650
	Electrical Engineering and Computer Science	2661
	Mechanical and Industrial Engineering	2690
MSurv	Nuclear Engineering	2700
	Surveying	2720
MSc	Civil Engineering	2750
	Electrical Engineering and Computer Science	2761

**Course Work Masters Degrees**

**Master of Engineering Science/Master of Surveying Science  
MEngSc/MSurvSc**

These are Faculty-wide degrees allowing for flexibility of choice between formal course work and research. The schools in the Faculty have developed recommended programs of study leading to specialization in certain areas.

Candidates are required to complete a program totalling 36 credits\* for formal course work. Alternatively a degree may be awarded for the completion of formal course work and a report on a project or completion of a thesis only. The number of credits for a project report are 9 or 18, and 36 for a thesis.

Candidates may undertake interdisciplinary studies and, subject to approval, are able to take subjects from any school in the Faculty, other faculties of the University and other universities or institutions. By means of this system, programs of studies best suited to the needs of the candidates may be selected.

Before enrolment an applicant should submit an intended program for approval by the school/division offering the majority of the credits to ensure that the prerequisite background held is adequate for all subjects including those taken in other schools or institutions.

**Admission Guidelines** An acceptable qualification is a degree at Honours level, or at Pass level to a superior standard in a four-year course in an approved discipline. The latter is defined as an average of 65% over the last two years of a full-time course (or last three stages of a part-time course) taken in minimum time. If the degree concerned is not in an acceptable discipline, or was of less than four years full-time study, a bridging or qualifying program is required. This is normally arranged by enrolment in the appropriate graduate diploma with the possibility of transferring to the Masters program after completion of requirements prescribed by the Faculty. See also *English Language Requirements* as detailed earlier under *Graduate School of Engineering*.

Applicants for admissions to a course of study leading to the award of a course work Masters degree should apply to the Academic Registrar on the prescribed form at least two calendar months before the commencement of the session in which registration is to begin. It may be necessary to limit entry to some formal courses because of available resources. In such cases, an application may be provisionally accepted 'subject to a place being available'. When a firm offer is made, it is subject to acceptance within one month.

\*See definition of 'credit' under *Graduate Subjects* later in this section.

**Period of Candidature** The normal period is two academic sessions (full-time) or four academic sessions (part-time) from the date of enrolment. The maximum period of candidature is four academic sessions (full-time) and eight academic sessions (part-time). In special cases an extension of time may be granted. A candidate is not permitted to continue in a course if the credit value of the subjects failed totals more than six.

**Master of Biomedical Engineering  
MBlomedE**

This degree is primarily obtained through course work but includes a project report conducted in either a hospital or other institution. The course of study offers scope for original research into the application of engineering principles and technology to medical problems. Candidates must complete a program totalling 60 credits, 40 of which must be for the study of subjects at graduate level.

**Admission Guidelines** An acceptable qualification is a degree at Honours level, or at Pass level to a superior standard in a four-year course in an approved discipline. The latter is defined as an average of 65% over the last two years of a full-time course (or last three stages of a part-time course) taken in minimum time. If the degree concerned is not in an acceptable discipline, or was of less than four years full-time study, a bridging or qualifying program is usually required. This is normally arranged by enrolment in the appropriate graduate diploma with the possibility of transferring to the Masters program after completion of requirements prescribed by the Faculty. See also *English Language Requirements as detailed earlier under Graduate School of Engineering.*

Applicants for admission to a course of study leading to the award of a course work Masters degree should apply to the Academic Registrar on the prescribed form at least two calendar months before the commencement of the session in which registration is to begin.

**Period of Candidature** The normal period is three and one third academic sessions (full-time) or six academic sessions (part-time) from the date of enrolment. The maximum period of candidature is five academic sessions (full-time) and eight academic sessions (part-time). In special cases extensions may be granted.

**Master of Safety Science  
MSafetySc**

The Master of Safety Science is an interdisciplinary course involving the study of the principles of engineering, law, management, medicine and science as applied to the field of occupational safety.

**Admission Guidelines** An acceptable qualification is a degree at Honours level, or at Pass level to a superior standard in a four-year course in an approved discipline. The latter is defined as an average of 65% over the last two years of a full-time course (or last three stages of a part-time course) taken in minimum time. If the degree concerned is not in an acceptable discipline, or was of less than four years full-time study, a bridging or qualifying program is required. This is normally arranged by enrolment in the appropriate graduate diploma with the possibility of transferring to the Masters program after completion

of requirements prescribed by the Faculty. See also *English Language Requirements as detailed under Graduate School of Engineering.*

Applicants for admission to a course of study leading to the award of a course work Masters degree should apply to the Academic Registrar on the prescribed form at least two calendar months before the commencement of the session in which registration is to begin. It may be necessary to limit entry to some formal courses because of available resources. In such cases, an application may be provisionally accepted 'subject to a place being available'. When a firm offer is made, it is subject to acceptance within one month.

**Period of Candidature** The normal period is three academic sessions (full-time) and six academic sessions (part-time) from the date of enrolment. The maximum period of candidature is four academic sessions (full-time) and eight academic sessions (part-time). In special cases an extension of time may be granted. A candidate is not permitted to continue in a course if the credit value of the subjects failed totals more than six.

**Courses of Study**

Courses of study leading to the award of course work Masters degrees may be undertaken in the Faculty as follows:

Degree	School/Course	Course Code
MEngSc	Electrical Engineering and Computer Science	8500
	Industrial Engineering	8530
	Mechanical Engineering	8540
	Remote Sensing	8640
	Civil Engineering	8610
	Waste Management	8610
MSurvSc	Surveying	8640
	Surveying	8650
MBlomedE	Biomedical Engineering	8660
MSafetySc	Safety Science	8670

The program in **Remote Sensing** is offered in both the Faculty of Engineering and the Faculty of Applied Science. Entry into either Faculty depends upon the background of the applicant and the orientation of the proposed program.

The program in **Arid Lands Management**, to which the Faculty of Engineering contributes, is available in the Faculty of Applied Science (course code 8025). Details are available from the Faculty of Applied Science Handbook.

Subjects available in the Faculty of Engineering are listed toward the end of this section. However, not all electives are offered in any particular year. Subject descriptions appear in the following section of the handbook.

## Course Work Programs

Detailed information is available from the schools offering the courses.

### 8500 Electrical Engineering and Computer Science

#### Master of Engineering Science MEngSc

- All candidates must commence in Session 1 and possess an appropriate level of knowledge for the program subjects chosen.
- All candidates elect to study in at least one of the specific programs offered by the School of Electrical Engineering and Computer Science: each Program Co-ordinator will advise if applicants are adequately qualified to undertake the proposed subjects and must approve the chosen program.

All candidates must register in one of the following major areas and in at least one of its programs:

#### Major Area

Communications	<b>Program Co-ordinator:</b> Dr C.J.E. Phillips
	<b>Programs:</b>
	1. Communication Electronics
	2. Digital Communication and Systems
	3. Microwave and Optical Communications
	4. Signal Processing
Electric Power	<b>Program Co-ordinator:</b> Dr T.R. Blackburn
	<b>Programs:</b>
	1. Power Systems Engineering
	2. Electrical Power Technology
	3. Power Systems Engineering (for engineers from neighbouring countries)
Electronics	<b>Program Co-ordinator:</b> Dr R.S. Huang
	1. Solid State Devices
	2. Microelectronics
Computer Science	<b>Program Co-ordinator:</b> A/Prof A. Dunworth
	1. Computer Science
	2. Computer Engineering
Systems and Control	<b>Program Co-ordinator:</b> Dr D.H. Mee
	<b>Programs:</b>
	1. Digital Systems and Control
	2. Cybernetic Engineering and Advanced Robotics
	3. Biomedical Engineering (see co-ordinator)

Programs listed would normally consist of 18 credits of course work (6 subjects) and an 18 credit project. However, other appropriate programs or subjects in the same major area or other areas may be substituted for the project allowing completion of the 36 credits by course work only.

### Specialist Programs

#### 8501 Communications

##### 1. Communication Electronics

- Normally 18 credits of course work and an 18 credit project.
- One of the five elective subjects may be chosen from outside this program.

##### Compulsory subject

	Credits
6.340G Communication Electronics	3

##### Elective subjects

6.060G Microprocessor Systems	3
6.169G Microwave Circuits: Theory and Techniques	3
6.170G Microwave and Optical Devices	3
6.338G Television Systems	3
6.341G Signal Processing 1 - Fundamental Methods	3
6.343G Digital and Analogue Communications	3
6.404G Real Time Computing and Control	3
6.577G Integrated Circuit Design	3
6.665G VLSI System Architecture and Design	3

##### 2. Digital Communication and Systems

- Normally 18 credits of coursework and an 18 credit project.
- At least three subjects must be taken from the following list and the remaining subjects from other graduate programs within the Department and School.

	Credits
6.336G Digital Communication Networks 1	3
6.337G Digital Communication Networks 2	3
6.338G Television Systems	3
6.343G Digital and Analogue Communications	3
6.347G Digital Modulation and Coding	3

##### 3. Microwave and Optical Communications

- Normally 18 credits of course work and an 18 credit project.
- One of the three elective subjects may be chosen from outside this program.

##### Compulsory subjects

	Credits
6.150G Theory of Optical Fibres and Optical Signal Processing	3
6.167G Propagation and Transmission of Electromagnetic Waves	3
6.170G Microwave and Optical Devices	3

##### Elective subjects

6.164G Antenna Design and Applications	3
6.169G Microwave Circuits: Theory and Techniques	3
6.348G Optical Communications Systems	3

**4. Signal Processing**

- Normally 18 credits of course work and an 18 credit project.
- One of the four elective subjects may be chosen from outside the program.

**Compulsory subjects**

	Credits
6.341G Signal Processing 1 — Fundamental Methods	3
6.342G Signal Processing 2 — Advanced Techniques	3

**Elective subjects**

6.070G Digital Image Processing Systems	3
6.150G Theory of Optical Fibres and Optical Signal Processing	3
6.340G Communications Electronics	3
6.343G Digital and Analogue Communications	3
10.061G Advanced Mathematics for Electrical Engineers	3
10.361G Statistics	3

**8502 Electric Power**

**1. Power Systems Engineering**

- Normally 18 credits of course work and either an 18 credit project or a program in another area offered by the School
- Three elective subjects to be chosen.

**Compulsory subjects**

	Credits
6.202 Power Engineering 1	3
6.242G Power System Analysis	3
6.205G Power System Planning and Economics	3

**Elective subjects**

6.206G Power System Operation, Control and Protection	3
6.228G Power System Equipment	3
6.221G High Voltage Technology	3
6.215 Industrial Electrical Systems	3
6.229G Fields and Materials	3

**2. Electrical Power Technology**

- Normally 18 credits of course work and either an 18 credit project or a program in another area offered by the School
- Four elective subjects to be chosen.

**Compulsory subjects**

	Credits
6.229G Fields and Materials	3
6.221G High Voltage Technology	3

**Elective subjects**

6.228G Power System Equipment	3
6.224G Partial Discharges in Electrical Insulation	3
6.227G Insulation Performance in Electrical Plant	3
6.212 Power Engineering — Utilisation	3
6.242G Power System Analysis	3
6.215 Industrial Electrical Systems	3

**3. Power Systems Engineering**

(for engineers from neighbouring countries)

- Normally 18 credits of course work and an 18 credit project.
- Two elective subjects to be chosen.

**Compulsory subjects**

	Credits
6.202 Power Engineering 1	3
6.242G Power System Analysis	3

6.205G Power System Planning and Economics	3
6.2289 Power System Equipment	3

**Elective subjects**

6.221G High Voltage Technology	3
6.212 Power Engineering — Utilisation	3
6.206G Power System Operation Control and Protection	3
6.215 Industrial Electrical Systems	3
6.224G Partial Discharges in Electrical Insulation	3
6.227G Insulation Performance in Electrical Plant	3
6.229G Fields and Materials	3

**8503 Electronics**

- Normally 18 credits coursework and 18 credit project.
- There are no compulsory subjects, but at least 3 subjects should be chosen from one of the programs shown below.
- The remaining three subjects may be chosen from the alternative program list or outside these lists.

**1. Solid State Devices**

6.573G Advanced Semiconductor Devices	3
6.575G Integrated Circuit Technology	3
6.579G Solar Cells — Operations Principles, Technology and System Applications	3

**2. Microelectronics**

6.575G Integrated Circuit Technology	3
6.577G Integrated Circuit Design	3
6.573G Advanced Semiconductor Devices	3
6.665G VLSI Systems Architecture Design	3
6.340G Communication Electronics	3

**8504 Computer Science/Computer Engineering**

- Normally 36 credits of coursework or 18 credits of coursework and an 18 credit project.
- At least four elective subjects (coursework only programme) or at least two elective subjects (thesis programme) to be chosen as appropriate.

**Compulsory subjects**

6.060G Microprocessor Systems	3
6.660G Design and Analysis of Algorithms	3
6.663G Operating Systems	3
6.664G Compiling Techniques and Programming Languages	3

**Elective subjects (8504)**

6.468G Computer Display Systems and Interactive Instrumentation	3
6.654G Digital Systems	3
6.655G Computer Organization and Architecture	3
6.665G VLSI System Architecture and Design	3
6.666G Artificial Intelligence	3
6.667G Programming Languages: Fundamental Concepts	3
6.668G Computer Graphics	3
6.669G Formal Specification	3
6.670G Parallel and Distributed Computing Systems	3

**8505 Systems and Control**

**1. Digital Systems and Control**

- Normally 18 credits of course work and an 18 credit project.

Compulsory subjects	Credit
6.401G Computer Control Systems 1	3
6.403G Computer Control Systems 2	3
6.404G Real Time Computing and Control	3
6.405G Topics in Digital Control	3

Elective subjects	
6.060G Microprocessor Systems	3
6.342G Signal Processing 2 — Advanced Techniques	3
6.468G Computer Display Systems and Interactive Instrumentation	3
6.470G Robotics, Automation and Productivity Technology	3

**2. Cybernetic Engineering and Advanced Robotics**

- Normally 9 credits of course work and an 18 credit project.
- Remaining 9 credits may be taken from the elective list or other programs and subjects.

Compulsory subjects	
6.457G Cybernetic Engineering	3
6.469G Robot Vision	3
6.470G Robotics, Automation and Productivity Technology	3

Elective subjects	
6.060G Microprocessor Systems	3
6.070G Digital Image Processing Systems	3
6.342G Signal Processing 2 — Advanced Techniques	3
6.404G Real Time Computing and Control	3
6.468G Computer Display Systems and Interactive Instrumentation	3

**8530 Industrial Engineering**

**8540 Mechanical Engineering**

**Master of Engineering Science MEngSc**

A major field of study is required to be nominated and two-thirds of the 36 credits required for the degree must be taken in that major field. (Examples of major fields are heat engines, fluid mechanics and solar energy. Consult School Advisers for further details)

All candidates take either a 9 credit or 18 credit project on a topic in their major field.

Formal lecture subjects are not restricted to the School of Mechanical and Industrial Engineering, Faculty of Engineering or this University, but two-thirds of all credits must be taken at the University of New South Wales.

In consultation with their School Adviser, candidates at enrolment put together a program which is based on these requirements, but which may be modified from time to time in the light of changes in availability of subjects. These requirements also apply to a number of specialist courses which are offered by the School of Mechanical and Industrial Engineering and which are described below.

**Specialist Programs**

**1. Refrigeration and Air Conditioning**

Credits

19 credits of core subjects:

5.151-2G Refrigeration and Air Conditioning Design 1, 2	3,3
5.715G Two Phase Flow and Heat Transfer	3
5.731G Analysis of Heat Transfer	4
5.755-6G Refrigeration and Air Conditioning 1, 2	3,3

and  
18 credit Project Report

or

9 credit Project plus 8 credits from:

5.328-9G Control and Modelling of Mechanical Systems 1, 2	3,3
5.601G Computational Fluid Dynamics	3
5.653-4G Acoustic Noise 1, 2	2,2
5.655G Energy Conservation and System Design	3
5.722G Solar Thermal Energy Design	3
5.753G Ambient Energy Air Conditioning	2
5.757G Refrigeration and Air Conditioning Applications	3
5.759G Refrigeration and Air Conditioning Experimentation	3
47.090G Introduction to Occupational Health and Safety Law	3

or such other subjects as may be approved by the Head of School.

**2. Industrial Automation**

Credits

18 credits of core subjects taken from:

5.086G Digital Logic Fundamentals for Mechanical Engineers	3
5.087G Microprocessor Fundamentals for Mechanical Engineers	3
5.088G Industrial Applications of Microprocessors	3
5.089G Elements of Industrial Automation	3
5.090G The Analysis and Use of Integrated CAD/CAM systems	3
5.328-9G Control and Modelling of Mechanical Systems 1, 2	3,3
18.260G Computer Aided Programming for Numerical Control	3

and

18 credit Project Report

or

9 credit Project and a further 9 credits of subjects selected from:

5.317G Industrial Robotics	3
18.772G Information Processing Systems in Organization	2
18.868G Industrial Applications of Mathematical Programming	3

or such other subjects as may be approved by the Head of School

**3. Industrial Management**

3 credits of core subjects:

18.074G Industrial Management	3
18.965G Industrial Management Seminar	0

at least 11 credits selected from:

14.062G Accounting for Engineers	3
18.380G Methods Engineering	4
18.571G Operations Research 1	6
18.675G Economic Decisions in Industrial Management	3
18.776G Production and Inventory Control	2
<i>and</i>	
18.909G Project	9
<i>or</i>	
18.918G Project Report	18

The remaining credits may be selected from:

15.565G Industrial Relations	3
18.061G Industrial Experimentation 1	3
18.076G Decision Support Systems	3
18.171G Inspection and Quality Control	3
18.360G Ergonomics	3
18.371G Factory Design and Layout	3
18.464G Value Analysis/Engineering	3
18.465G Computer-Aided Manufacturing	3

Credits

18.672G Decision Theory for Industrial Management	3
18.764G Management of Distribution Systems	2
18.772G Information Processing Systems in Organizations	2
18.862G Linear Programming	2
18.863G Nonlinear Programming	2
18.870G Large Scale Optimization in Industry	3
18.868G Industrial Applications of Mathematical Programming	3
28.913G Marketing Management	3

or such other subjects as may be approved by the Head of School

**4. Operations Research**

*Prerequisites:*

- (i) 2 years of University level Mathematics
- (ii) minimum 40 hours University level course in Probability and Statistics (or enrolment in 5.0721 Computing or equivalent as a co-requisite)
- (iii) minimum 40 hours University level course in Engineering Economic Analysis (or enrolment in 18.675G Economic Decisions in Industrial Management as a co-requisite)
- (iv) competence in computer programming (or enrolment in 5.0721 Computing as a co-requisite).

12 credits of core subjects:

14.062G Accounting for Engineers	3
18.571G Operations Research 1	6
18.574G Management Simulation	3

Credits

18.970G Operations Research Seminar	0
18.909G Project	9
<i>or</i>	
18.918G Project Report	18

The remaining credits may be selected from:

18.074G Industrial Management	3
18.076G Decision Support Systems	3
18.360G Ergonomics	3
18.371G Factory Design and Layout	3
18.380G Methods Engineering	4
18.464G Value Analysis/Engineering	3
18.671G Decision Theory	2
18.672G Decision Theory for Industrial Management	3
18.673G Energy Modelling, Optimization and Energy Accounting	3
18.675G Economic Decisions in Industrial Management	3
18.760G Discrete Event Simulation Languages	3
18.761G Simulation in Operations Research	3
18.764G Management of Distribution Systems	2
18.765G Optimization of Networks	2
18.772G Information Processing Systems in Organizations	2
18.776G Production and Inventory Control	2
18.862G Linear Programming	2
18.863G Nonlinear Programming	2
18.870G Large Scale Optimization in Industry	3
18.874G Dynamic Programming	2
18.879G Mathematical Programming Analysis	3

or such other subjects as may be approved by the Head of School

**5. Advanced Analysis for Design**

*Prerequisites:*

- (i) 5.123 Mechanical Engineering Design 3 or equivalent
- (ii) 5.423 Mechanics of Solids 3 or equivalent

21 credits of core subjects:

5.414G Finite Element Applications	3
5.415G Stress Analysis for Mechanical Engineering Design 1	3
5.417G Mechanics of Fracture and Fatigue	3
5.909G Project (Design and Build)	9
18.360G Ergonomics	3

*plus* at least 5 credits selected from:

5.1242 Design Technology	2
5.1244 Project Management	2
5.1245 Computer Based Engineering Design (or 18.870G)	2
5.403G Experimental Stress Analysis	3
8.731G Project Management (or 8.732G)	3
8.732G Advanced Project Management Theory (or 8.731G)	3
18.464G Value Analysis/Engineering	3
18.675G Economic Decisions in Industrial Management	3
18.870G Large Scale Optimization in Industry (or 5.1245)	3

# Engineering

The remaining credits, resulting overall in at least 36 credits, must be chosen from an approved list of subjects, details of which may be obtained from the School of Mechanical and Industrial Engineering.

Students who elect to take the 9 credit Project will be required to take one of the following specialist options:

## Industrial Automation

The following two subjects from the Industrial Automation package subject to availability:

5.086G	Digital Fundamentals for Mechanical Engineers	3
5.089G	Industrial Applications of Microprocessors	3
5.090G	The Analysis and Use of Integrated CAD/CAM Systems	3

## Robotics

The following two subjects from the Industrial Automation package subject to availability:

5.086G	Digital Fundamentals for Mechanical Engineers	3
5.317G	Industrial Robots together with	3
5.320G	Artificially Intelligent Machines	3
<i>or</i>		
6.404G	Real Time Computing and Control	3
6.469G	Robot Vision	3
6.470G	Robotics, Automation and Productivity Technology	3

## Manufacturing Management

14.062G	Accounting for Engineers	3
18.675G	Economic Decisions in Industrial Management	3
18.776G	Production and Inventory Control	3

## Manufacturing Design

*Either*

18.380G	Methods Engineering	3
18.171G	Inspection and Quality Control	3
18.371G	Factory Design and Layout	3
<i>or</i>		
14.062G	Accounting for Engineers	3
18.461G	Design for Production	3
18.464G	Value Analysis and Engineering	3

## 6. Nuclear Engineering

15 credits of core subjects:

5.230G	Radioactivity 1	3
5.231G	Radioactivity 2	3
5.232G	Neutronics	3
5.233G	Nuclear Safety	3
5.234G	Nuclear Power Assessment	3

*and*

5.918G	Research Project	18
<i>or</i>		
5.909G	Project	9

The remaining credits may be selected from:

18.673G	Energy Modelling, Optimization and Energy Accounting	3
5.320G	Artificially Intelligent Machines	3
5.414G	Finite Element Applications	3
5.415G	Stress Analysis for Mechanical Engineering Design 1	3
5.417G	Mechanics of Fracture and Fatigue	3
5.601G	Computational Fluid Dynamics	3
5.715G	Two Phase Flow and Heat Transfer	3
5.731G	Analysis of Heat Transfer	4

or other such subjects as may be approved by the Head of School.

## 7. Computer Integrated Manufacturing

18 credits of core subjects:

18.074G	Industrial Management	3
18.260G	Computer Aided Programming for Numerical Control	3
18.465G	Computer Aided Manufacturing	3
97.601G	Computer Aided Design for Manufacture	3
97.602G	Computer Integrated Manufacturing	3
97.603G	Product Design and Technological Innovation	3

*and*

18 credit Project Report

Credits

*or*

9 credit Project

The remaining credits may be selected from:

### Industrial Automation (subject to availability)

5.086G	Digital Logic Fundamentals for Mechanical Engineers	3
5.088G	Industrial Applications of Microprocessors	3
5.090G	The Analysis and Use of Integrated CAD/CAM Systems	3

### Robotics (subject to availability)

*Either*

5.086G	Digital Logic Fundamentals or Mechanical Engineers	3
5.317G	Industrial Robotics	3
5.320G	Artificially Intelligent Machines	3

*or*

6.404G	Real Time Computing and Control	3
6.469G	Robot Vision	3
6.470G	Robotics, Automation and Productivity Technology	3

**Manufacturing Management**

14.062G	Accounting for Engineers	3
18.675G	Economic Decisions in Industrial Management	3
18.776G	Production and Inventory Control	2

**Manufacturing Design**

*Either*

18.380G	Methods Engineering	4
18.171G	Inspection and Quality Control	3
18.371G	Factory Design and Layout	3

*Or*

14.062G	Accounting for Engineers	3
18.461G	Design for Production	4
18.464G	Value Analysis and Engineering	3

*Or*

5.317G	Industrial Robotics	3
97.604G	Flexible Manufacturing Systems	3
97.605G	Computer-Aided Design for Manufacture 2	3

**8610  
Civil Engineering**

**Master of Engineering Science  
MEngSc**

The School of Civil Engineering offers a large number of graduate subjects which allow the flexibility of many combinations to provide relevant groupings both in an academic and professional sense. The main technical groupings are:

- engineering construction and management
- geotechnical engineering
- structural engineering
- transport engineering
- water engineering

All candidates are required to undertake a project with the other credits being obtained from formal course work. Full details of preferred programs in the various specialists areas are available from the School.

**8610  
Waste Management**

**Master of Engineering Science  
MEngSc**

**8085  
Waste Management**

**Master of Engineering Science  
MAppSc**

Candidates are required to complete a course totalling at least

36 credits, made up of compulsory subjects, elective subjects and a project. The degree may be obtained internally on a full time (normally 2 sessions of 18 credits) or part time (normally 4 sessions of 9 credits) basis. An external course program is also offered (normally over 4 sessions) with resource material posted to students and evaluation made on written assignments.

Candidates would be enrolled as MEngSc or MAppSc depending on their previous qualification experience and course content.

**Compulsory subjects**

8.872G	Management of Wastes	3
8.873G	Waste and Wastewater Analysis and Environmental Requirements	3
8.874G	Waste Management Science	3
25.715G	Sources of Waste and Landfill Disposal	3
48.067G	Treatment, Disposal and Resource Recovery of Solid and Liquid Wastes	3
48.388G	Unit Operations in Wastewater Sludge and Solids Management	3

**Project(MEngSc)**

8.909G	Project	9
8.918G	Project Report	18

**Project (MAppSc)**

46.512G	Project	9
46.513G	Project Report	18

**Elective subjects**

Selection of the subjects for the formal course work must be approved by the Director of the Centre for Waste Management. For a graduate degree specializing in Waste Management a candidate would normally complete 18 credits of core subjects plus 9 credits selected from the list of elective subjects.

7.152G	Mining Conservation	3
7.535X	Mine Fill Technology	2
48.391G	Atmospheric Pollution Control (Theory)	3
48.391X	Atmospheric Pollution Control (Theory)	3
48.392G	Atmospheric Pollution Control (Practical Aspects)	3
8.857G	Sewage Treatment and Disposal	3
8.870G	Hydraulics and Design of Water and Wastewater Treatment Plants	3
25.702G	Hydrogeology	3
25.704G	Environmental Geology	3
25.707X	Geopollution Management	3
25.707G	Geopollution Management	3
46.203G	Medical Aspects	1
46.204G	Legislative Aspects	1
47.481G	Management of Dangerous Materials	3
47.120G	Human Behaviour and Safety Science	3
48.063G	Industrial Water and Wastewater Engineering	3

**8640  
Remote Sensing**

**Master of Engineering Science  
MEngSc**

Candidates are required to complete a course totalling at least 36 credits, made up of compulsory subjects, elective subjects and a project or research project. Compulsory subjects not offered in a particular year may be substituted by an equivalent subject, approved by the appropriate Head of School. The degree will normally comprise one year of full-time study (two sessions of 18 credits) or two years of part-time study (four sessions of 9 credits each).

Candidates who are not exempted from any of the compulsory subjects and who opt for the Research Project (18 credits), will achieve the required 36 credits without any elective subjects.

## Compulsory subjects

	Credits
27.043G Remote Sensing Applications	3
29.600G Principles of Remote Sensing	3
29.602G Remote Sensing Procedures	3
29.605G Ground Investigations for Remote Sensing	3
97.580G Image Analysis in Remote Sensing	3
97.581G Microwave Remote Sensing	3

## Project

Project in Remote Sensing† or	9
Research Project in Remote Sensing†	18

†The subject number for these subjects varies according to the school in which the candidate is enrolled.

## Elective subjects

Candidates are required to include additional subjects selected from the following listed elective subjects, or from other relevant subjects offered within the University, as approved by the appropriate Head of School, to complete a program totalling 36 credits.

	Credits
6.070G Digital Image Processing Systems	3
6.468G Computer Display Systems and Interactive Instrumentation	3
6.711 Computing 1A	4
6.712 Computing 1A	3
25.816G Remote Sensing (in Applied Geology)	2
27.174G Remote Sensing Instrumentation and Satellite Programs	3
27.644G Computer Mapping and Data Display	3
27.672G Geographic Information Systems	3
27.911G Soil Erosion and Conservation	6
27.914G Terrain Evaluation	6
29.213G Physical Meteorology	3
29.604G Land Information Systems	3

## 8650 Surveying

### Master of Surveying Science MSurvSc

Programs of study leading to the degree of MSurvSc are offered by the School of Surveying in a range of topics including:

- advanced surveying
- geodesy

- photogrammetry
- land development and management
- land and geographic information systems

Candidates are allowed a wide choice in selecting programs. Subjects can be selected to suit individual student needs and typical programs can be supplied by the School on request. The program of study must total at least 36 credits. One credit is normally equal to attendance for one hour per week for one session but some senior undergraduate subjects may be taken for partial credit towards the degree. The program normally includes a Project of 9 credits or a Project of 18 credits. Examples of suitable external subjects are electronic computing, statistics, oceanography, and a range of others.

## 8650 Surveying

### Master of Surveying Science MSurvSc in Land and Geographic Information Systems

Candidates are required to complete a course totalling at least 36 credits made up of compulsory subjects, elective subjects and a project or project report. Compulsory subjects not offered in a particular year may be substituted by an equivalent subject approved by the appropriate Head of School. The course will normally comprise one year of full-time study (two sessions of 18 credits) or two years of part-time study (four sessions of 9 credits each).

## Compulsory subjects

	Credits
27.672G Geographic Informations Systems	3
29.608G Cadastral Systems	3
55.823G Files and Data Base Systems	3
29.604G Land Information Systems	3
27.043G Remote Sensing Applications	3
29.532G Computer-Assisted Mapping	3

## Elective subjects

27.644G Computer Mapping and Data Display	3
29.7120 Computer Graphics	2
97.580G Image Analysis in Remote Sensing	3
55.817G Information Storage and Retrieval Systems	6
55.815G Economics of Information Systems	3

## Project

29.909G Projects	9
29.918G Projects Report	18

The Masters degree program in Land and Geographic Systems is offered in both the Faculty of Engineering and the Faculty of Applied Science. Entry into either Faculty depends on the background of the applicant and the orientation of the proposed program.

**8660  
Biomedical Engineering**

**Master of Biomedical Engineering  
MBiomedE**

The program of study must total 60 credits and include at least 40 credits at graduate level.

Strand A subjects are directed to candidates with an engineering/physical sciences background and Strand B to those with a medical/biological sciences background. Selection of subjects is not limited to those listed below; relevant approved subjects from other areas may be undertaken. A research project is compulsory and may be undertaken concurrently with other subjects. An 18 credit Project Report is the normal requirement.

**Session 1 (March-June)**

	Credits
73.111 Physiology 1 (full year) (Strand A)	C 3
70.011C Introductory Anatomy (Strand A)	HR 6
32.101G Mathematical Modelling for Biomedical Engineers (Strand B)	C 4
32.501G Computing for Biomedical Engineers (Strand B)	HR 4
6.481G Introductory Physiology for Engineers <sup>1</sup>	3
32.025G Radiation Physics	5
32.040G Analogue Electronics for Biomedical Engineers	4
32.060G Biomedical Systems Analysis	3
32.551G Biomechanics of Physical Rehabilitation <sup>2</sup>	3
32.561G Mechanical Properties of Biomaterials <sup>2</sup>	3
32.601G Biomedical Applications of Microprocessors 1 <sup>3</sup>	3
32.621G Biological Signal Analysis	3
32.701G Dynamics of the Cardiovascular System	3
42.407G Biological Principles	3
47.061G Principles of Ergonomics	3
72.402G Principles of Disease Processes <sup>4</sup>	3

**Session 2 (July-November)**

	Credits
73.111 Physiology 1 (continued)	
32.010G Biomedical Engineering Practice	HR 2
32.012G Biomedical Statistics	4
32.050G Microprocessors and Circuit Design for Biomedical Engineers <sup>5</sup>	4
32.311G Mass Transfer in Medicine	4
32.321G Physiological Fluid Mechanics	4
32.332G Biocompatibility	3
32.541G Mechanics of the Human Body <sup>2</sup>	3
32.602G Biomedical Applications of Microprocessors 2 <sup>7</sup>	3
32.603G Static and Flow Cytometry	3
32.611G Medical Instrumentation <sup>6</sup>	3
32.018G Project Report <sup>8</sup> or C	18
32.030G Project Report <sup>8</sup>	30

- C Compulsory
- HR Highly recommended.
- 1 For part-time students, ONLY, who are unable to do 73.111.
- 2 These 3 electives vary according to Session in which offered. Only 1 is offered per year. Prerequisite for 32.541G and 32.551G: 70.011C or equivalent.
- 3 Prerequisite: 32.050G or equivalent.
- 4 For non-medical graduates only. Prerequisite: 73.111 or equivalent; pre- or co-requisite: 70.011C.
- 5 Prerequisites: 32.501G and 32.040G or equivalents.
- 6 Prerequisite: 32.040G or equivalent.
- 7 Subject follows on from 32.601G.
- 8 Research project may be done concurrently with course work during the other Sessions. An 18-credit Project Report is the normal requirement.

**8670  
Faculty of Engineering**

**Master of Safety Science  
MSafetySc**

Candidates are required to complete a program totalling 54 credits made up of 12 credits of preliminary subjects (selected according to previous qualifications), 22 credits of compulsory subjects, 11 credits of Safety Engineering electives, and a 9 credit Project. The preliminary subjects enable graduates from a wide range of disciplines (such as engineering, science, medicine, economics, law) to reach an adequate standard of comprehension for studying the compulsory and elective subjects.

**Preliminary subjects**

	Credits
<i>Statistics and Computing</i>	
No more than 4 credits selected from:	
16.901G Health Services Statistics 1	2
32.012G Biomedical Statistics	4
47.030G Computing for Safety Science	3
<i>Management</i>	
Either:	
18.074G Industrial Management	3
or	
30.935G Organizational Behaviour A	3

# Engineering

## Other:

47.051G	Principles of Engineering Mechanics	3
47.090G	Introduction to Occupational Health and Safety Law	3
70.201G	Introductory Functional Anatomy	3
80.701G	Occupational Disease	3

## Compulsory Subjects

47.052G	Introduction to Safety Engineering	3
47.061G	Principles of Ergonomics	3
47.120G	Human Behaviour and Safety Science	3
47.180G	Management for Safety	3
47.330G	The Accident Phenomenon	3
80.702G	Occupational Health Control	3
90.502	Industrial Safety and Health Law	4

## Safety Engineering Electives

2.251G	Toxicology, Occupational and Public Health	6
18.380G	Methods Engineering	4
39.908G	Community Noise Control	2
47.054G	Machines and Structures Safety	3
47.060G	Electrical Safety	3
47.062G	Applied Ergonomics	3
47.070G	Ventilation	3
47.230G	Radiation Protection	3
47.480G	Fire and Explosion	3
47.481G	Management of Dangerous Materials	3
79.616G	Occupational Epidemiology	3
79.617G	Occupational Medicine Practice	6

## Project

47.909G	Project	9
or		
47.918G	Project Report	18

## Graduate Diplomas

Courses of study leading to the award of a Graduate Diploma in Engineering provide graduates with opportunities to extend their professional knowledge. In most cases, candidates may choose from a range of subjects in the special area of their choice. There are also opportunities to select subjects from other professional areas in which candidates may be interested. In addition, the graduate diploma courses in **Engineering Developments** are intended for those who wish to take a more general program in several areas of interest.

Before enrolment, an applicant should submit an intended program for approval by the school or centre offering the majority of the credits. Candidates must complete a program totalling

30 credits. Forty per cent of these may consist of approved undergraduate subjects and the program may contain subjects from other schools of the Faculty, other faculties of the University and other universities or institutions subject to meeting any prerequisite requirements. If an applicant nominates a course of study from the list below, at least half of the credits should come from the subjects taken in that area.

### Admission Guidelines

An applicant for admission to a graduate diploma course should be a graduate of the University of New South Wales or other approved university or have other qualifications as may be approved by the Faculty of Engineering. Applicants should apply to the Academic Registrar on the prescribed form at least two calendar months before the commencement of the session in which registration is to begin. It may be necessary to limit entry because of available resources. In such cases, an application may be provisionally accepted 'subject to a place being available'. When a firm offer is made, it is subject to acceptance within one month.

### Period of Candidature

The normal period is two academic sessions (full-time) or four academic sessions (part-time) from the date of enrolment. The maximum period of candidature is four academic sessions (full-time) and six academic sessions (part-time). In special cases extensions may be granted. A candidate is not permitted to continue in a course if the credit value of the subjects failed totals more than six.

Courses of study leading to the award of a graduate diploma may be undertaken in the Faculty of Engineering as follows:

School/Course	Course Code
<b>Graduate Diploma in Engineering:</b>	
Biomedical Engineering	5462
Civil Engineering	5461
Waste Management*	5461
Electrical Engineering and Computer Science	5463
Industrial Engineering	5465
Mechanical Engineering	5466
Nuclear Engineering	5467
<b>Graduate Diploma in Engineering Developments</b>	<b>5470</b>
<b>Graduate Diploma in Remote Sensing*</b>	<b>5495</b>
<b>Graduate Diploma in Safety Science**</b>	<b>5480</b>
<b>Graduate Diploma in Ergonomics**</b>	<b>5485</b>
<b>Graduate Diploma in Surveying</b>	<b>5490</b>

\*The Graduate Diplomas in Remote Sensing and Waste Management are offered in both the Faculty of Engineering and the Faculty of Applied Science. Entry into either Faculty depends upon the background of the applicant and the orientation of the proposed program.

\*\*The Graduate Diplomas in Ergonomics and Safety Science are interdisciplinary, structured courses for candidates from a wide range of backgrounds.

Further details of the recommended programs of study may be obtained from the course authorities concerned.

Subjects available in the Faculty of Engineering are listed at the end of this section. However, not all electives are offered in any particular year. Subjects available by tape correspondence as well as all subject descriptions, appear later in this handbook.

## Graduate Subjects

The subjects which may be available for a candidate proceeding to the award of the degree of Master of Engineering Science, Master of Safety Science, Master of Surveying Science, Master of Biomedical Engineering and Graduate Diploma are listed below. Not all electives are necessarily offered in any particular year.

Under the credit system in operation in the Faculty, one credit is normally equal to one hour's attendance per week for one session. The qualification 'normally' is required because of the varying ways in which credits are distributed for course work, design, critical review or research in the different schools.

Many graduate subjects assume that students have prior, or preliminary, knowledge of the area of study. It is the responsibility of students to acquaint themselves with this level of assumed prior knowledge and take steps, if necessary, to obtain it. This may, for example, involve a course of preparatory reading before commencing the subject.

In some cases the assumed level of knowledge for a specific subject is indicated in this Handbook by the statement of assumed knowledge. This is intended as a guide to the assumed prior knowledge and often uses the description of other subjects in the Handbook (graduate and undergraduate) to indicate the content and level which the lecturer will assume. Students who are in doubt as to the adequacy of their preparation should contact the lecturer concerned and discuss the matter. The lecturer in charge of a subject has the authority to decide whether or not the student has the appropriate level of assumed knowledge.

### Safety Science

	Credits
47.030G	3
47.051G	3
47.052G	3
47.054G	3
47.060G	3
47.061G	3
47.062G	3
47.070G	3
47.090G	3
47.180G	3
47.120G	3
47.230G	3
47.330G	3
47.480G	3
47.481G	3
47.903G	3
47.909G	9
47.918G	18

## Civil Engineering

### Department of Transport Engineering

	Credits
8.401G	3
8.402G	6
8.403G	3
8.404G	3
8.405G	3
8.406G	3
8.407G	3
8.408G	3
8.409G	3
8.410G	3
8.411G	3
8.412G	3
8.413G	3
8.414G	3
8.415G	3
8.416G	6
8.417G	6
8.418G	3
8.419G	3
8.420G	3

### Department of Engineering Construction and Management

	Credits
8.701G	3
8.702G	3
8.703G	3
8.704G	3
8.705G	3
8.706G	3
8.707G	3
8.710G	3
8.714G	3
8.723G	3
8.724G	3
8.725G	3
8.726G	3
8.727G	6
8.728G	6
8.731G	3
8.732G	3

### Department of Geotechnical Engineering

8.753G	3
8.776G	3
8.777G	3
8.781G	3
8.782G	3

## Engineering

			Credits
8.783G	Pavement Materials	3	
8.784G	Pavement Design	3	
8.785G	Pavement Evaluation and Maintenance	3	
8.786G	Industrial and Heavy Duty Pavements	3	
8.788G	Site Investigations	3	
8.790G	Stability of Slopes	3	
8.791G	Foundation Engineering 1	3	
8.792G	Foundation Engineering 2	3	
8.793G	Geomechanics	3	
8.858G	Water Quality Management**		3
8.860G	Investigation of Groundwater Resources 1		3
8.861G	Investigation of Groundwater Resources 2		3
8.862G	Fluvial Hydraulics		3
8.863G	Estuarine Hydraulics		3
8.864G	Arid Zone Hydrology		3
8.865G	Arid Zone Waters Resources Management		3
8.868G	Public Health Science		3
8.869G	Instrumentation and Control in Water Supply and Wastewater Engineering		3
8.870G	Hydraulics and Design of Water and Wastewater Treatment Plants		3
8.871G	Water Supply and Sanitation in Developing Countries		3
8.872G	Management of Wastes		3
8.873G	Waste and Wastewater Analysis and Environmental Requirements		3
8.874G	Waste Management Science		3
8.875G	Hydrological Processes		3
8.876G	Applied Hydrological Modelling		3
8.877G	Flood Design 1		3
8.878G	Flood Design 2		3
8.879G	Flood Design 3		3
8.880G	Groundwater Modelling		3

### Department of Structural Engineering

8.802G	Elastic Stability 1	3
8.803G	Elastic Stability 2	3
8.804G	Vibration of Structures 1	3
8.805G	Vibration of Structures 2	3
8.806G	Prestressed Concrete 1	3
8.807G	Prestressed Concrete 2	3
8.808G	Prestressed Concrete 3	3
8.809G	Reinforced Concrete 1	3
8.810G	Reinforced Concrete 2	3
8.811G	Reinforced Concrete 3	3
8.812G	Plastic Analysis and Design of Steel Structures 1	3
8.813G	Plastic Analysis and Design of Steel Structures 2	3
8.814G	Analysis of Plates and Shells	3
8.817G	Experimental Structural Analysis 1	3
8.818G	Bridge Design 1	3
8.819G	Bridge Design 2	3
8.820G	Structural Analysis and Finite Elements 1 (SAFE 1)	3
8.821G	Structural Analysis and Finite Elements 2 (SAFE 2)	3
8.822G	Structural Analysis and Finite Elements 3 (SAFE 3)	3

### Other Subjects

8.901G	Civil Engineering Elective 1	3
8.902G	Civil Engineering Elective 2	3
8.909G	Project	9
8.918G	Project Report	18
8.936G	Thesis*	36

\*A 36 credit Thesis is not normally approved in the school. The normal program includes a 9 credit Project.

\*\*Students specializing in Public Health Engineering normally study 42.211G Principles of Biology and 42.214G Biotechnology in the School of Biotechnology.

### Department of Water Engineering

8.830G	Hydromechanics	3
8.831G	Closed Conduit Flow	3
8.832G	Pipe Networks and Transients	3
8.833G	Free Surface Flow	3
8.835G	Coastal Engineering 1	3
8.836G	Coastal Engineering 2	3
8.842G	Groundwater Hydrology	3
8.843G	Groundwater Hydraulics	3
8.847G	Water Resources Policy	3
8.848G	Water Resources System Design	3
8.849G	Irrigation	3
8.850G	Drainage of Agricultural Lands	3
8.851G	Unit Operations in Public Health Engineering	3
8.852G	Water Distribution and Sewage Collection	3
8.855G	Water and Wastewater Analysis and Quality Requirements	3
8.856G	Water Treatment**	3
8.857G	Sewage Treatment and Disposal**	3

### Electrical Engineering and Computer Science

### Department of Communications

	Credits	
6.050G	Occasional Elective	3
6.070G	Digital Image Processing Systems	3
6.150G	Theory of Optical Fibres and Optical Signal Processing	3
6.164G	Antenna Design and Applications	3
6.167G	Propagation and Transmission of Electromagnetic Waves	3
6.169G	Microwave Circuits: Theory and Techniques	3
6.170G	Microwave and Optical Devices	3
6.336G	Digital Communication Networks 1	3
6.337G	Digital Communication Networks 2	3
6.338G	Television Systems	3

	Credits
6.340G Communication Electronics	3
6.341G Signal Processing 1—Fundamental Methods	3
6.342G Signal Processing 2—Advanced Techniques	3
6.343G Digital and Analogue Communications	3
6.347G Digital Modulation	3
6.348G Optical Communication Systems	3

**Department of Electric Power Engineering**

6.205G Power System Planning and Economics	3
6.206G Power System Operation, Control and Protection	3
6.221G High Voltage Technology	3
6.224G Partial Discharges in Electrical Insulation	3
6.227G Insulation Performance in Electrical Plant	3
6.228G Power System Equipment	3
6.229G Fields and Materials	3
6.242G Power Systems Analysis	3
6.250G Power Elective 1	3
6.251G Power Elective 2	3

**Department of Electronics**

6.550G Solid State Electronics Elective	3
6.573G Advanced Semiconductor Devices	3
6.575G Integrated Circuit Technology	3
6.577G Integrated Circuit Design	3
6.578G Solar Energy Conversion	3
6.579G Solar Cells — Operating Principles, Technology and System Applications	3

**Department of Systems and Control**

6.401G Computer Control Systems 1	3
6.403G Computer Control Systems 2	3
6.404G Real Time Computing and Control	3
6.405G Topics in Digital Control	3
6.433G Design of Advanced Microprocessor Systems	3
6.457G Cybernetic Engineering	3
6.468G Computer Display Systems and Interactive Instrumentation	3
6.469G Robot Vision	3
6.470G Robotics, Automation and Productivity Technology	3
6.484G Biological Signal Analysis	3

**Department of Computer Science**

6.650G Computer Science Elective — VLSI System Architecture and Design	3
6.654G Digital Systems	3
6.655G Computer Organization and Architecture	3
6.666G Artificial Intelligence	3
6.667G Programming Languages: Fundamental Concepts	3
6.668G Computer Graphics	3
6.669G Formal Specification	3
6.670G Parallel and Distributed Computing Systems	3

**Other subjects**

10.061G Advanced Mathematics 1 for Electrical Engineers	3
10.361G Statistics	3

**Project or Thesis**

6.918G Project Report (not normally approved for part-time students)	18
6.936G Thesis (not normally approved for part-time students)	36

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**Mechanical and Industrial Engineering**

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	Credits
5.045-6-7G Advanced Topics in Mechanical Engineering	2,2,2
5.048G Advanced Topic in Mechanical Engineering	3
5.049G Advanced Topic in Mechanical Engineering	3
5.073G Ordinary Differential Equations in Mechanical Engineering	3
5.086G Digital Logic Fundamentals for Mechanical Engineers	3
5.087G Microprocessor Fundamentals for Mechanical Engineers†	3
5.088G Industrial Applications of Microprocessors	3
5.089G Elements of Industrial Automation‡	3
5.090G The Analysis and Use of Integrated CAD/ CAM Systems	3
5.151-2G Refrigeration and Air Conditioning Design 1, 2*	3,3
5.230-1G Radioactivity 1, 2	3,3
5.232G Neutronics	3
5.233G Nuclear Safety	3
5.234G Nuclear Power Assessment	3
5.317G Industrial Robotics	3
5.318-9G Advanced Mechanism Analysis and Synthesis 1, 2	3,3
5.320G Artificially Intelligent Machines	3
5.328-9G Control and Modelling of Mechanical Systems 1‡, 2	3,3
5.336G Random Vibrations	2
5.338G Mechanical Vibration Analysis	3
5.403G Experimental Stress Analysis	3
5.414G Finite Element Applications	3
5.415-6G Stress Analysis for Mechanical Engineering Design 1, 2	3,3
5.417G Mechanics of Fracture and Fatigue	3
5.601G Computational Fluid Dynamics	3
5.602G Numerical Fluid Dynamics and Heat Transfer	3
5.616-7G Internal Combustion Engines 1, 2	3,3
5.621-2G Gasdynamics 1, 2	2,2
5.631-2G Lubrication Theory and Design 1, 2	2,2
5.653-4G Acoustic Noise 1, 2	2,2
5.655G Energy Conservation and System Design	3
5.715G Two Phase Flow and Heat Transfer*	4
5.722G Solar Thermal Energy Design	3
5.731G Analysis of Heat Transfer*	4
5.732G Power Plant Engineering	3

# Engineering

		Credits			Credits
5.753G	Ambient Energy Air Conditioning	2	18.875G	Geometric Programming	2
5.755-6G	Refrigeration and Air Conditioning 1, 2*	3,3	18.876G	Advanced Mathematics for Operations Research	2
5.757G	Refrigeration and Air Conditioning Applications	3	18.879G	Mathematical Programming Analysis	3
5.759G	Refrigeration and Air Conditioning Experimentation	3	18.965G	Industrial Management Seminar	0
5.909G	Project	9	18.967G	Advanced Topic in Production Engineering	2
5.912-3G	Naval Hydrodynamics 1, 2	2,2	18.968G	Advanced Topic in Production Engineering	2
5.918G	Project Report	18	18.969G	Advanced Topic in Production Engineering	2
5.936G	Thesis§	36	18.970G	Operations Research Seminar	0

\*Candidates wishing to specialize in Refrigeration and Air Conditioning should select this subject.

†Candidates wishing to specialize in Industrial Automation should select this subject.

§A 36 credit thesis is not normally approved in the School of Mechanical and Industrial Engineering.

## Department of Industrial Engineering

18.061G	Industrial Experimentation 1	3
18.062G	Industrial Experimentation 2	3
18.074G	Industrial Management	3
18.076G	Decision Support Systems	3
18.171G	Inspection and Quality Control	3
18.260G	Computer Aided Programming for Numerical Control	3
18.261G	Computer Automation	3
18.360G	Ergonomics	3
18.371G	Factory Design and Layout	3
18.380G	Methods Engineering	4
18.461G	Design for Production	4
18.464G	Value Analysis/Engineering	3
18.465G	Computer-Aided Manufacturing	3
18.571G	Operations Research 1	6
18.574G	Management Simulation	3
18.579G	Case Studies in Operations Research	3
18.671G	Decision Theory	2
18.672G	Decision Theory for Industrial Management	3
18.673G	Energy Modelling, Optimization and Energy Accounting	3
18.675G	Economic Decisions in Industrial Management	3
18.760G	Discrete Event Simulation Languages	3
18.761G	Simulation in Operations Research	3
18.763G	Variational Methods in Operations Research	3
18.764G	Management of Distribution Systems	2
18.765G	Optimization of Networks	2
18.770G	Stochastic Control	2
18.772G	Information Processing Systems in Organizations	2
18.774G	Applied Stochastic Processes	2
18.775G	Networks and Graphs	2
18.776G	Production and Inventory Control	2
18.777G	Time Series and Forecasting	2
18.778G	Scheduling and Sequencing	2
18.779G	Game Theory	2
18.862G	Linear Programming	2
18.863G	Non-Linear Programming	2
18.868G	Industrial Applications of Mathematical Programming	3
18.870G	Large Scale Optimization in Industry	3
18.871G	Mathematics for Operations Research	2
18.874G	Dynamic Programming	2

## Centre for Manufacturing and Automation

97.601G	Computer Aided Design for Manufacture	3
97.602G	Computer Integrated Manufacturing	3
97.603G	Product Design and Technological Innovation	3
97.604G	Flexible Manufacturing Systems	3
97.605G	CAD for Manufacture 2	3

Note 1: Candidates taking their Projects in Industrial Management are generally required to take 18.074G and 18.965G plus at least 11 credits from 18.380G, 18.571G, 18.675G, 18.776G and 14.062G Accounting for Engineers. Before enrolling in the Projects they must have had one year's relevant industrial experience and have access to industry for their project topics.

Note 2: Candidates taking their projects in Operations Research are generally required to take the 18.571G, 18.574G, 18.970G and 14.062G Accounting for Engineers.

Note 3: All Master of Engineering Science candidates in the Department of Industrial Engineering must include 18.909G or 18.918G in their programs.

†A 36 credit Thesis is not normally approved in the School of Mechanical and Industrial Engineering.

## Surveying

29.101G	Aspects of Electromagnetic Distance Measurement	3
29.102G	Characteristics of Optical Surveying Instrumentation	3
29.103G	Precise Engineering Surveys	3
29.106G	Special Topic in Surveying A	3
29.107G	Special Topic in Surveying B	3
29.151G	Adjustment of Control Surveys	3
29.210G	Satellite Surveying	3
29.211G	Introduction to Geology	3
29.213G	Physical Meteorology	3
29.217G	Gravimetric Geoid Evaluations	3
29.530G	Analytical Photogrammetry	3
29.532G	Computer Assisted Mapping	3

	Credits
29.600G Principles of Remote Sensing	3
29.602G Remote Sensing Procedures	3
29.603G Statutory Control of Land Development	3
29.604G Land Information Systems	3
29.605G Ground Investigations for Remote Sensing	3
29.608G Cadastral Systems	3
29.909G Project	9
29.918G Project Report	18
29.936G Thesis	36

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### Centre for Biomedical Engineering

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	Credits
32.009G Project	9
32.010G Biomedical Engineering Practice	2
32.012G Biomedical Statistics	4
32.018G Project Report	18
32.025G Radiation Physics	4
32.030G Project Report	30
32.040G Analogue Electronics for Biomedical Engineers	4
32.050G Microprocessors and Circuit Design for Biomedical Engineers†	4
32.060G Biomedical Systems Analysis	4
32.101G Mathematical Modelling for Biomedical Engineers	4
32.311G Mass Transfer in Medicine	4
32.321G Physiological Fluid Mechanics	4
32.332G Biocompatibility	3
32.501G Computing for Biomedical Engineers	4
32.541G Mechanics of the Human Body‡	3
32.551G Biomechanics of Physical Rehabilitation‡	3
32.561G Mechanical Properties of Biomaterials‡	3
32.601G Biomedical Applications of Microprocessors 1**	3
32.602G Biomedical Applications of Microprocessors 2†††	3
32.603G Static and Flow Cytometry	3
32.611G Medical Instrumentation*	3
32.621G Biological Signal Analysis	3
32.701G Dynamics of the Cardiovascular System	3
72.402G Principles of Disease Processes††	3

†Prerequisite 32.501G and 32.040G or equivalents.

‡These 3 electives vary according to session offered. Only one is offered each year.

\*Prerequisite 32.040G or equivalent.

††For non-medical graduates only. Prerequisite 73.111 or equivalent; pre- or co-requisite 70.011C.

\*\*Prerequisite 32.050G or equivalent.

†††Follows on from 32.601G.

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### Graduate Diploma Subjects

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Graduate Diploma programs in all schools of the Faculty may include subjects from the above list, subject to the approval of the Head of School responsible for the subject.

In addition the following subjects are offered specially for Graduate Diploma candidates. Not all electives are necessarily offered in any particular year.

### School of Electrical Engineering and Computer Science

	Credits
6.060G Microprocessor Systems	3
6.481G Introductory Physiology for Engineers	3
6.659G Data Bases and Networks	3
6.660G Design and Analysis of Algorithms	3
6.661G Business Information Systems	3
6.663G Operating Systems	3
6.664G Compiling Techniques and Programming Languages	3

### School of Mechanical and Industrial Engineering

5.086G Digital Logic Fundamentals for Mechanical Engineers	3
18.380G Methods Engineering	4
18.580G Operations Research	6
18.681G Engineering Economic Analysis	3
18.780G Production Control	2
14.001 Introduction to Accounting A	3
14.002 Introduction to Accounting B	3
14.042G Industrial Law	2
14.062G Accounting for Engineers	3

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### Project Reports and Theses

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Supervision of project reports and theses will generally be available in the following areas of research interest in the Schools of the Faculty. Alternatively, design and other topics may be chosen by arrangement.

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### Civil Engineering

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#### Engineering Construction and Management

Construction techniques. Equipment selection. Field studies of spatial layout, material flow, and construction operations.

## Engineering

Micro, macro, and system structure of construction operations.  
Civil engineering management.  
Critical path methods, and operations research methods in engineering construction.  
Information flow requirements and decision processes of office and field agents.

### Geotechnical Engineering

Shear strength of jointed rock, soft rock and clay soils.  
Expansive soils.  
Mine tailings and power station ash disposal.  
Uncertainty in geotechnical engineering.  
Landsliding—groundwater response to rainfall, progressive failure, probability of failure.  
Influence of soil fabric and mineralogy on properties.  
Grouting with cement and chemicals.  
Predicting excavability of rock.

### Numerical Methods in Geomechanics

Finite element techniques and their applications in geotechnical engineering including static and dynamic loading.  
Theoretical and numerical studies of rock blasting  
Numerical techniques in static and dynamic fracture mechanics.  
Application of artificial intelligence and fuzzy-sets in geotechnical engineering.

### Pavement Engineering

Skid resistance.  
Pavement management and rehabilitation.  
Interlocking concrete block pavements.  
Accelerated trafficking studies of pavements and pavement materials.  
Constitutive relationships of soils and pavement materials.  
Pavement designs and analysis.

### Civil Engineering Materials

Specification and quality control of concrete.  
Investigation of alternative cementitious materials.  
Examination of pozzolanic potential of indigenous materials.  
Utilisation of industrial waste materials in concrete.  
Chemistry and mineralogy of cement and lime stabilisation.

### Groundwater

Water movement in unsaturated soils.  
Pollutant movement in soils.  
Salinity studies.  
Groundwater studies and modelling.  
Well hydraulics.

### Hydrology

Flood estimation.  
Yield and reservoir studies.  
Hydrological instrumentation, data collection, and processing.  
Mathematical rainfall-runoff models.

Stochastic hydrology.  
Hydrological processes.  
Hydrometeorology.  
Urban drainage.  
Arid Lands Hydrology.

### Hydraulics

Two-fluid systems with small density differences.  
Sediment motion.  
Air entrainment in water in open channels and close conduits.  
Wave action and coastal engineering.  
Flow through porous media.  
Hydraulic transportation of solids.  
Coastal engineering and breakwater stability.  
Closed conduit flow.

### Prestressed Concrete Structures

Partially prestressed concrete beams.  
Analysis and design of end blocks for post-tensioned beams.

### Public Health Engineering

Sewage sludge conditioning and filtration.  
Clarifiers and sedimentation in water and waste water treatment.  
Filtration.  
Fluidized bed aerobic and anaerobic treatment.  
Aerobic digestion.  
Nutrient control.  
Treatment of high strength waste waters.  
Chemical fixation of hazardous wastes.

### Reinforced Concrete Structures

Torsion, bending and shear in reinforced concrete and prestressed concrete beams.  
Creep and shrinkage effects in reinforced concrete structures.  
Shear and torsion in reinforced concrete flat slab floors.  
Composite steel-concrete and concrete-concrete construction.

### Structural Analysis

Development of computer methods for the analysis of multi-storey flat plate structures.  
Development and application of finite element techniques.  
Investigation of elastic stability.  
Analysis of dynamic response of off-shore structures and buildings.

### Transport Engineering

Problems of land use and transport interaction.  
Theories of traffic structure and flow.  
Measurements, planning and control of traffic.  
Transport systems analysis.  
Transport and the environment — accidents, energy, intrusion, noise and pollution.  
Investigation of human factors.  
Economic evaluation of transport investments.  
Transport planning — local, urban, and regional systems.

Investigations into transport economics, policy and decision-making.  
 Investigations of the geometric shape of the road alignment on the driver's view of the road.  
 Study of road alignment design in three dimensions.

### **Water Resources Engineering**

Multi-objective water resources planning.  
 Hydro-economic studies.  
 Optimization problems in water resource systems design.  
 Drought studies.  
 Flood plain management.  
 Arid lands management.

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## **Electrical Engineering and Computer Science**

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### **Communications**

Optical communications.  
 Optical fibres and integrated optics.  
 Electro-optic devices such as sensors.  
 Digital communications.  
 Digital radio and modulation methods.  
 Computer communications and local area networks.  
 New architectures for local area networks.  
 Switching and stored program control systems.  
 UHF and microwave circuits and devices.  
 Microwave measurements.  
 Antennas and phased arrays.  
 Radar and navigational aids.  
 Signal processing and analysis.  
 Active and adaptive filtering.  
 Digital filters.  
 Digital signal processor chip applications.  
 Acoustic and seismic signal processing.  
 Speech recognition and synthesis.  
 Real-time speech to text conversion.  
 Communications aids for the handicapped.  
 Digital image processing.  
 Electronic music.  
 Man-machine interaction.

### **Computer Science**

Computer organization.  
 Computer graphics.  
 Artificial intelligence.  
 Expert systems  
 Operating systems.  
 Languages.  
 Scheduling.  
 Network projects.  
 Data base machine projects.  
 Computer aided design.  
 Computer aided instruction projects (CAI)  
 Fault tolerant computer systems.

Office automation and electronic publishing.  
 Computer aids for dyslexic children.  
 Digital systems description languages.  
 Integrated circuit and logic testing.  
 VLSI systems.

### **Electric Power**

Power systems analysis and planning.  
 The stability, dynamics and control of electric power systems.  
 Power system protection.  
 Static VAR compensation.  
 Design and optimal operation of distribution systems.  
 Transformer design.  
 Electrical measurements and data acquisition.  
 Application of insulating material.  
 High voltage and high current phenomena.  
 Arcing fault characteristics.  
 Electrical machines and drives.  
 Electrical equipment for hazardous atmospheres.  
 Gaseous discharges and insulation.  
 Partial discharge detection and location.  
 Superconductivity.  
 Electromagnetic transient analysis.  
 Harmonic analysis.  
 Wind power generation and integration.  
 Load management and control.  
 Production costing and pricing in power systems.  
 Computer aided teaching systems.  
 Power electronics.  
 Remote area supply.

### **Electronics**

Semiconductor device physics.  
 Integrated circuit design.  
 Integrated circuit technology.  
 Surface elastic wave devices.  
 Microelectronic sensors.  
 Photovoltaic solar energy conversion.  
 Computer-aided IC design.  
 Dry etching.  
 Remote sensing.  
 Integrated circuits for advanced signal processing

### **Systems and Control**

Boiler-turbine modelling, control and simulation.  
 Digital systems and digital signal processing.  
 Computer aided design of control systems.  
 Microprocessor technology in control systems and information displays.  
 Biomedical engineering: gait analysis, compartmental modelling, physiological systems modelling.  
 Medical applications of microprocessors.  
 Biological signal analysis.  
 Cybernetic engineering and advanced robotics: pattern, image and scene analysis, learning machines, vision and assembly.  
 Large text systems design.  
 Query language development.  
 Industrial applications of control and simulation.  
 Adaptive control.

## Engineering

Digital control.  
Multivariable control.  
Control applications of expert systems.  
Identification and systems modelling.

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## Mechanical and Industrial Engineering

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### Applied Mechanics

Biomechanics.  
Mechanics of solids. Stress analysis.  
Impact mechanics.  
Adaptive control systems.  
Process stimulation and control.  
Spatial and planar mechanisms.  
Dynamics of machines.  
Rotor bearing dynamics.  
Multi-mode vibrations.  
Lubrication and wear.  
Hydrodynamic dampers.  
Computer aided design.  
Industrial automation.  
Mechanical harvesting of fruit and vegetables.  
Mechanical handling, grading and processing of agricultural produce.  
Development of shearing equipment.  
Metering and placement of seed and fertilizer.

### Fluid Mechanics/Thermodynamics — including Aeronautical Engineering, Naval Architecture and Nuclear Engineering

Two-phase flow with and without heat transfer. Slurries.  
Conveying of solid dusts by gases.  
Hydraulic transients.  
Hydrodynamics, water hammer. Fluidics.  
Conduction, convection, and radiation. Natural convection.  
Computational fluid dynamics and heat transfer.  
Refrigeration and air conditioning.  
Energy conversion and conservation.  
Solar energy and systems.  
Engine performance and emissions.  
Gas dynamics. Transonic flow. Shock waves.  
Jets, turbulent mixing. Noise. Hot wire and optical measuring methods.  
Large scale structures.  
Light aircraft design and performance.  
Development of a ship structure optimization system.  
Analysis and design of plated grillages.  
Vortex shedding in aeronautical and maritime engineering.  
Economic studies relative to ship industry.  
Hydrodynamics of planing surfaces.  
Problems in wave resistance.  
Finite element methods.  
Neutron transport and diffusion theory.  
Thermal and thermo-mechanical analysis of reactor components.  
Nuclear reactor noise theory and analysis.  
Nuclear fuel cycles  
Reactor channel hydrodynamics.

Numerical methods for reactor analysis and simulation.  
Nuclear power planning and reactor strategy.  
Risk assessment.  
Radiation processing.

### Industrial Engineering — comprising Operations Research and Production Engineering

Engineering economic analysis.  
Efficiency of production lines.  
Optimum shearing policies for rolled bars.  
Application of probability theory in the allocation of engineering tolerance.  
Computer generation of timetables.  
Job shop scheduling.  
Least-cost tolerance.  
Optimum reject allowance.  
Operational simulation.  
Variety reduction.  
Probabilistic networks.  
Optimization techniques relevant to information processing systems.  
Statistical decision theory.  
Production scheduling for variable demand.  
Inventory and production control.  
Optimum control.  
Mathematical programming.  
Dynamic programming.  
Geometric programming.  
Integer programming.  
Large scale optimization.  
Applications of operations research to real-world problems.  
Stochastic processes.  
Applications of optimization techniques.  
Experimental and theoretical investigations of the following process: machining, extrusion, indentation, compression, rolling, drawing.  
Performance of single and multipoint cutting tools including tool life and economics of machining.  
Properties of materials at high rates of strain.  
Materials handling studies.  
Factory design and location studies.  
Plant layout by computer.  
Ergonomics.  
Occupational safety and health.  
Production design studies.  
Engineering design analysis and tolerance technology.  
Metrology studies.  
Group technology studies.

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## Surveying

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### Geodesy and Satellite Positioning

Positioning with GPS.  
Geoid and gravimetric studies.  
Satellite geodesy and precise orbit determinations.

Geodynamics: crustal motion studies using satellite laser ranging and very long baseline interferometry data and GPS.  
Adjustment of continental control networks.  
Ionospheric and tropospheric effects in GPS measurements.

### **Photogrammetry.**

Design of analytical plotter software.  
Aerotriangulation, computer applications, block adjustment, independent model triangulation.  
Digital terrain models.  
Photogrammetry with digital images.  
Location of features on digital images.  
Geometry of image sensors, remote-sensing imaging devices.  
Mapping applications of remotely sensed data.  
Non-topographic applications.

### **Land Information Systems (LIS)**

LIS pertaining to Local Government needs.  
Role of Local Government in a state-wide LIS.  
Incorporation of remote sensing into LIS.  
Data acquisition and upgrading in LIS.  
LIS networks.  
LIS in developing countries.  
Land tenure, land registration and cadastral surveying systems.

### **Surveying**

Precise navigation with GPS.  
GPS surveying.  
Testing and calibration of GPS instruments.  
Application of GPS to engineering projects.  
Analysis of deformation measurements.  
High precision electronic distance measurement.  
Applications of inertial technology.  
Precision surveys in industry.  
Monitoring of structures and terrains.  
Metrology.  
Design of networks in engineering.

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### **Biomedical Engineering**

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Modelling of respiratory function, cardiovascular function, nervous system, artificial kidney therapy, extracorporeal heart-lung support, endocrine system and other body systems.  
Development of biomaterials.  
Investigation of physiological fluid mechanics.  
Microprocessor control of medical equipment.  
Limb and joint dynamics studies.  
Development of implantable electrodes.  
Development of rehabilitation devices.  
Statistical analysis of patient therapy and modes of patient treatment.  
Development and evaluation of new hospital equipment and treatment procedures.

Signal analysis of wave forms from medical diagnostic equipment.  
Implants for fracture support and joint replacement.  
Improved drug administration.  
Arterial haemodynamics and ventricular-vascular interaction.  
Mechanisms of age-related arterial degeneration and hypertension.  
Isolated heart studies of the coronary circulation and electrophysiology.

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### **Remote Sensing**

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Incorporation of auxiliary data into classification procedures.  
Application of satellite data to Urban Area studies.  
Monitoring land use change using remotely sensed data.  
Determining the characteristics of surface reflectance.  
Analysis of image quality.  
Application of satellite imagery to small scale mapping.  
Multispectral linear transformations.  
Application of spaceborne synthetic aperture radar data.  
Application of aircraft and satellite data to arid land studies.  
Application of satellite data to geological studies.  
Synergism of radar, visible and infrared remotely sensed data.  
Analysis of high resolution SPOT and Landsat TM data.

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### **Waste Management**

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Landfill site selection.  
Leachate testing.  
Chemical fixation.  
Domestic solid waste collection routing.  
Hydrogeological sampling.  
Acid waste treatment.  
Metals removal.  
Toxicity testing.  
Legal aspects of hazardous waste.

## Graduate Study

# Subject Descriptions

## Identification of Subjects by Number

A subject is defined by the Academic Board as 'a unit of instruction approved by the University as being a discrete part of the requirements for a course offered by the University'.

Each approved subject of the University is identifiable both by number and by name as this is a check against nomination of subject other than the one intended.

Subject numbers are allocated by the Academic Registrar and the system of allocation is based on the following guidelines:

1. The authority offering the subject, normally a School of the University, is indicated by the number before the decimal point.
2. Each subject number is unique and is not used for more than one subject title.
3. Subject numbers may not be re-used with a new subject title within ten years of previous use.
4. Graduate subjects are indicated by a suffix 'G' to a number with three digits after the decimal point. In other subjects three or four digits are used after the decimal point.

Subjects taught are listed in full in the handbook of the faculty or board of studies responsible for the particular course within which the subjects are taken. Subject descriptions are contained in the appropriate section in the handbooks.

The identifying numerical prefixes for each subject authority are set out on the following page.

**Servicing Subjects** are those taught by a school or department outside its own faculty. Their subject descriptions are published in the handbook of the faculty which originates the subject and are also published in the handbook of the Faculty in which the subject is taught.

The following pages contain descriptions for most of the subjects offered for the courses described in this book, the exception being the General Education subjects. For General Education subjects see the **General Education Handbook** which is available free of charge.

### HSC Exam Prerequisites

Subjects which require prerequisites for enrolment in terms of the HSC Examination percentile range, refer to the **1978 and subsequent Examinations**.

Candidates for enrolment who obtained the HSC in previous years or hold other high school matriculation should check with the appropriate school on what matriculation status is required for admission to a subject.

### Information Key

The following is the key to the information which may be supplied about each subject:

**S1** Session 1, **S2** Session 2

**F** Session 1 *plus* Session 2, ie full year

**S1 or S2** Session 1 or Session 2, ie choice of either session

**SS** single session, but which session taught is not known at time of publication

**CCH** class contact hours

**L** Lecture, followed by hours per week

**T** Laboratory/Tutorial, followed by hours per week

**hpw** hours per week

**C** Credit or Credit Units

**CR** Credit Level

**DN** Distinction

**W** weeks of session

School, Department etc	Faculty	Page	School, Department etc	Faculty	Page
*Subjects also offered for courses in this handbook			*Subjects also offered for courses in this handbook		
1 School of Physics	Science		44 School of Microbiology	Biological and Behavioural Sciences	
2 School of Chemistry*	Science		45 School of Biological Science	Biological and Behavioural Sciences	
3 School of Chemical and Industrial Engineering (New Course)	Applied Science		46 Faculty of Applied Science	Applied Science	
4 School of Materials Science and Engineering	Applied Science		<b>47 Centre for Safety Science</b>	<b>Engineering</b>	<b>93</b>
<b>5 School of Mechanical and Industrial Engineering</b>	<b>Engineering</b>		48 School of Chemical Engineering and Industrial Chemistry*	Applied Science	
<b>6 School of Electrical Engineering and Computer Science</b>	<b>Engineering</b>		49 School of Applied Bioscience	Applied Science	
7 School of Mines* (Mineral Processing and Extractive Metallurgy and Mining Engineering)	Applied Science		50 School of English	Arts	
<b>8 School of Civil Engineering</b>	<b>Engineering</b>		51 School of History	Arts	
9 School of Fibre Science and Technology (Wool and Animal Science)	Applied Science		52 School of Philosophy	Arts	
10 School of Mathematics*	Science		53 School of Sociology	Arts	
11 School of Architecture	Architecture		54 School of Political Science	Arts	
12 School of Psychology	Biological and Behavioural Sciences		55 School of Librarianship	Professional Studies	
13 School of Fibre Science and Technology (Textile Technology)	Applied Science		56 School of French	Arts	
14 School of Accounting*	Commerce and Economics		57 School of Theatre Studies	Arts	
15 School of Economics*	Commerce and Economics		58 School of Education	Professional Studies	
16 School of Health Administration*	Professional Studies		59 Department of Russian Studies	Arts	
17 Faculty of Biological and Behavioural Sciences	Biological and Behavioural Sciences		60 Faculty of Arts	Arts	
<b>18 School of Mechanical and Industrial Engineering (Industrial Engineering)</b>	<b>Engineering</b>		61 Department of Music	Arts	
19 School of Information Systems	Commerce and Economics		62 School of Science and Technology Studies	Arts	
20 Centre for Petroleum Engineering Studies	Applied Science		63 School of Social Work	Professional Studies	
21 Department of Industrial Arts	Architecture		64 School of German Studies	Arts	
<b>23 School of Nuclear Engineering</b>	<b>Engineering</b>		65 School of Spanish and Latin American Studies	Arts	
25 School of Mines* (Applied Geology)	Applied Science		66 Subjects Available from Other Universities		
26 Centre for Liberal and General Studies	Liberal and General Studies		67 Faculty of Science	Science	
27 School of Geography*	Applied Science		68 Board of Studies in Science and Mathematics	Board of Studies in Science and Mathematics	
28 School of Marketing*	Commerce and Economics		70 School of Anatomy*	Medicine	
<b>29 School of Surveying</b>	<b>Engineering</b>		71 School of Medicine	Medicine	
30 School of Industrial Relations and Organizational Behaviour*	Commerce and Economics		72 School of Pathology*	Medicine	
31 School of Optometry	Science		73 School of Physiology and Pharmacology*	Medicine	
<b>32 Centre for Biomedical Engineering</b>	<b>Engineering</b>	<b>97</b>	74 School of Surgery	Medicine	
34 Faculty of Arts	Arts		75 School of Obstetrics and Gynaecology	Medicine	
35 School of Building*	Architecture		76 School of Paediatrics	Medicine	
36 School of Town Planning	Architecture		77 School of Psychiatry	Medicine	
37 School of Landscape Architecture	Architecture		78 School of Medical Education	Medicine	
38 School of Applied Bioscience (Food Science and Technology)	Applied Science		79 School of Community Medicine	Medicine	
39 Graduate School of the Built Environment*	Architecture		80 Faculty of Medicine*	Medicine	
40 Academic Board			81 Medicine/Science/Biological Sciences	Medicine	
41 School of Biochemistry	Biological and Behavioural Sciences		85 Australian Graduate School of Management	AGSM	
42 School of Applied Bioscience (Biotechnology)*	Applied Science		90 Faculty of Law	Law	
			<b>97 Faculty of Engineering</b>	<b>Engineering</b>	
			98 School of Banking and Finance	Commerce and Economics	
			99 Department of Legal Studies and Taxation	Commerce and Economics	

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**Chemistry**


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**Graduate Study****2.251G Toxicology, Occupational and Public Health****F L1T3**

Important classes of toxic materials found in the environment; treatment of pesticide residues, industrial chemicals of various types, toxic gases, mould metabolites and bacterial toxins occurring in food, carcinogenic substances, toxic metals, etc. Effects of these substances on living organisms, particularly man. Practical work: pesticide residue analysis, blood and urine analysis, gas sampling and analysis, trace metal determination and experiments on the animal metabolism of toxic substances.

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**Mechanical and Industrial Engineering**


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**5.045G Advanced Topic in Mechanical Engineering****C2****5.046G Advanced Topic in Mechanical Engineering****C2****5.047G Advanced Topic in Mechanical Engineering****C2****5.048G Advanced Topic in Mechanical Engineering****C3****5.049G Advanced Topic in Mechanical Engineering****C3**

Subjects which may be offered by a Visiting Professor for graduate credit.

**5.073G Ordinary Differential Equations in Mechanical Engineering****C3**

Solutions and their meaning, integration constants, linearity; special methods of solution; integration factors; variation of parameters; Euler, higher order linear equations; physical origins of ordinary differential equations and linear systems; linearization of engineering problems; stability of engineering systems.

**5.086G Digital Logic Fundamentals for Mechanical Engineers****C3**

*Excluded: 6.021E, 6.631 and equivalent.*

Discrete logic elements; assembly design; misoriented design; support devices; microprocessor units.

**5.087G Microprocessor Fundamentals for Mechanical Engineers****C3**

*Prerequisite: 5.086G or equivalent. Excluded: 6.0318, 6.432, 6.613, 6.060G, 6.433G, 6.651G and equivalent.*

Microprocessor chips; system design; memory; past design; programming; applications.

**5.088G Industrial Applications of Microprocessors****C3**

*Prerequisite: 5.087G or equivalent. Excluded: 6.432, 6.433G, 6.651G and equivalent.*

Coding and programming. Transducer selection. Information transfer. Data storage. Power output device control. Application to industrial automation and control. Laboratory complement to lectures.

**5.089G Elements of Industrial Automation****C3**

An introductory overview of the elements of Industrial Automation systems and the factors governing their use in industry.

**5.090G The Analysis and Use of Integrated CAD/CAM Systems****C3**

*Prerequisite: 5.089G.*

Economic background to the use of CAD/CAM systems. Elements in systems for use with machining centres, lathes and sheet metal machinery. Data input techniques. Coordinate handling. Machine specific post processors. Data verification and output integrity analysis. Techniques for interfacing machine tools with computers. Restrictions imposed by requirements for real time control. Integration with accounting and cost analysis systems. Choice of computer. Factors in CAD/CAM system selection.

**5.151G Refrigeration and Air Conditioning Design 1****C3**

*Assumed Knowledge: 5.715G, 5.755G, 5.756G or equivalent.*

**5.152G Refrigeration and Air Conditioning Design 2****C3**

*Prerequisite: 5.151G or equivalent.*

Design of refrigeration equipment compressors; throttling devices; condensers; evaporators. Cooling towers: evaporative condensers; air conditioning coils. Generators and absorbers for absorption systems. Piping systems. Air ducts. Steam raising and water heating equipment. Calculation of transient heating and cooling loads. Air conditioning systems. Load analysis and system capability.

**5.230G Radioactivity 1****C3**

Atomic structure, natural and man-made radionuclides. Radionuclide transformations and nuclear radiations, energy levels and decay schemes. Build-up and decay chain mathematics. Interaction of ionizing radiation with matter, range of charged particles and attenuation of gamma radiation. Detection and instrumentation, counting statistics. Applications of radiation and radioisotopes.

**5.231G Radioactivity 2****C3**

Biological effects of radiation and radiological protection, the ICRP and the ALARA concept. Gamma shielding, from point, line, cylindrical and distributed sources. Radiation dose estimation from external and internal sources. Atmosphere dispersion, and modes of transport of radionuclides in the biosphere and geosphere. Compartment model formulations and applications in radioecology and radiation dosimetry.

**5.232G Neutronics****C3**

Review of relevant nuclear and neutron physics. Neutron transport and the diffusion approximation. Slowing down, resonance absorption and thermalization in homogenous and heterogenous systems. Monte Carlo methods for neutron transport. Critical bare and reflected reactors in fewgroup and multigroup diffusion theories. Reactivity effects, burnup and breeding in nuclear reactors. Reactor kinetics, and response to local and global perturbations.

**5.233G Nuclear Safety****C3**

Radiological hazards of the nuclear fuel cycle, environmental impacts. Sources and characteristics of special nuclear materials. Safeguards, material accounting and statistical testing. Nuclear accidents, source terms and consequences. Safety assessment methodologies, probabilistic risk assessment, event and fault trees. Risk assessment case studies: fission, fusion, waste, etc. Inherently safe reactors. Comparative risks of energy production technologies.

**5.234G Nuclear Power Assessment****C3**

Nuclear energy resources and utilization, converters, breeders, fusion, accelerators, hybrids. Operational and safety characteristics of nuclear power plants. Cost components: capital, operating, fuel cycle. Licensing, regulation, finance, manpower and safety cost factors. Mathematical formulations for costing and optimization. Cost assessment case studies.

**5.317G Industrial Robotics****C3**

Applications survey. System structure, hardware, software, handling. Linkage kinematic structure; power transmission. Linkage structural design. Actuator choice. Interface hardware. Feedback. Function programming philosophies. Control algorithms. Problem specification; solution preparation. Writing, storage, implementation of computer algorithms.

**5.318G Advanced Mechanism Analysis and Synthesis 1****C3**

*Assumed knowledge: 5.301 or 5.3021 or 5.333 or equivalent. Excluded: 5.3040, 5.315G.*

Algebraic displacement, velocity and acceleration analyses of simple and complex planar mechanisms. Instantaneous kinematics: centrodes; inflection and Bresse circles; acceleration centre; Euler-Savary equation; cubic of stationary curvature; centring point curve. Coupler curves and their properties; curve cognates. Constraint and freedom; mobility; velocity closure of a loop; special configurations; singularities. Various methods of synthesis.

**5.319G Advanced Mechanism Analysis and Synthesis 2****C3**

*Excluded: 5.316G and equivalent.*

A selection of topics from *Planar mechanisms*: kinematic analysis of complex mechanisms; kinetic analysis; kinematic geometry; precision position synthesis. *Cams*: basic and common curves; equations of motion; development of profile; determination of system geometry and mechanical properties; noise, wear, backlash and manufacture. *Spatial linkages*: structural analysis; closure equations; screw system algebra; special configurations.

**5.320G Artificially Intelligent Machines****C3**

The principles of operation of machines into which limited powers of decision making have been delegated. The grouping of intelligent machines. Cognition; sensor technology; parsing; information representation; convolutions; software and hardware environments.

**5.328G Control and Modelling of Mechanical Systems 1****C3**

As for 5.329G.

**5.329G Control and Modelling of Mechanical Systems 2****C3**

*Prerequisite: 5.328G or equivalent.*

Development of modelling techniques using both digital and analogue computation, with special emphasis on the representation of non-linearities. Typical examples of mechanical systems.

**5.336G Random Vibrations****C2**

*Assumed knowledge: 5.331 or 5.333 or equivalent.*

Probability, vibration theory review, linear mechanical system response to random vibrations. Statistical characteristics: autocorrelation, spectral density, convolution, narrow band processing, consistency, applications.

**5.338G Mechanical Vibration Analysis****C3**

*Assumed knowledge: 5.303 and 5.423 or equivalent. Excluded: 5.334, 5.348, 5.335G and equivalent.*

Means of controlling inertia-induced vibration in machinery. Frequency response functions of damped and undamped systems;

laboratory classes. Eigenvalues and eigenvectors for multi-degree of freedom systems, including geared shaft systems. Beam and plate vibration via finite element analysis, with laboratory experiments to verify finite element results.

## 5.403G Experimental Stress Analysis C3

*Excluded: 5.401G.*

Strain gauging: practice, theory, instrumentation, data acquisition and processing, applications, load cell design. Photoelasticity: transmission and reflective. Brittle coatings. Dye penetrants. Practical laboratory classes throughout.

## 5.414G Finite Element Applications C3

*Excluded: 5.419, 5.823.*

Introduction to finite element and associated graphics packages. Principles of mesh design and validation. Specification of boundary conditions including use of symmetry. Estimation of the cost of solution. Interpretation of results. Assessment of the accuracy of the results. Convergence to the exact solution. Selection of applications from linear and non-linear elasticity: three dimensional solids, plates and shells, plasticity, buckling and post-buckling behaviour, thermal stresses, dynamics including natural and forced vibration.

## 5.415G Stress Analysis for Mechanical Engineering Design 1 C3

*Assumed knowledge: 5.423 or equivalent. Excluded: 5.434 and equivalent.*

Plates, shells: primary, secondary and peak stresses, relations to strength. Pressure vessels. Current design philosophies:

## 5.416G Stress Analysis for Mechanical Engineering Design 2 C3

*Assumed knowledge: 5.423 or equivalent.*

Topics selected from: Plastic collapse. Limit state design. Stress concentrations. Plate girder panel structures. Lightweight structures. Machine frames. High temperature components. Gears.

## 5.417G Mechanics of Fracture and Fatigue C3

*Excluded: 5.428G and 5.429G and equivalent, 5.424.*

Theories of fracture; failure modes. Ductile, brittle fracture. Mechanics of crack propagation, arrest. Measurement of static fracture properties. Fatigue crack initiation, propagation. Engineering aspects of fatigue.

## 5.601G Computational Fluid Dynamics C3

Incompressible flow: primitive equations; stream function, vorticity equations. The conservative property. Stability analysis. Explicit, implicit methods. Upwind differences. SOR methods. Fourier series methods. Pressure, temperature solutions. Solving the primitive equations.

## 5.602G Numerical Fluid Dynamics and Heat Transfer C3

*Assumed knowledge: 5.623, Excluded: 5.717G, 5.635*

Introduction: Review of the mechanisms of heat transfer. *Governing equations for convection:* continuity, Navier-Stokes, energy. Boundary layer equations for forced and natural convection. Boundary conditions. *Approximate analytical solution methods:* momentum and energy integral equations. Polhausen technique. Similarity formulation. Solution by conversion to initial value problem. *Finite difference methods:* finite difference approximations of partial differential equations. Consistency stability and convergence. Application to the boundary layer and full equations of motion and energy.

## 5.616G Internal Combustion Engines 1 C3

*Excluded: 5.643.*

Thermodynamic cycles. Combustion, reaction kinetics. Real engine cycles. Chart, computer analysis. Spark ignition engines. Flame physics. Combustion chamber design. Charging, discharging; heat transfer; friction. Emissions, fuels, computer modelling: efficiency, performance, emissions. Testing. Laboratory.

## 5.617G Internal Combustion Engines 2 C3

*Prerequisite: 5.615G or 5.616G or equivalent.*

Modifications, alternatives to SI engine: Stratified charge, rotary, orbital, turbo charged, two stroke. Compression ignition engine: combustion knock, chamber design, emissions. Gas turbines. Cycles, limitations, regeneration, combustion, emission. Axial, centrifugal compressors, turbines; matching. Aircraft, automotive, industrial types. Stirling engines: cycle analysis, design. Laboratory.

## 5.621G Gasdynamics 1 C2

*Excluded: 5.653, 5.811.*

One dimensional steady flow: isentropic channel flow, normal shock waves, supersonic wind tunnels and diffusers. Two dimensional steady flow: oblique shock waves, Prandtl-Meyer expansions, nozzles, airfoils. One dimensional unsteady flow: moving waves, reflections, explosions in ducts, shock tubes; method of characteristics, internal flows, piston and valve effects.

## 5.622G Gasdynamics 2 C2

*Prerequisite: 5.621G or equivalent.*

Kinematics, dynamics, thermodynamics, vorticity. Nozzle. Wind tunnel. Diffusers. Shock waves; steady, moving. Method of characteristics. Combustion. Real gas behaviour at high temperature. Hypersonic aerodynamics, free molecule flow, re-entry; high energy experimental methods.

## 5.631G Lubrication Theory and Design 1 C2

*Excluded: 5.6342.*

History of lubrication, types of bearing and bearing operation, nature of surfaces and their contact, modes of lubrication, prop-

erties of lubricants, viscous flow in pipes and channels, measurement of viscosity, infinitely long and short bearing approximations, one dimensional analysis of short bearing, other slider bearing geometries, the effect of end leakage, hydrostatic or externally pressurised bearings, squeeze films.

**5.632G Lubrication Theory and Design 2 C2**

*Prerequisite: 5.631G or equivalent.*

Continuum equations of hydrodynamic lubrication. Journal bearing dynamics. Rolling contacts. Elastohydrodynamic lubrication. Grease lubrication. Plasto-elastohydrodynamic lubrication. Metal forming, cutting lubrication.

**5.653G Acoustic Noise 1 C2**

*Excluded: 5.3541.*

Acoustic plane wave equation, standing waves, energy density, intensity, decibel scales. Human response, annoyance and damage criteria. Transmission between media, absorbing materials. Mufflers, Three dimensional wave equation. Transmission in ducts. Room acoustics.

**5.654G Acoustic Noise 2 C2**

*Prerequisite: 5.653G or equivalent. Excluded: 5.3542.*

Noise measurement, microphones, frequency analysis, transient and average measurement. Frequency weightings. Flow noise, noise from jets, fans, propellers. Noise of machines, modal response, damping.

**5.655G Energy Conservation and System Design C3**

Examination of some existing systems, assessment of their energy losses and their improvement by tuning. Alternative energy sources and their availability, energy utilization and efficiency in various systems. Environmental aspects, assessment of emissions, means of improvement. Economically viable energy technology under present conditions. Expected trends in energy technology in the short and long term. A number of case studies.

**5.700G Power Production Assessment C3**

*Assumed knowledge: 5.630 and 5.636 or equivalent.*

Components of hydro, coal and nuclear fuel power station designs. Economics of power production. Operation and maintenance of costs. Efficiency and heat balance calculations of thermal power stations. Comparison of electrical energy production costs of different power stations.

**5.715G Two Phase Flow and Heat Transfer C3**

*Assumed knowledge: 5.636 or equivalent. Excluded: 5.664.*

Nature of multiphase flow. Flow regime maps. Two-phase flow in vertical, horizontal and inclined pipes. Modelling of two-phase flow: homogenous model; drift flux model; drift velocity model; separated model. Annular and stratified flows. Flow in adiabatic pipes. Flow in heated pipes. The critical flow of a two-phase mixture. Pressure drop and heat transfer correlations in pipes.

Subcooled, nucleate, pool and film boiling. Forced convection surface boiling. Critical heat fluxes in boiling. Mechanisms of heat transfer in boiling. Nucleation, bubble dynamics and bubble parameters. Film and dropwise condensation on flat plates. Condensation on horizontal tubes and tube banks. Condensation inside tubes. Two-phase heat exchangers. Experimental techniques in two-phase flow.

**5.722G Solar Thermal Energy Design C3**

*Excluded: 5.644, 5.720G and equivalent.*

Characteristics of solar radiation and solar collectors. Collector efficiency evaluation and prediction of long term performance. System modelling, energy storage; computer simulation and modelling of performance and economic worth.

**5.731G Analysis of Heat Transfer C4**

*Assumed knowledge: 5.636 or equivalent. Excluded: 5.716G, 5.717G.*

Steady-state and transient heat conduction in one, two and three dimensions with application of analytical, numerical and analogical techniques. Conduction in solids with a heat source. Heat transfer in moving fluid media. Free and forced convection for internal and external flows. Differential and integral treatments of boundary layer problems. Laminar and turbulent boundary layers. Heat exchange between two fluids separated by a wall. Radiation properties of surfaces and gases. Analysis of radiation exchange between real and idealized surfaces. Interaction of radiation with conduction and convection. Heat transfer analysis of selected problems.

**5.732G Power Plant Engineering C3**

*Assumed knowledge: 5.620, and 5.626 or equivalent.*

Energy sources, power plant, thermodynamics. Fuel, combustion processes and equipment. Boilers, turbines, and condensers. Heat exchangers, pumps, water supply and treatment systems. Air circulating and heating systems. Station operation and performance. Economics of electrical power production. Environmental impacts of power plants. Alternate sources of energy.

**5.753G Ambient Energy Air Conditioning C2**

*Assumed knowledge: 5.636 or equivalent.*

Prediction of heat storage effects in air conditioned structures. Performance of passive and active ambient energy heating and cooling systems using correlations and simulation. Use of TRNSYS program package. Simple evaporative cooling. Open cooling cycles: single and double regenerative evaporative cooling and applications; nearly reversible evaporative cooling; adiabatic desiccant open cooling cycles.

**5.755G Refrigeration and Air Conditioning 1 C3**

Review of thermodynamic principles; evaluation of thermodynamic properties of real fluids. Refrigerants, their properties and applications. Gas cycle refrigeration. Steam-jet refrigeration. Vapour compression refrigeration; analysis and performance characteristics of the complete cycle; analysis and performance of multipressure systems. Analysis of the performance of compressors, condensers, evaporators and expansion devices. Thermo-electric refrigeration.

## 5.756G Refrigeration and Air Conditioning 2 C3

*Assumed knowledge: 5.755G or equivalent*

Psychrometrics; application to air conditioning design. Direct contact heat and mass transfer; application to the design of cooling towers and air washers. Cooling and dehumidifying coils. Properties of homogeneous binary solutions; steady flow processes with binary mixtures. Rectification of a binary mixture. Analysis of absorption systems. Production of low temperatures. Liquefaction and rectification of gases. Magnetic cooling.

## 5.757G Refrigeration and Air Conditioning Applications C3

Industrial, commercial and domestic applications of refrigeration and air conditioning. Refrigeration technology. The science and technology of foods. Building design and construction.

## 5.759G Refrigeration and Air Conditioning Experimentation C3

*Prerequisites: 5.755G, 5.756G. Co-requisites: 5.151G, 5.152G.*

Performance testing and system evaluation of multistage R22/brine system, R12 forced draft cooler system and dual duct air conditioning plant. Instrumentation, data acquisition and control of refrigeration plant. Use of calorimeter rooms for testing and rating of equipment. Transient performance characteristics of direct expansion coil and system, under different ambient conditions. Group project involving the designing, building, commissioning, instrumenting and testing of refrigeration and air conditioning equipment.

## 5.909G Project C9

## 5.912G Naval Hydrodynamics 1 C2

*Assumed knowledge: 5.630 or 10.411A or equivalent.*

As for 5.913G

## 5.913G Naval Hydrodynamics 2 C2

*Prerequisite: 5.912G or equivalent.*

Advanced treatment of topics selected from: ship waves and ship resistance; ship manoeuvrability; ship motion and seakeeping; hydrofoil and propeller theory; aero and hydrodynamics of surface effect machines.

## 5.918G Project Report C18

## 5.936G Thesis C36

## 6.050G Occasional Elective C3

This syllabus changes from one occasion to the next, allowing presentation of a modern topic at graduate level, particularly by visiting academics of eminence.

## 6.060G Microprocessor Systems S2 C3

*Assumed knowledge: 6.012D or 6.621 and 6.021E or 6.631. Excluded: 6.0318, 6.613, 5.087G, 5.088G.*

Basic computer architecture: fetching and executing instructions; Motorola 6809 registers and instructions; assemblers, addressing modes; bus waveforms; interfacing to a bus; parallel interfacing; the PIA; handshaking; interrupts; critical regions; buffered I/O; stack data frames; recursion; serial interfacing: the ACIA; direct memory access (DMA); dynamic memory; Microprocessor examples.

## 6.070G Digital Image Processing Systems C3

*Excluded: 6.467G.*

The fundamentals of digital image processing with topics selected from the following: Visual perception and the image model, transforms, enhancement, sharpening and smoothing, restoration, encoding, segmentation, reconstruction of images from projections and tomography, satellite imaging and imaging in remote sensing; image processing hardware and systems; picture processing; measurement and inspection.

## 6.150G Theory of Optical Fibres and Optical Signal Processing C3

Wave propagation in single mode and multimode optical fibres, gaussian approximation of fields in single mode fibre, spot size, equivalent step index of single mode fibre, material and waveguide dispersions, birefringent fibres. Ray theory in multimode fibre, intermodal dispersion, optimal profile, mode coupling, optical equalization. Measurement of fibre characteristics. Fundamentals of optical image formation. Spatial filtering. Optical sensors. Optical signal processing including holography and Radon transform.

## 6.164G Antenna Design and Applications C3

*Pre-requisite: 6.167G.*

Principles of phased arrays and reflector antennas with some emphasis on space-borne and ground-terminal antennas for satellite communications. Analysis and synthesis of phased array, null steering theory. Single and dual reflector antennas, offset-reflector systems, optimization techniques. Effects of satellite orbital saturation on design of ground terminal antennas. Monopulse tracking antennas. Antenna tolerance theory.

## 6.167G Propagation and Transmission of Electromagnetic Waves C3

Fundamental concepts and analytical techniques of guided wave propagation. Waveguide theory; coaxial lines, rectangular and circular waveguides and surface wave propagation. Poynting theorem, power flow, impedances. Wave attenuation: evanescent modes, conductor and dielectric losses. Phase and group velocities, dispersion. Numerical techniques; the finite differ-

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## Electrical Engineering and Computer Science

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ence method. Tropospheric and ionospheric propagation. Basic antenna theory. Aperture antennas. Phased Arrays.

**6.169G Microwave Circuits: Theory and Techniques C3**

A review of transmission line theory, the Smith Chart and matching networks. The measurement and use of scattering parameters. Passive component design for microstrip circuits. Noise properties of two-port networks. The characterization and use of microwave transistors and diodes. Microwave subsystems.

**6.170G Microwave and Optical Devices C3**

Principles and applications of microwave amplifying and control devices. Includes microwave transistors, Gunn and impact diodes and recent developments in ultra high speed transistors. Principles and applications of optical sources and detectors. Includes lasers, LEDs, electro-optic and acoustic-optic modulators and switches, optical detectors.

**6.205G Power System Planning and Economics C3**

Review of conventional planning techniques and their limitations. Introduction of a novel approach based on welfare maximisation. Examples of its application to coordinated supply and demand side planning in problems - such as demand forecasting, supply reliability, maintenance scheduling, transmission planning and demand management.

**6.206G Power System Operation, Control and Protection C3**

Control of system frequency: system frequency dynamics, load frequency control of interconnected systems, automatic generation control. Unit commitment and economic despatch. Control of system voltage and reactive power. Problems of power system operation: security of supply, load forecast, power flow control, fault level containment, stability. Protection of power system and transmission lines: main protection, back up protection, system protection under emergency. Protection in distribution systems.

**6.221G High Voltage Technology C3**

*Assumed knowledge: 6.202 or equivalent. Excluded: 6.222.*

Introduction to the technology involved in the design and testing of high voltage power system equipment. Study of the practical applications of relevant materials, with emphasis on properties of insulation systems (gases, liquids and solids) and the interaction of the materials in non-uniform fields. Methods of testing under steady state, AC and DC, and surge conditions are incorporated in the laboratory work. Design examples are taken from insulator, bushing, cable, power capacitor, transformer, rotating machine and switchgear technologies.

**6.224G Partial Discharges in Electrical Insulation C3**

*Assumed knowledge: 6.202 or 6.222 or equivalent.*

Aspects of partial discharge phenomena and their effect on

electrical insulation. The physical processes involved in partial discharges plus the interpretation of results from measurements on simple and complex apparatus, such as power cables, power capacitors, rotating machines and transformers. Techniques studied include digital based systems with particular emphasis being given to practical applications, in order to relate theoretical concepts to measurements which are subject to laboratory or on-site limitations.

**6.227G Insulation Performance in Electrical Plant C3**

*Assumed knowledge: 6.202 or 6.222 or equivalent.*

Design test requirements. Forms of high voltage works test: alternating, impulse, switching surge and direct. Non-destructive tests: dielectric loss angle, partial discharge and insulation resistance. Methods of determining material condition: moisture content, gas in oil, liquid chromatography, impurities, statistical breakdown tests, determination of aging and residual life. Commissioning and site tests.

Demonstrations and projects to support the lecture material.

**6.228G Power System Equipment C3**

*Assumed knowledge: 6.202 or equivalent.*

Operating characteristics and design features of the major equipment components of a power system. Includes a general treatment of equipment rating, thermal design, electrodynamic forces, equipment protection and data acquisition. Specific items of equipment include power transformers, instrument transformers, switchgear, overhead lines and underground cables, surge arrestors, gas insulated systems, power factor correction equipment and alternators. Protection of electrical equipment. Effects of electromagnetic fields on personnel.

**6.229G Fields and Materials C3**

General description of the inter-relationship between the different types of fields (electric, magnetic and thermal) and materials when used in various areas of electric power engineering. Topics include: a general coverage of dielectric, conducting, magnetic and thermal materials; solution of Poisson's Laplace's and Fourier's equations for simple geometries and calculation of electric, magnetic and thermal fields, including boundary effects; a selection of typical applications from thermal rating, electric heating, contact effects, laser action, surface electron emission, etc; a brief outline of some measurement techniques applicable to the above.

**6.242G Power System Analysis S2 C3**

*Assumed knowledge: 6.202 or equivalent. Excluded: 6.203.*

Emphasis on interconnected system operation, performance and control. Digital computer techniques for power system operation, performance and control. Digital computer techniques for power system analysis. Review of topics in numerical analysis, simultaneous linear and non-linear equations, numerical integration, sparsity programming techniques. Load-flow. Short-circuit analysis. Steady-state and transient stability analysis. Harmonics.

**6.250G Power Elective 1**

As for 6.550G Solid State electronics Elective.

## 6.251G Power Elective 2

C3

As for 6.550G Solid State Electronics Elective.

## 6.336G Digital Communication Networks 1

C3

*Excluded:* 6.652.

Discussion of networks, their characteristics and suitability for data communication. Data transmission on telephone networks; modems and interfaces. ISO/OSI reference model with particular reference to the physical layer, data link layer and network layer. LAN's and their interconnection through a WAN. Contention and token passing systems. Protocols. Elements of network architecture. Channel capacity. Queuing problems. Noise and handling of errors. Error detection coding. Selected elements of IEEE802 recommendations. Examples of some LAN's. Digital services in Australia.

## 6.337G Digital Communication Networks 2

C3

*Prerequisites:* 6.652 or 6.336G.

Builds on the material presented in 6.336G. Examples of contention systems. Token systems with particular reference to LAN's with ring topology. Sub-layer MAC (Medium Access Control Machine) and its functions. Recovery from faults such as lost token, duplicate token etc. Network layer. Gateways and network sub-layers. Transport and session layer protocols. Centrally controlled systems. Distributed systems. Protocol efficiency. Spread spectrum systems. Computer and laboratory modelling of LAN's.

## 6.338G Television Systems

C3

*Prerequisites:* 6.167G, 6.341G. *Excluded:* 6.333.

Principles and practice of modern television systems. Human perception of coloured visual images. Techniques and standards for terrestrial and satellite broadcasting, and cable TV systems. High definition television. Digital television. Data transmission within the television signal: Teletext. Networks. Recording techniques on video tapes and laser discs.

## 6.340G Communication Electronics

C3

*Assumed knowledge:* 6.0316 or similar.

Electronic aspects of modern analogue and digital communication systems. Topics selected from: electronic systems design; electromagnetic compatibility and interference; electronic system noise; analogue modulators, demodulators, frequency conversion circuits, AM and FM transmitters and receivers; television electronics; phase locked loops; switched capacitor and other practical filter technologies; surface acoustic wave devices.

## 6.341G Signal Processing 1—Fundamental Methods

C3

*Excluded:* 6.042.

Fundamental principles of the analysis and processing of analogue and digital signals with emphasis on digital methods. Generalized Fourier analysis; convolution, correlation, energy and power density spectra for signals and linear systems. Sampling, the discrete Fourier transform (DFT) and fast Fourier transform (FFT) algorithms. Fundamentals of filter design and reali-

zation of analogue and digital filters, including active filters and special purpose programmable digital signal processors. Digital processing of analogue signals, filter stability, sensitivity and finite word length effects in the realization of digital filters.

## 6.342G Signal Processing 2—Advanced Techniques

C3

*Prerequisite:* 6.341G or similar.

Advanced techniques of digital signal processing with applications in communications and control, radar and sonar and the processing of speech, seismic signals and images. Topics selected from: digital methods for sampling rate changes, advanced FFT algorithms and the chirp z-transform algorithm. Advanced digital filtering methods. Analysis of random signals and noise in linear systems and non-linear devices. Estimation and measurement of power density spectra. Linear prediction and parameter estimation for speech analysis and spectrum estimation. Mean-square estimation and adaptive filtering for the detection and estimation of signals in noise, equalization, echo and noise cancelling and deconvolution. Nonlinear techniques; homomorphic signal processing and cepstral analysis, median filtering, etc. Short-time spectral analysis and time-frequency distributions. Two-dimensional signal processing.

## 6.343G Digital and Analogue Communications

C3

*Co-requisite:* 6.042 or 6.341G or similar. *Excluded:* 6.323 or similar.

*Prerequisite or co-requisite for 6.347G Digital Communications and 6.348G Optical Communications.*

Fundamentals of modern telecommunications systems, including theoretical and practical aspects of: linear and non-linear analogue modulation (AM, SSB, FM, etc), digital signal transmission, pulse code modulation, computer communication, effects of noise in analogue and digital systems, error control, multichannel systems (FDM, TDM, etc), synchronization, relay systems, optimum transmitters and receivers.

## 6.347G Digital Modulation

C3

*Prerequisite:* 6.343G or similar.

Advanced and unified treatment of digital transmission systems. Baseband ASK digital communication systems including intersymbol interference, eye patterns, power spectral density, probability of error estimates and bounds, Nyquist criterion partial response signals (eg simple and modified duobinary). Digital modulation including various types of shift keying modulation such as amplitude, amplitude and phase, phase, frequency and minimum shift keying (ASK, APSK, OAPSK, PSK, FSK and MSK), power spectral density, probability of error, signal constellations and system comparison. Equalization including linear, non-linear, adaptive and automatic equalization and Viterbi decoders.

## 6.348G Optical Communications Systems

C3

*Prerequisites:* 6.150G, 6.170G.

Calculation of bandwidth of single mode and multimode fibres. Review of transmitter and receiver circuits. Connection and launching efficiency between fibre and optical source. Fibre to

fibre splicing and connection, losses due to fibre imperfection, fault location. Fibre cable, mechanical strength of fibre. Direct intensity modulation system, sensitivity of receiver, repeater design. Coherent optical communication system: laser frequency and intensity stability, polarization-maintaining optical fibre, heterodyne receiver. Coding for digital optical communication systems: OOK, PSK, FSK, DPSK. Analogue optical communication system: optical source linearity, PFM, repeater spacing calculation. Wavelength division multiplex. Optical fibre local area networks. Synchronization. Optical communication in hostile environments.

### 6.401G Computer Control Systems 1 C3

An introduction to the use of CAD packages and coverage of the control theory necessary to understand the design of fundamental control systems. Selected computer packages, sampling and conversion, difference equation models, polynomial forms, z-transforms, differential equation models, operator forms, s-transforms, block diagrams, flow diagrams and state space models, connections between discrete and continuous models, classical continuous design, Root locus, Nyquist, Bode, classical discrete design, w-transforms, PID controllers, simple controller design schemes (time/polynomial), Dahlin Higham, pole placement, approximations, Smith predictor, deadbeat, stochastic observers, pre-whitening, stochastic processes, time domain, frequency domain, correlation, identification, moving average models.

### 6.403G Computer Control Systems 2 C3

*Prerequisite:* 6.401G

Builds on the material of 6.401G, completing coverage of basic material considered necessary for modern control system synthesis and design. Revision of model forms: discrete-continuous, polynomial-state space. Observability, controllability, observers — deterministic, stochastic processes, stochastic models, innovation models, prediction, multivariable PI tuning, linear quadratic regulator design, Kalman filtering, stochastic control, LQG, disturbances, measured disturbances, feedforward control, estimated disturbances, identification, simultaneous estimation of states and parameters, simple adaption, servomechanism problems, cascade control, multiple sampling rates, non-linear elements.

### 6.404G Real Time Computing and Control C3

*Prerequisites:* 6.401G or assumed knowledge equivalent to 6.432 or 6.413.

Examines the implementation of modern control techniques and associated instrumentation using distributed computers. Practical hardware aspects, including measurement and actuation, data conditioning, acquisition and transmission, microprocessor devices, and other distributed computing components. Commercial realisations ranging from PLCs to full process control computing systems. Software: executive operating systems, concurrency, control algorithms, numerical problems, languages and development tools in the real-time context. Design of the man-machine interface using interactive computer display systems. The role of simulation and other CAD tools. Steps of engineering development from concept to commissioning. The viewpoint of industrial design is maintained throughout.

### 6.405G Topics In Digital Control C3

*Prerequisites:* 6.401G, 6.403G.

Possible modules include: identification, estimation, multivariable systems, robust control, optimization, adaptive control, biomedical applications, instrumentation and sensors, robotics, industrial/design case studies, non-linear identification, non-linear control, variable structure systems, expert systems and others to be decided.

### 6.406G Advanced Control Topics C3

*Prerequisites:* 6.401G, 6.403G.

From one to three models, covering advanced control theory, with an emphasis on applications. The modules are not limited to digital control. Typical modules include: identification, estimation, multi-variable systems, robust control, optimization, adaptive control, biomedical applications, instrumentation and sensors, robotics, industrial/design case studies, non-linear identification, non-linear control, variable structure systems, expert systems and others to be decided.

### 6.433G Design of Advanced Microprocessor Systems C3

*Prerequisite:* 6.060G.

Aims to familiarize the systems designer with the architecture and applications of the rapidly expanding family of microprocessor hardware support devices for dedicated control functions. *Topics include:* review and comparison of bus protocols of common systems: architecture, programming and applications of specialized system support devices and peripheral control chips; single chip microprocessors, architecture and applications to dedicated control tasks. *Laboratory work* includes individual design projects involving typical systems application of these devices.

### 6.457G Cybernetic Engineering C3

The genesis of cybernetics; fundamentals of cybernetic engineering; machines modelled on life and their evolution to robots. Topics include biological information transmission, memory and efficiency with aspects of biochemical coding and control, genetic and neural; basics of brain models and the development of pattern recognition techniques, learning machines and syntactic structures; includes the Perceptron view and brain modelling; the Albus approach to robotics, anthropomorphic robots; the social consequences of the dual evolution of robots.

### 6.468G Computer Display Systems and Interactive Instrumentation C3

*Prerequisite:* 6.060G.

Man-machine-process communication and control, and associated microprocessor based instrumentation. Review of appropriate analog and digital technology. Microcomputer hardware and programming for interactive communication using both machine and high-level languages. Display devices, operating principles and performance limitations. Hardware and software

techniques for computer-generation and processing of pictures. Colour and movement. Interactive design and graphics creation. The geometry of transformations and projections. Light pens and other input devices.

## **6.469G Robot Vision** **C3**

*Prerequisite: 6.070G or equivalent.*

Material oriented towards image understanding, scene analysis and world models for robots incorporating vision; including imaging techniques and geometries for vision, modelling the imaging process and image understanding, edges, range information, surface orientation, boundaries and regions, motion and optic, flow, texture, structural description, matching and inference, vision robotics.

## **6.470G Robotics, Automation and Productivity Technology** **C3**

Principles of Robotics relevant to future trends in automating the manufacturing process. Such aspects as arm configurations, dynamics and control with relevant sensing methods; image understanding for inspection, assembly and control together with trends in artificial intelligence for Robotics are discussed.

## **6.481G Introductory Physiology for Engineers** **S1 L2T2 C3**

*Excluded: 6.402.*

An introduction to biophysics and physiology for Engineers. Cells, tissues and organ systems with emphasis on their functional and regulatory characteristics and their interaction. An introduction to computer models of physiological control systems demonstrating their value in understanding the dynamics of complex neural, hormonal and circulatory responses to changes in homeostasis.

## **6.484G Biological Signal Analysis** **C3**

*Excluded: 6.341G.*

Digital computer methods of extracting information from biological signals using filtering and averaging, expectation density functions, correlation functions, spectral analysis and other techniques. Methods of constructing models of biological systems.

## **6.550G Solid State Electronics Elective** **C3**

This syllabus changes from one occasion to the next, allowing presentation of a modern topic at graduate level, particularly by visiting academics of eminence.

## **6.573G Advanced Semiconductor Devices** **C3**

*Excluded: 6.512.*

Theory and operating characteristics of a range of semiconductor devices including bipolar diodes and transistors, MOS devices and circuit connections, charge coupled devices, solar cells, light emitting diodes and semiconductor lasers.

## **6.575G Integrated Circuit Technology** **C3**

Fabrication processes for MOS and bipolar integrated circuits. Crystal growth, wafer preparation, maskmaking, photolithography, oxidation, diffusion, ion implantation, selective oxidation, plasma processing, silicon deposition, conductor systems and contacts. Advanced technologies.

## **6.577G Integrated Circuit Design** **C3**

*Assumed knowledge: 6.0316 or 6.322.*

An advanced treatment of the design of integrated circuits with emphasis on the relationships between technology, device characteristics and circuit design. Includes properties and modelling of bipolar and MOS circuit components, circuit analysis and simulation, layout rules, analog functions such as operational and power amplifiers; multipliers, D/A and A/D converters. Analog MOS circuits. Digital circuits include gates, compound functions, RAM, ROM, speed and power analysis. Economics and yield analysis for MSI, LSI and VLSI devices.

## **6.578G Solar Energy Conversion** **C3**

World and Australian energy resources. General energy conversion principles and their application. Characteristic of received solar radiation. Thermal conversion and selectively absorbing surfaces. Biological methods of conversion. Fundamentals of photovoltaic generation.

## **6.579G Solar Cells — Operating Principles, Technology, and System Applications** **C3**

Harnessing of sunlight by using solar cells to convert it directly to electricity. The properties of sunlight and of the semiconductors used in solar cells are reviewed and their interaction described. Factors important in the design of solar cells and the current technology used to produce cells. Likely future developments in this technology. System applications ranging from systems which are currently viable economically to residential and central power systems which may be a possibility for the future.

## **6.654G Digital Systems** **C3**

*Assumed knowledge: 6.021E. Excluded: 6.612.*

Computer architecture, implementation and realization. Use of hardware description languages for the analysis, design and specification of arithmetic units, storage and control Microprogramming techniques.

## **6.655G Computer Organization and Architecture** **C3**

*Assumed knowledge: 6.0318 or 6.613.*

Basic principles of computer architecture. A comparative study of the architectural features of a number of significant computer systems.

**6.659G Data Bases and Networks C3**

*Assumed knowledge:* 6.641 (Pass Conceded (PC) awarded prior to Session 2, 1983, is not acceptable for this subject). *Excluded:* 6.622, 6.633, 14.607, 14.608, 55.823G.

Data base management systems: data models; relational and network structures; data description languages; data manipulation languages; multi-schema structures. Data integrity and security; recovery; privacy. Computer Networks: economic and technological considerations; digital data transmission; error detection and recovery; network configurations; circuit switching, packet switching; communication protocols, current international standards; data compression; encryption and decryption.

**6.660G Design and Analysis of Algorithms C3**

*Assumed knowledge:* 6.641 (Pass Conceded (PC) awarded prior to Session 2, 1983, is not acceptable for this subject). *Excluded:* 6.642.

Techniques for the design and performance analysis of algorithms for a number of classes of problems. Analysis of algorithms: order notation, recurrence equations, worst case and expected order statistics. Design of efficient algorithms: recursion, divide and conquer, balancing; backtracking algorithms, branch and bound, dynamic programming; set manipulation problems; fast search algorithms, balanced optimal and multi-way trees; graph representations and algorithms; pattern matching algorithms. NP — complete problems. Design and specification of programs: modularization, interface design, introduction to formal specification techniques.

**6.661G Business Information Systems C3**

*Assumed knowledge:* 6.641 (Pass Conceded (PC) awarded prior to Session 2, 1983, is not acceptable for this subject), 14.501. *Excluded:* 6.647, 14.602, 14.603, 14.605.

Accounting concepts and terminology. Auditing, internal controls. Systems Analysis. Flowcharting. Decision tables. Models of business information systems. System design. Feasibility studies, presentation of designs, implementation testing. The COBOL programming language. Data files: sequential, random, index sequential, inverted. File updating. Data bases, integrated information systems.

**6.663G Operating Systems C3**

*Assumed knowledge:* Background in basic logical design and computer programming equivalent to 6.631 and 6.641. *Exclusions:* 6.672, 6.632.

Introduction to operating systems via an intensive case study of a particular system, namely the UNIX Time-sharing system which runs on the PDP11 computer. Includes system initialization, memory management, process management, handling of interrupts, basic input/output and file systems. A comparison of UNIX with other operating systems. General principles for operating system design.

**6.664G Compiling Techniques and Programming Languages C3**

*Assumed knowledge:* Background in data structures equivalent to subject 6.641. *Exclusions:* 6.672, 6.643.

Language description: phrase structure grammars. Chomsky classifications, context-free grammars, finite state grammars,

Backus Naur Form, syntax graphs, LL(k), LR(K), LAL(k). Lexical analysis: translation of an input (source) string into a (machine independent) quasi-terminal symbol string Finite state recognizers. Syntax analysis: top-down compilation for LL(1) grammars using syntax graph driven analysers or recursive, descent. Bottom-up compilation for simple and weak-precedence and LR(k) grammars. Semantic analysis: program translation and code generation, attributed grammars. Compiler generators: automatic generation of compilers for LALR(1) grammars. Code optimization by systematic program transformation. Run-time organization: activation record stacks heap management.

**6.665G VLSI System Design C3**

*Assumed knowledge:* Background in electronic design equivalent to 6.532.

The design and implementation of very large scale integrated systems, using both nMOS and CMOS technologies. The use and construction of CAD tools, including simulators, layout generators, and plot utilities. MOS failure modes, testing and design for testability. A study of some digital subsystems, digital architectures and design styles will be carried out. An integral part of the course is an MSI/VLSI design project. Selected project designs will be submitted for fabrication and returned to students for testing.

**6.666G Artificial Intelligence C3**

*Assumed knowledge:* Background to final year Computer Science level, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.

Overview of current research in Artificial Intelligence. Some of the topics are: the representation of knowledge, search techniques, problem solving, machine learning, expert systems, natural language understanding, and languages for Artificial Intelligence. Students are also required to prepare a report and give a seminar on one aspect of A.I. such as: robotics, vision, language understanding, speech recognition, A.I. languages, learning.

**6.667G Programming Languages: Fundamental Concepts C3**

*Assumed knowledge:* Background to final year Computer Science level, equivalent to subjects 6.631, 6.642, 6.632 and 6.643.

Fundamental aspects of programming language definition, semantics and implementation models. The current approach uses denotational semantics. Denotational semantics is a formal method for describing the abstract meaning of programming languages.

**6.668G Computer Graphics C3**

*Assumed knowledge:* Background to final year Computer Science levels, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.

Background to use and evaluate existing graphics packages, or to write a graphics package of your own. Topics include: vector, circle, and character generation, graphics hardware — raster, random scan, and storage tube displays, graphics display controller chips, basic 2D transformations, windowing, clipping, viewports, display segmentation, polygon clipping and filling, basic 3D transformations, perspective transformation, 3D clipping, hidden line and surface removal, graphical input devices. Existing graphics packages and standards are examined — Grogan, Core, GKS, and Tektronics.

## 6.669G Formal Specification

C3

*Assumed knowledge: Background to final year Computer Science Level, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.*

Introduction to formal specification techniques; use of predicate logic and modern set theory to describe computing systems; Schema notation for structuring large specifications; Schema calculus to prove properties of specifications; Refinement techniques for transformation of specifications into executable programs; refinement of abstract data types.

## 6.670G Parallel and Distributed Computing Systems C3

*Assumed knowledge: Background to final year Computer Science level, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.*

Parallelism (concurrency) in functionally coupled and distributed (communicationally coupled), hardware and software, computing systems. Topics will be selected from: Synchronisation, communication and arbitration; Computational paradigms — s; concurrent synchronous processing, lists, trees; Computational paradigms — p: vectors, arrays, APL tables, associative lookup structures; Synchronous bit-serial architectures: n-operand arithmetic, n-operand comparison; Pure pipeline and Systolic architectures and problems; Pipelined ALUs — multiple bus data path architectures; Memory-Processor architecture: super-imposed code-word processors, image identifiers, inner product processors; Object based systems; Languages with communication and processes: CSP, ADA C++; Locally and geographically distributed systems: Failure tolerant computer systems.

## 6.918G Project Report

C18

## 6.936G Thesis

C36

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# Mines

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## 7.152G Mining Conservation

The reclamation of excavated land; integration with operational stages of mining. Mining cycles of alluvial, strip, and open cuts, land clearing, stabilizing the mined area, socio-economic aspects of mining, rehabilitation costs, government regulations. Examination and evaluation of a current operation.

## 7.535G

## 7.916G Atmospheric Pollution and Control (Theory)

S1 or S2 L3

Causes, properties, dispersion, measurement and monitoring, control and legislation of air pollution in ambient and industrial environments.

## 7.917G Fire and Explosion

S1 or S2 L2

Chemistry and physics of combustion reactions; types of flames; deflagration and detonation; ignition; fire point; flammable limits. Industrial fuel-fired appliances; fire risks in buildings; fire fighting equipment; flame proofing; fire and explosive risks in chemical process industries; case studies. Use of appropriate standards and legislation. Fire research; insurance.

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# Civil Engineering

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## 8.401G Human Factors in Transport

SS C3

Human capabilities, ergonomic principles, attitudes to new concepts, planning, the law; application to transport planning, design and implementation. The human as a processor of information, influence on design of transport facilities particularly information displays, signals signs and lighting.

## 8.402G Transport, Environment, Community

F C6

Effect of transport on public health, environment and communities. Analysis of unwanted effects of transport activity: accidents, noise, pollution, intrusion; causation, measurement, preventative and remedial action. Community reaction to transport activity; government, bureaucracy and public involvement in transport policy and environment impact statements.

## 8.403G Theory of Land Use/Transport Interaction

S1 C3

Theoretical aspects of land use/transport planning. Basic concepts, data collection methods, systems models and equation of state (function behavioural, optimizing). Introduction to land use-transport modelling (land use, generation, distribution, modal assignment, network assignment, evaluation). Planning methodologies (short-, medium-, long-term; action planning, strategic planning; local, urban, regional national).

## 8.404G Local Area Transport Planning

S1 C3

Application of theoretical methods to local area planning. Local government planning and engineering: pedestrian planning, frontage land use problems, analysis of residential areas, industrial estates, shopping centres and recreational facilities, accessibility studies, environmental studies, parking studies.

## 8.405G Urban Transport Planning Practice

SS C3

Analytical techniques for urban land use/transport planning practice. Planning methodology: traffic generation, trip distribution, modal-choice, traffic assignment, evaluation. Land use forecasting: calibration and verification of behavioural models, application of mathematical programming models, case studies, public transport problems.

**8.406G Regional Transport Planning S2 C3**

The role of transport in economic and social development in regions including Third World countries; historical and contemporary analysis. Analytical techniques for regional planning. Planning practice, feasibility studies, evaluation methods. Case studies.

**8.407G Transport Systems Design (Non-Urban) S1 C3**

Process of location of road, railway and airport facilities. Data collection alternative routes, public discussion, methods, techniques, aids, plans and diagrams produced. Geometric form; differences between road, railway and airport carriageway layout. Optical guidance, design models, landscape, provision for surface-water signposting, fencing and posts.

**8.408G Transport System Design (Urban) S2 C3**

Types of urban transport facilities. Distributors, streets, bicycle routes, walk-oriented areas, bus lanes and rapid transit lanes, stops and change terminals, noise control. Minimum geometric form; speed range controls, provision for surface water on urban roads, landscape. Design of intersection and parking areas.

**8.409G Interchange Design SS C3**

Central projection theory and application to alignment design; perspective drawing methods, introduction to aerial and terrestrial photogrammetry, photomaps and photomontage as applied to transport facilities. Speed change lanes, exit and entrance terminals, ramp types, ramp speeds and design. Interchange location and layout, provision for surface water, signposting. Computer use. Safety measures during maintenance.

**8.410G Highway Engineering Practice Part 1 S1 C3**

Highway systems and organization. Roles and interaction of public and statutory highway and transportation authorities and research organizations. Sources and administration of highway finance. Highway programming. Feasibility studies. Engineering investigation and planning of highways and interchanges. Factors affecting long-term performance of transport facilities. Definition of design parameters. Factors of safety.

**8.411G Highway Engineering Practice Part 2 S2 C3**

Selection, comparison and critical evaluation of design procedures. Roles of ICES and other computer-oriented engineering systems in highway planning, design and construction. Maintenance systems. Economic modelling, investment costs. Prediction of performance. Implementation and revision of design decisions. Optimal use of resources. Project management for roads and interchanges. Choice of construction techniques. Upgrading of existing facilities, stage construction.

**8.412G Economics for Transportation Studies S1 C3**

Introductory macro and micro economic theory. The pricing mechanism in transport and distinctive characteristics of transport demand and costs. National income and social accounts with

particular reference to the transport sector. Economics of public enterprise. Cost-benefit analysis and modelling. Engineering economics (compound interest) and budget determination. Econometrics. Selected special problems in the economics of transport modes.

**8.413G Transport Economics S2 C3**

Cost and price analysis for each of the transport modes (road, rail, air and sea). Welfare analysis and taxation theory with respect to transport. Economics of location, economics of land use models; regional trade model.

**8.414G Transport Systems Part 1 S1 C3**

Definition of basic traffic elements, zero flow travel time, capacity, impedance/flow relationship. Transport Networks. The determination of shortest path, maximum flow, in networks. The topological description of networks. System parameters, performance. Application of network analysis to existing road, rail and air transport systems.

**8.415G Transport Systems Part 2 S2 C3**

Historical introduction to transport systems and development of various transport modes, road (vehicles, pedestrians, cycles), conveyer, rail, sea and air. Analysis of the operational characteristics of vehicles in the transport modes of road, rail and air. Analysis of the requirements of the rights of way for each transport mode. Development of optimum criteria for the distribution of cargo and passenger traffic. Terminals and mode transfer facilities. Development of system operational models. Energy consideration, new systems.

**8.416G Traffic Engineering F C6**

Road inventory; traffic measurements; flow, speed, origin-destination, accidents, road structure. Road capacity: controlled and uncontrolled intersections, highways and freeways. Signal systems. Traffic operations and control; arterial and network systems. Parking. Hazard analysis and safety improvement. Enforcement. Bus service operation.

**8.417G Transport and Traffic Flow Theory F C6**

Analysis of deterministic and stochastic models of the traffic stream. Topics covered include the following. Definition and measurement of traffic stream parameters. Space and time distribution of speed. Overtaking models and the moving-observer method. Fundamental diagram of traffic. Car-following theory. Headway and counting distributions. Introduction to queueing theory. Simulation techniques. Signalized and unsignalized intersections.

**8.418G Statistics for Transport Studies Part 1 S1 C3**

Data collection and processing. Probability, variates, sampling of values. Standard distributions, sampling distributions. Inference: point estimation, hypothesis testing and interval estimation; power, confidence, sample size. Regression. Generating functions. Sums of random variable. Distribution-free inferences.

## 8.419G Statistics for Transport Studies Part 2

S2 C3

*Assumed knowledge: 8.418G*

Linear models. Analysis of variance and co-variance. Simple and multiple regression. Design of experiments, interpretation of results. Sample survey design and analysis.

## 8.420G Transport Engineering Elective

SS C3

An occasional offering in a specialized Transport and Highways topic selected according to current demand and/or availability of a local or visiting specialist.

## 8.701G Economic Decision Making in Civil Engineering

SS C3

Review of practical engineering decision-making problems and relevant techniques. Engineering economics, benefit/cost analysis, consideration of inflation and taxation in investment decisions, bidding, decision theory, microeconomic theory, objectives and criteria, multiple objective planning.

## 8.702G Network Methods in Civil Engineering

SS C3

Graphs, flow-in networks, optimal paths, critical path schedule, resources levelling, simulation networks, stochastic networks, project management, further applications.

## 8.703G Optimization Techniques in Civil Engineering

SS C3

Search, linear programming, non-linear programming, geometric programming, calculus of variations, maximum principle, applications.

## 8.704G Stochastic Methods in Civil Engineering

SS C3

Queueing, Markov processes, theory of storage, reliability, renewal, application, transportation and allocation.

## 8.705G System Modelling

SS C3

The development of system models for specific problem areas and decision positions. Problem environment, goals, objectives, and definition established by field contact and team discussion, information flow requirements and the design of user-oriented decision processes. Class size is limited to selected students.

## 8.706G Experimental Methods In Engineering Research

SS C3

Purposes of experimentation in engineering research. Design of experiments; factorial and other designs; replication. Analysis of experimental data: analysis of variance and covariance; special analysis; other statistical methods. Decision theory.

## 8.707G Numerical Methods in Civil Engineering

SS C3

Numerical integration, iterative processes. Solution of linear equations, especially sparse and banded systems. Approximation of functions. Eigenvalue problems Design of programs. Implementation using PASCAL. Comparison study of FORTRAN and PASCAL.

## 8.710G Advanced Topics in Optimization in Civil Engineering

SS C3

Special studies in optimization in Civil Engineering design and construction to be offered from time to time by appropriate specialists.

## 8.714G Advanced Topics in System Modelling

SS C3

Special studies in system modelling to be offered from time to time by appropriate specialists.

## 8.723G Construction Design

SS C3

Design of field services and structures; compressed air services, cofferdams, ground anchors, floating plant, formwork and falsework, bridge centring, well-points and dewatering systems.

## 8.724G Construction Technology

SS C3

A selection of topics from; drilling, blasting techniques, tunnelling, rock-bolting and other ground support, earth/rock transport, harbours, railways, dams, bridges, structural steelwork techniques, pipeline construction, foundation grouting, compressed air work.

## 8.725G Construction Accounting and Control

SS C3

Engineering economic planning, control of labour, plant and materials. Insurances. Financial accounting. Project finance and taxation. Management accounting techniques and cost controls.

## 8.726G Construction Law and Professional Practice

SS C3

Nature and sources of law, court procedures, interpretation of documents, evidence, technical opinions. Contract law. Company law. Arbitration. Duties of an engineer.

## 8.727G Construction Planning and Estimating

F C6

Project initiation and development, feasibility studies, planning and estimating procedures, contract administration; estimating cost of labour plant and materials, indirect cost and overheads, profit; construction administration. Preparation of cost estimate for a major civil engineering project.

## 8.728G Design of Construction Operations

F C6

Heavy equipment, labour intensive, and composite operations; spatial layout and material flow concepts; the modelling of oper-

ations at the micro, macro, and systems level; engineered estimates and productivity prediction models; analysis of construction operations by timelapse methods; field methods at foreman, superintendent, engineer, and project manager levels; field studies of specific construction operations.

### **8.731G Project Management** **SS C3**

A problem-oriented approach to Project and Mission Management; the nature of engineering and construction projects; the project team; behavioural aspects of project management; the organization and management of project resources; short term field planning and management strategies.

### **8.732G Advanced Project Management Theory** **SS C3**

A theoretical and formative approach to Project and Mission Management; management strategies and project success evaluation techniques; organizational and behavioural aspects of the project team structure; behaviour norms and their impact on project team motivation; project management decision processes; case studies in project management.

### **8.753G Soil Engineering** **SS C3**

Clay mineralogy and its effect on soil properties. Principles of preloading of soils and its effect on foundation behaviour. Design and construction aspects of soil improvement techniques including lime and cement stabilization, chemical grouting, vertical drains, dynamic consolidation, vibroflotation sand and gravel piles, lime piles, freezing, electro-osmotic dewatering. Design and construction of diaphragm walls, ground and rock anchors.

### **8.776G Rock Mechanics** **SS C3**

Description of rock mass and discontinuities, strength and failure criteria, classification systems. Data collection and presentation. Initial stresses and their measurements, methods of stress analysis, stresses around underground openings. Selection of design of tunnel support systems, steel sets, rock bolts and shotcrete. Design of large underground openings. Excavation. Methods of prediction. Blasting.

### **8.777G Numerical Methods in Geomechanics** **SS C3**

Fundamentals of finite element and boundary element methods; application to practical geotechnical design and case studies; deformation and flow problems; linear and non-linear analysis; application to underground opening, stability of slopes, foundations, mining excavation; seepage and consolidation soil-structure interaction problems; earth pressures, retaining walls and buried pipes, thermal stress analysis.

### **8.781G Advanced Concrete Technology 1** **SS C3**

Basic structure of concrete. Morphology of hydrated cement paste. Constituents of cements. Paste — aggregate bond, strength microcracking and failure mechanisms. Code and special criteria for acceptance and rejection of concrete. Statistical principles, applications to specification and quality control of concrete. Non-destructive testing. Accelerated curing and

and special high strength concretes for column and prestressed construction. Recent developments in constituent materials, special cements and admixtures. Workability, mix design theories and practical applications.

### **8.782G Advanced Concrete Technology 2** **SS C3**

Concrete as structural material. Elastic properties. Volume changes, shrinkage and thermal stresses; creep; predicated and design values. Cracking of plain and reinforced concrete, extensibility; cracking problems caused by volume changes and creep effects in mass structures. Bond and impact strengths. Durability and fatigue of reinforced and prestressed concrete. Types of durability breakdown, reinforcement corrosion in marine and environments and sea water attack, sulphate attack from aggressive ground water. Waste water attack. Design recommendations for durability. Engineered repair of concrete structures.

### **8.783G Pavement Materials** **SS C3**

Properties and usage of soil and rock as pavement materials. Response of pavement materials to traffic and environmental factors. Concepts of durability. Improvement of soil properties by stabilisation. Compaction. Selection and comparative evaluation of selected subgrade, sub-base and base materials. Specifications and acceptance testing. Quality control. Properties and usage of bitumens, asphalts and tars. Manufacture and use of bituminous concrete. Mix design. Sprayed seals. Concrete for rigid pavements and sub-bases. Lean concrete, cement-grouted bituminous concrete.

### **8.784G Pavement Design** **SS C3**

Types of pavement, selection on basis of cost and performance. Sub-grade conditions, working platforms and use of geofabrics. Soil moisture equilibrium and drainage requirements. Prediction and characterisation of traffic wheel loadings. Role of environmental factors including temperature and moisture. Stress distribution in flexible and rigid pavements. Computer-based and approximated methods of analysis. Principles of mechanistic design. Comparative evaluation of design criteria and design procedures for flexible and rigid pavements for roads and airfields.

### **8.785G Pavement Evaluation and Maintenance** **SS C3**

Types of pavement distress, their origins and remedy. Evaluation and prediction of pavement condition. Pavement instrumentation and monitoring. Routine monitoring using deflection, role of accelerated trafficking tests. Measurement and reporting of physical distress including cracking, rutting and roughness. Measurement and prediction of skid resistance. Environmental factors. Pavement maintenance for flexible and rigid pavements. Overlays and membranes, recycling. Maintenance scheduling and management. Optimal use of maintenance funds.

### **8.786G Industrial and Heavy Duty Pavements** **SS C3**

Functions of industrial and heavy-duty pavements. Port pavements, container facilities, bulk cargo areas, mine haulage roads,

factory and warehouse floors and hardstands operation requirements. Economic considerations. Types of industrial pavement. Advantages and disadvantages of flexible, rigid and segmented pavements. Types of load, industrial vehicles, contained stacking, bulk cargo. Load equivalency concepts, Port Area wheel loads, standard design vehicles, formulation and application of loading spectra. Pavement design procedures for new pavements and overlays. Selection of pavement materials. Construction, maintenance and rehabilitation of industrial pavements. Railtrack design, integration of railtrack and vehicular pavements. Settlement and drainage considerations.

## **8.788G Site Investigations** **SS C3**

Engineering geology mapping and terrain classification. Drilling, trenching and sampling of rock and soil. In-situ testing of soil and rock. Laboratory testing of soil and rock. Assessment of design parameters. Instrumentation to measure pore pressure, stress, displacement.

## **8.790G Stability of Slopes** **SS C3**

Stability of natural and constructed slopes in civil and mining engineering. Stability analysis; stabilization methods and design; monitoring. Design of slopes in soft ground, soil and rock, and in partially saturated slopes; design of open cut mines. Probabilistic methods.

## **8.791G Foundation Engineering 1** **SS C3**

Stress distribution beneath foundations, settlement analysis, design of shallow footings, design of pile foundations, cast in-situ piles, foundation on shrink-swell soils, lateral earth pressures, foundations on rock, site investigations.

## **8.792G Foundation Engineering 2** **SS C3**

Advanced consolidation theory, non-linear behaviour, soil structure interaction, design of rafts and piled rafts, analysis and construction of piled foundations, steel piles, braced cuts, temporary support of excavations, design of foundations for dynamic loading, machine foundations.

## **8.793G Geomechanics** **SS C3**

The fundamentals of the effective stress concept, clay mineralogy, seepage analysis and Laplace equation method of fragments, fundamentals of liquefaction and cyclic mobility, basic and advanced consolidation theory including Terzaghi's 1D theory, nonlinearity and Biot's theorem critical state soil mechanics theory, hyperbolic model, fundamentals of continuum stress analysis, theory of elasticity, constitutive relationships and failure criteria for real soils and rocks and soil plasticity.

## **8.802G Elastic Stability 1** **SS C3**

Euler strut; uniform and non-uniform cross sections. Eccentric loading; stressing beyond the elastic limit. Struts continuous over several supports. Stability of frames.

## **8.803G Elastic Stability 2** **SS C3**

Energy methods of formation of stability problems. Approximate methods. Thin-walled open section struts; lateral buckling of beams; bending and buckling of thin plates.

## **8.804G Vibration of Structures 1** **SS C3**

Review of basic aspects. Analysis of lumped mass systems with various degrees of freedom. Vibration in beams and other continuous structures.

## **8.805G Vibration of Structures 2** **SS C3**

Vibration of buildings. Earthquake and blast loading. Bridges under moving loads. Vibration effects in foundations. Generalized dynamics and Lagrange's Equations.

## **8.806G Prestressed Concrete 1** **SS C3**

Historical development. Methods of prestressing. Elastic analysis and design. Flexural capacity and shear capacity of prestressed elements.

## **8.807G Prestressed Concrete 2** **SS C3**

Analysis and design of statically indeterminate structures. Methods of securing continuity. Composite structures. Creep and shrinkage effects in concrete structures.

## **8.808G Prestressed Concrete 3** **SS C3**

Partially prestressed concrete; cracked section analysis; crack control and deflection calculations; determination of appropriate level of prestress; strength calculations. Rational design procedures for prestressed members. Continuous beams; secondary moments; practical design procedures.

Prestressed slabs; two-way slabs; flat slabs; load balancing approach to design, effect of tendon distribution; design procedures, flexural and shear strength; deflections.

## **8.809G Reinforced Concrete 1** **SS C3**

Historical development. Methods of analysis and design, including limit state concepts. Analysis and design for bending, compression and combined bending and compression. Slenderness effects in columns. Shear and torsion. Serviceability requirements.

## **8.810G Reinforced Concrete 2** **SS C3**

Application of limit theorems to structural concrete. Lower bound methods of design. Analysis and design of plates and slabs. Detailing of members and connections for strength and serviceability. Joints.

## **8.811G Reinforced Concrete 3** **SS C3**

Preliminary design of concrete structures. Fatigue effects. Composite construction. Design of multi-storey buildings. Marine structures.

**8.812G Plastic Analysis and Design of Steel Structures 1****SS C3**

The perfectly plastic material, the plastic hinge; plastic collapse of beams and frames; upper and lower bound theorems; introduction to design principles and methods.

**8.813G Plastic Analysis and Design of Steel Structures 2****SS C3**

Estimation of deflections; factors affecting plastic moment; shake-down; three-dimensional plastic behaviour; minimum weight design.

**8.814G Analysis of Plates and Shells****SS C3**

Stress and strain in thin elastic plates bent by transverse loads. Solutions of the plate equation. Application. Stress and strain in thin plates loaded in the plane of the plate. Applications.

**8.817G Experimental Structural Analysis 1****SS C3**

Dimensional analysis and principles of similitude, model analysis and design of models. Instrumentation and special methods of measurement. Evaluation of data.

**8.818G Bridge Design 1****SS C3**

Historical development. Design philosophies. Loadings and factors of safety. Design of slab and slab-and-beam bridges; skew and stiffened-kerb bridges, multibeam bridge decks. Analysis of orthotropic plates and grid frames. Plate web girders and box girders.

**8.819G Bridge Design 2****SS C3**

Advanced bridge design. Box girder and cable-braced bridges in steel and reinforced concrete. Orthotropic plate construction. Design of bridges by limit state methods. Serviceability requirements.

**8.820G Structural Analysis and Finite Elements 1****SS C3**

Stiffness analysis of structures. Basis of finite elements: Principle of virtual work, variational theorems, constraint equations. Effects of inplane rigid floors and axially rigid members on the behaviour of multi-storey frames.

**8.821G Structural Analysis and Finite Elements 2****SS C3**

Variational formulation of the finite elements. Plane stress and plate-bending elements. Mesh grading. Flat slabs and flat plates in building frames. Hybrid elements and shear wall analysis. Iso-parametric elements, numerical integration. Finite elements methods in numerical analysis.

**8.822G Structural Analysis and Finite Elements 3****SS C3**

Application of the finite method to analysis of structures. Verification of the results of standard computer programs. Structural stability and vibration of structures.

**8.830G Hydromechanics****SS C3**

General equation of fluid motion, potential flow, conformal mapping, laminar flow, Navier-Stokes equations; turbulence, shear flows, jets and wakes, boundary layers, turbulent mixing, diffusion, air entrainment, cavitation, stratification.

**8.831G Closed Conduit Flow****SS C3**

Theories for energy loss in conduit flows, roughness at pipe walls and tunnels, design applications. Cavitation in conduits, transport of waterborne mixtures in pipes, accuracy of flow measurement in pipe lines.

**8.832G Pipe Network and Transients****SS C3**

Multiple and branching pipes, energy distribution in pipe systems. Computer solution of pipe network problems. Unsteady flow in pipes. Branching pipes and reflectors. Effect of pumping plant behaviour.

**8.833G Free Surface Flow****SS C3**

Theory of waterflow in open channels. Application of theory to design of hydraulic structures, spillways, control gates, energy dissipators, channel transitions. Use of hydraulic models.

**8.835G Coastal Engineering 1****SS C3**

Theory of periodic waves as applied to tides and wind generated waves in water of varying depths. Wave and tide prediction.

**8.836G Coastal Engineering 2****SS C3**

Wave forces on structures, shore processes and beach erosion. Estuarine hydraulics, wave and tide models.

**8.842G Groundwater Hydrology****SS C3**

Confined and unconfined aquifers, analogue and digital models of aquifer systems, water movement in the unsaturated zone, recharge, groundwater quality, sea water intrusion.

**8.843G Groundwater Hydraulics****SS C3**

Mechanics of flow in saturated porous materials, steady and unsteady flow to wells, leaky aquifers, partial penetration, multiple aquifer boundaries, delayed yield from storage, regional studies.

**8.847G Water Resources Policy****SS C3**

Resource economics, water supply, water demand, multiple objective planning, multiple purpose projects, water law, water administration, case studies.

**8.848G Water Resource System Design****SS C3**

Principles of the optimal design and operation of multiple purpose, multiple component, water resource system; evaluation of cost and benefits in complex and simple systems.

**8.849G Irrigation**

**SS C3**

Soils, soil-water relationships, plants, climate, crop requirements; water budgets, sources, quality, measurement; irrigation efficiency. Design of irrigation systems, appurtenant works, distribution.

**8.850G Drainage of Agricultural Land**

**SS C3**

Characteristics of drainage systems, steady and unsteady state drainage formulae, conformal transformation solutions, soil characteristics field measurement of hydraulic conductivity and soil water pressure, significance of unsaturated zone, practical aspects.

**8.851G Unit Operations in Public Health Engineering**

**SS C3**

Theory of physical, chemical, biological, and hydraulic processes used in both water and wastewater treatment. Applications where these are common to both water and wastewater treatment.

**8.852G Water Distribution and Sewage Collection**

**SS C3**

Water collection, transmission and distribution systems — layout design and analysis, reservoirs, pumping. Sewage collection design and analysis — capacities, corrosion, pumping.

**8.855G Water and Wastewater Analysis and Quality Requirements**

**SS C3**

The effects of impurities in water and wastewater on its suitability for various beneficial uses, and methods used for detecting impurities. Analytical methods used in water and wastewater treatment for monitoring and process control.

**8.856G Water Treatment**

**SS C3**

Application of processes and process variations used to upgrade the quality of water for specified uses, with particular reference to the treatment of water for municipal use.

**8.857G Sewage Treatment and Disposal**

**SS C3**

**8.857X Sewage Treatment and Disposal (external) S2 C3**

Application of processes and process variations used to improve the quality of sewage effluent, and the disposal of the effluent. Re-use of effluents where applicable. Sludge treatment and disposal.

**8.858G Water Quality Management**

**SS C3**

Fundamental concepts; systems approach to quality aspects of water resource systems; quality interchange systems; quality changes in estuarine, surface, and ground water. Quality management by engineered systems. Economic criteria relating to water use and re-use systems.

**8.860G Investigation of Groundwater Resources 1**

**SS C3**

Occurrence and extraction of groundwater, investigation and drilling methods, systems approach, optimization techniques, conjunctive use studies, quality of groundwater.

**8.861G Investigation of Groundwater Resources 2**

**SS C3**

Geophysical methods, remote sensing, photo-interpretation, arid-environment studies, analog models, case studies.

**8.862G Fluvial Hydraulics**

**SS C3**

Unsteady and varied flow in non-uniform channels, secondary currents, sediment transport, channel morphology, scour and shoaling, river control works, modelling of fluvial processes.

**8.863G Estuarine Hydraulics**

**SS C3**

Classification of estuary types and their characteristics. Tides, their origin, prediction and effect on estuarine circulation. Entrainment and mixing process in estuaries. Salinity intrusion, tidal flushing, dispersion of pollutants. Sediment transport, channel stability.

**8.864G Arid Zone Hydrology**

**S1 L1½T1½ C3**

*Co-requisite: 8.837G, 8.838G.*

Arid zone rainfall characteristics, data collection and instrumentation, runoff processes, infiltration, transmission loss, recharge processes, flood characteristics and design; water yield, storage of water; evaporation and evaporation suppression; sediment transport and measurements.

**8.865G Arid Zone Water Resources Management**

**SS L1½T1½ C3**

Water as a resource: demand for and supply of water; works and management to match demand with supply. Special features of the arid zone climate, water uses, quantification of demand quantities and qualities; measurement of flow rate, volume, quality. Engineering works: design, construction, operation and maintenance of work, including excavation tanks, dams, pipelines, pumps, windmills, engines and motors, troughs; costs; reliability; energy sources for pumping. Special practices: water spreading, irrigation including trickle irrigation; evaporation reduction, desalination.

**8.868G Public Health Science**

**S1 C3**

Impact of water and wastewater treatment on disease transmission. Monitoring methods used for pathogens and indicator organisms, structure and degradation of large molecules, biochemical pathways of anabolism and catabolism and the characterization of micro-organisms.

**8.869G Instrumentation and Control in Water Supply and Wastewater Engineering****S2 C1**

Principles of primary elements, instrument response and reliability, control methods and the response of plants to control conditions in water and wastewater treatment and supply systems.

**8.870G Hydraulics and Design of Water and Wastewater Treatment Plants****S2 C3**

*Co-requisites: 8.856G, 8.857G or equivalent.*

Application of hydraulic principles to flows within treatment plants. Selection and integration of unit processes required for water and wastewater treatment, plant layout, plant design including hydraulic profiles, the influence of flow and load variability, instrumentation and control strategies.

**8.871G Water Supply and Sanitation in Developing Countries****S2 C3**

*Prerequisites: 8.851G, 8.855G, 8.868G or equivalent.*

Selection of appropriate technology for water supply and wastewater treatment and disposal to account for hot climates and low per capita incomes. Design basis for systems and the operating requirements.

**8.872G Management of Wastes****S2 L2T1 C3****8.872X Management of Wastes (external)****S1 C3**

Management and control strategies in waste management, legal requirements, local and overseas legislation, case studies of waste management.

**8.873G Waste and Wastewater Analysis and Environmental Requirements****S1 L1½T1½C3****8.873X Waste and Wastewater Analysis and Environmental Requirements (external)****S1 C3**

Principles of analytical methods used in chemical analysis of wastes and wastewaters, sampling schemes, statistical evaluation of data, environmental requirements to prevent pollution.

**8.874G Waste Management Science****S1 L2T1C3****8.874X Waste Management Science (external)****S1 C3**

Aspects of chemistry, biology and geology relevant to waste management, equilibrium and kinetic approaches, cell structure and metabolisms, formation and classification of rocks and soils.

**8.875G Hydrological Processes****SS C3**

Hydrological cycle, water and energy balances and circulation, precipitation process, interception, infiltration, storm runoff process, evaporation and transpiration, surface groundwater interactions, land use effects.

**8.876G Applied Hydrological Modelling****SS C3**

Introduction to hydrological models, deterministic catchment models, model calibration and verification, stochastic models, storage yield analysis for reservoir design, extension of records, stochastic reservoir analysis or identification of groundwater systems, conjunctive use systems.

**8.877G Flood Design 1****SS C3**

Introduction to flood estimation, frequency analysis of hydrological data, design rainfall data, hydrograph analysis, storm rainfall-runoff relations, design flood estimation for small to medium sized catchments including the rational method, introduction to urban drainage design.

**8.878G Flood Design 2****SS C3**

Introductory flood routing, loss rates, linear and nonlinear response, unit hydrographs, runoff routing, choice of method of flood estimation, urban drainage design.

**8.879G Flood Design 3****SS C3**

Flood frequency analysis, river flood routing, catchment characteristics, estimation of extreme floods, synthetic unit hydrographs, design hydrograph methods, application of runoff routing models.

**8.880G Groundwater Modelling**

Groundwater modelling of porous media, fractured rock and low permeability materials. Analogue, numerical analytical models. Matrix structure and inverse methods, stochastic modelling and characterization of variability, Modelling Multiphase Fluids and regional groundwater flow. Applications to borefield management, salt water intrusion, mine dewatering, geotechnical problems.

**8.901G Civil Engineering Elective 1****SS C3**

A Session 1 occasional elective on a civil engineering topic, selected according to current demand and availability of local and visiting specialists.

**8.902G Civil Engineering Elective 2****SS C3**

A Session 2 occasional elective on a civil engineering topic, selected according to current demand and availability of local and visiting specialists.

**8.909G Project****C9****8.909X Project (external)**

A minor research investigation involving analysis and interpretation of data, or a critical review and interpretation of literature on a selected topic, or a design project.

**8.918G Project Report****C18**

### 8.918X Project Report (external)

As for 8.909G but involving more substantial investigation.

### 8.936G Thesis

C36

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## Mathematics

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### 10.061G Advanced Mathematics for Electrical Engineers

C3

Boundary value problems in partial differential equations. Selected topics from complex variable analysis, integral transforms, and orthogonal functions and polynomials.

### 10.361G Statistics

C3

Probability theory, a survey of random processes with engineering applications — processes in discrete and continuous time. Markov processes, ergodicity, stationarity, auto-correlation, power spectra, estimation of auto-correlation and power spectra.

### 32.012G Biomedical Statistics

SS L2½T1½ C4

Statistical assessment of normal and diseased states. Statistical relationships between multiple variables used to assess disease; analysis of variance, regression, factor analysis, discriminant analysis. Progression of diseases over time. Diagnosis and assessment of treatments. Experimental design and sampling. Computation methods.

### 32.101G Mathematical Modelling for Biomedical Engineers

S1 L3T1 C4

Model formulation and validation of ordinary and partial differential equations by analytical and numerical techniques.

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## Accounting

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### 14.062G Accounting for Engineers

F L1½

Problems related to industrial situations, and their relevance in decision-making. Manufacturing and cost accounts, budgeting and budgetary control, cost analysis and control and profit planning.

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## Industrial Relations and Organizational Behaviour

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### 30.565G Industrial Relations A

S1 L3

*Prerequisite: Nil.*

Concepts and issues in Australia industrial relations at the macro or systems level, with overseas comparisons where appropriate. Labour movements and the evolution of employee-employer relations in the context of industrialization and change; origins and operations of industrial tribunals at the national and state levels; structure, operations and objectives of Australian trade unions and employer bodies; role of governments and their instrumentalities, nature of industrial conflict resolution such as arbitration and bargaining; and national wage policy.

### 30.935G Organization Behaviour

S1 L3

*Prerequisite: Nil.*

Relationships between individuals and organizations. Individual behaviour—personality, perception, motivation, learning, performance. Organizations as settings for individual behaviour—types of organization, work organizations. Interaction, groups and work groups. Organizational influences on work behaviour; structural factors and the design of work; reward systems; organizational cultures and social influences. The development of individual-organization relationships: participation, socialization, careers; conflict, stress and adaptation; organizational effectiveness.

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## Health Administration

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### 16.901G Health Service Statistics 1

S1 L2

Statistical methods and theory; frequency distributions and their descriptions; an introduction to probability; principles of sampling; estimation and hypothesis testing; statistical decision theory; normal, Poisson and binomial distributions; linear regression; index numbers; time series analysis. Data drawn from the health planning field used to illustrate these methods.

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## Industrial Engineering

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Industrial Engineering is a Department within the School of Mechanical and Industrial Engineering.

### 18.061G Industrial Experimentation 1

C3

Design of experiments with reference to industrial problems; planning experiments; significance testing; simple comparative experiments, accelerated experiments; fatigue testing, tool life

testing; economic aspects of experimental design; analysis of variance or randomized block, latin square and factorial experiment designs.

**18.062G Industrial Experimentation 2 C3**

Regression analysis; use of orthogonal polynomials in regression analysis and analysis of variance; confounding in factorial design; response surfaces and determination of optimum conditions.

**18.074G Industrial Management C3**

Definitions of management; evolution of management thought, classical, quantitative and behavioural schools; interactions between organizations and their environment. The planning process; strategic and tactical planning, developing planning premises, nature of managerial decision making, quantitative aids, management by objectives. Organizational structures; co-ordination and spans of control, the informal organization, authority delegation and decentralization, groups and committees, managing organizational change and conflict. Motivation, performance and satisfaction; leadership, interpersonal and organizational communication, staffing and the personnel function. The control process; budgetary and non-budgetary methods of control, use of management information systems.

**18.076G Decision Support Systems C3**

Perspectives on organizational and individual decision making; basic philosophy of Decision Support Systems; knowledge representation techniques; DSS models and operators; Data Base Management systems in DSS; iterative design techniques; the DSS/user interface; practical design and implementation of a Decision Support System.

**18.171G Inspection and Quality Control C3**

Economics of measurement; advanced measuring and inspection methods; non-destructive testing; quality control systems; sampling by attributes and variables; standardization; case studies; process capability and variability; machine tools acceptance testing; alignment procedures.

**18.260G Computer Aided Programming for Numerical Control C3**

*Assumed knowledge: 5.0721 or equivalent. Excluded: 18.224.*

Overview of N.C. systems and manual programming. Computer assisted programming dealing with specific and generalized part programming. Mathematics for computer assisted part programming. High level language requirements for part programming. Study of the structure and use of automatic programmed tools (APT). Selection of operating conditions.

**18.261G Computer Automation C3**

Computer architecture including central processor, random-access memory, read only memory, input/output ports, peripherals, and the relationships between each. A systematic study of the requirements for interfacing computers to the real world.

Machine code, assembly language, and high level languages such as BASIC or FORTRAN with a comparison of each for particular applications. Development of small computer system for machine tool control, automated inspection, supervision, stock control, etc.

**18.360G Ergonomics C3**

Applied anatomy and kinesiology, anthropometry; application to work place arrangement, seating and bench design, tool and equipment design, lifting techniques, consumer product and architectural design. Physiological and psychological aspects of work and fatigue; measurement of energy consumption, limits to energy expenditure at work, static muscular fatigue, boredom. Environment effects; natural and artificial lighting arrangements, problems of perception, colour; noise and vibration, preventive measures; heat and ventilation, thermal regulation in humans, criteria for comfort, effects of pollutants. Man-machine interface. Displays, machine controls, reaction times, vigilance. Applications of ergonomics to occupational safety and health. Ergonomic research methodology.

**Note:** A project forms a substantial proportion of the assessment for this subject.

**18.371G Factory Design and Layout C3**

*Assumed knowledge: 18.303 or 18.380G or equivalent.*

*Production requirements:* processes, machines and storage; optimum factory size, multiple factories. *Plant location:* single and multiple factories and warehouses; location models and economic analysis. *Factory design:* function; appearance; economic factors; environmental factors. *Materials handling systems:* influence on layout; economic choice between alternatives; long-distance transport. *Layout design:* by product: types of production line, means of line balancing, queueing theory applications. By process: travel charts and computer programs for optimization. Group technology. Practical aspects; provision of services and amenities; layout visualization methods.

**Note:** A project forms a substantial proportion of the assessment for this subject.

**18.380G Methods Engineering C4**

*Methods study:* history and objectives. Charting and systematic improvement of methods, factory and workplace layout. Ergonomics. Physical and social aspects of working conditions. *Work measurement:* defining and using 'standard times'. Time study techniques and problems, predetermined motion-time systems, work sampling, standard data and formulae. Accuracy and statistical testing of data. *Industrial psychology:* motivation to work, socio-technical systems, sources of job satisfaction. Financial incentive schemes, job enrichment and worker participation. Laboratory exercises.

**18.461G Design Production C4**

Influence of manufacturing processes on design; design simplification and standardization; value engineering; economics of process selection; case studies.

## 18.464G Value Analysis and Engineering

C3

Cost reduction through value analysis/engineering illustrated by case studies. Selection of projects to be studied, collection of information, creative problem solving, development of alternatives, functional analysis system technique, functional evaluation, cost-function relationship, decision making, communication and implementation of the proposal. Applications to engineering design and services.

## 18.465G Computer-Aided Manufacturing

C3

Brief review of numerical control (NC) manufacturing systems. Elements of the CAM systems: CAM data base, production management, manufacturing control. Computers in manufacturing. Computer process monitoring and control. Production systems at the plant and operations levels. Supervisory computer control. Flexible manufacturing systems.

## 18.471G Design Communication

C2

Communication systems in design; aids to design communication; engineering drawing practice; standardization; interpretation of design information.

## 18.571G Operations Research 1

C6

*Excluded: 6.646, 18.503, 18.551, 18.580G.*

The formation and optimization of mathematical models. The development of decision rules. Some techniques of operations research such as mathematical programming, queueing theory, inventory models, replacement and reliability models and simulation. These techniques are applied to situations drawn from industrial fields, for example, production planning and control. Practical problems of data collection, problem formulation and analysis.

## 18.574G Management Simulation

C3

Problem definition. Principles of model building. Participation in an operational simulation. Construction of decision rules. Operations. Research case studies and seminars.

## 18.579G Case Studies in Operations Research

C3

Problems confronting management are seldom in the form of clear cut textbook type exercises; rather they are often ill-structured and ambiguous. A variety of such problems in operations research/management science is considered with emphasis on the common pitfalls that arise in solving real world problems and the comparison of different strategies for solution. Students are expected to prepare written reports on certain cases considered suitable for submission to management.

## 18.580G Operations Research

C6

*Excluded: 6.646, 18.503, 18.551, 18.571G.*

The formulating and optimization of mathematical models. The development of decision rules. Some techniques of operations research such as mathematical programming, queueing theory, inventory models, replacement and reliability models; simulation. These techniques applied to situations drawn from indus-

trial fields, eg production planning and inventory control. Practical problems of data collection, problem formulation and analysis.

## 18.671G Decision Theory

C2

*Excluded: 18.672G.*

Theories of choice, value, risk and uncertainty for the individual and for multi-person situations. Statistical decision theory. Bayes and minimax rules. Optimum sampling.

## 18.672G Decision Theory for Industrial Management

C3

*Excluded: 18.671G.*

Decisions with multiple objectives. Indifference curves and trade-offs. Value functions for two or more attributes. Decisions under uncertainty. Utility theory. Bayesian decisions in discrete and continuous space. Value of information. Optimal sampling. Applications in investment, marketing, production.

## 18.673G Energy Modelling, Optimization and Energy Accounting

C3

The analysis of energy systems using computer models. Applications of such models range from policy analysis at government level investment analysis within individual industries. Covers both the formulation of energy models and the techniques used to obtain optimized solutions, with examples from actual studies. Effects of uncertainty and the use of energy accounting as an analytical tool.

## 18.675G Economic Decisions in Industrial Management

C3

*Excluded: 18.603.*

*General aspects:* the economic objective, the single-period investor's model, economic criteria, the mathematics of finance. *Deterministic models:* project evaluation using discounted cash flow analysis; capital structure; debt and equity financing; cost of capital and the minimum acceptable rate of return; taxation; inflation and its effects. *Probabilistic models:* multiple objectives and multi-attribute value systems based on means and variances of cash flows. *Particular applications of economic decision-making:* venture and risk analysis, risk management, static and dynamic replacement models, rent-or-buy decisions, breakeven analysis, expansion and economic package concepts, analysis of projects with public financing.

## 18.681G Engineering Economics Analysis

C3

Price-output decisions under various competitive conditions. The time-value of money, net present worth and DCF rate of return, and their application in the selection and replacement of processes and equipment. Construction and optimization of particular models, eg replacement, capital rationing. Measures of profitability.

## 18.760G Discrete-Event Simulation Languages

C3

*Assumed knowledge: 18.503 or 6.646 or 18.761G or equivalent.*

Basic elements of simulation languages: random number generation, process generation, list and set processing, data struc-

tures, time advance and event scanning, gathering and resetting statistics, graphics, Simulation language world views. Comparative review of commercially available simulation languages such as Simscript, GPSS, ECSL, and Simula, and a study of one of them in depth. Simulation using personal computers. Simulation language preprocessors.

### **18.761G Simulation in Operations Research** C3

*Excluded: 18.503, 6.646.*

The relationship of simulation to other methods of comparing alternative solutions to industrial problems. Computer simulation languages. Process generation. Variance reduction techniques. Analysis of simulation generated time series. Formulation and construction of models for simulation. Problems of simulation. Design of simulation experiments. Optimization through simulation. Examples of the use of simulation. Heuristics.

### **18.763G Variational Methods in Operations Research** C2

The variational problem and its history. The modern formulations. Mathematical Theory. Application to a wide range of problem areas such as production and inventory control, advertising, machine maintenance and natural resource utilization.

### **18.764G Management of Distribution Systems** C2

*Assumed knowledge: 18.503.*

The distribution system: single depot location, multi-depot location, vehicle scheduling, vehicle loading, fleet size, case studies.

### **18.765G Optimization of Networks** C2

*Prerequisite: 18.551.*

Network representation of decision problems. Activity networks PERT-CPM, Euler and Hamiltonian paths, shortest path, maximum flow, multi-commodity flow, out-of-kilter algorithm, convex cost networks, stochastic cost networks — GERT.

### **18.770G Stochastic Control** C2

Markov decision processes for finite and infinite planning horizons. Optimality criteria. Contraction mappings. Computational techniques. Optimal stopping. Semi-markov decision processes. Application to inventory, replacement and queues.

### **18.772G Information Processing Systems in Organizations** C2

The place of operations research in information processing systems. Computer hardware and software. Data structures and data manipulation techniques. Typical structures of suites of programs. The life cycle of information processing systems. System design. Applications packages with emphasis on systems for production and inventory control. Major problems in information processing systems.

### **18.773G Optimal Control in Operations Research** C2

Brief survey of dynamic optimization techniques. Introduction to the calculus of variations and the maximum principle for both continuous and discrete systems. Applications to operations research problems drawn from the areas of production and inventory control, machine maintenance, investment and natural resource utilization.

### **18.774G Applied Stochastic Processes** C2

Examples of stochastic processes, basic concepts and Markov chains. Renewal theory. Applications to queues, inventory replacement, risk, business and marketing. Markov decision processes.

### **18.775G Networks and Graphs** C2

Basic concepts. Application of Hamiltonian paths, Euler cycles, tress, planar graphs, dominating and independent sets to operations research problems. Shortest route algorithms. Concept of maximum flow in a network applied to transportation assignment and scheduling problems.

### **18.776G Production and Inventory Control** C2

*Excluded: 18.004*

Overview of the basic issues in Production and Inventory control. Material Requirements Planning: the Master Production Schedule; structuring Bills of Materials for MRP; Capacity planning and control; shop floor scheduling and lead time reduction; cycle counting; lot sizing techniques; implementation of MRP systems in practice. Just-in-Time (JIT) production; the Kan Ban system; production planning and control in Flexible Manufacturing Systems (FMS); the relation between MRP, JIT and FMS.

### **18.777G Time Series Forecasting** C2

Stationary series. Autoregression. Spectral analysis. Estimation of trends, seasonal effects and parameters. Exponential smoothing. Error analysis and tracking signal. Choice of method.

### **18.778G Scheduling and Sequencing** C2

Criteria for evaluation schedules. Scheduling of single machines. Job-shop scheduling with two, three or more machines. Permutation schedules. Groups of machines. Scheduling constrained resources.

### **18.779G Game Theory** C2

Two-person zero-sum games: the minimax theorem, relationship to linear programming. Two-person general-sum games. Non-cooperative and co-operative n-person games. Games without side payments. Economic market games.

### **18.780G Production Control** C2

Modes of manufacture; information flow in multi-stage production systems; classical production and inventory models and control techniques; Material Requirements Planning; Just-in-Time Production; Flexible Manufacturing Systems and their control.

# Engineering

## 18.862G Linear Programming

C2

Formulation of models. The revised simplex method. Sparse matrix techniques. Implementation on computers. Duality and postoptimality analysis. Extensions to the simplex method. Generalized upper bounding. Decomposition. Integer programming. Applications in industry.

## 18.863G Nonlinear Programming

C2

Formulation of models. Single variable optimization. Numerical techniques for unconstrained optimization. Methods for linear constraints. Penalty function methods for nonlinear constraints: Lagrangian methods. Applications in industry.

## 18.864G Applied Geometric Programming

C2

Optimization concepts developed for function of polynomial form. Solution techniques for such problems, sensitivity of solution. Applications of geometric programming to problems from engineering and operations research.

## 18.868G Industrial Applications of Mathematical Programming

C3

Problem formulation: development of objective and constraints. Conventions for large-scale matrix construction; list and table processing. Matrix generator languages; the MGG package. Data organization, interpretation of output, automatic preparation of report. Examples from industry. Case studies and projects.

## 18.870G Large Scale Optimization in Industry

C3

*Excluded: 5.1245.*

Large-scale linear programming: sparse constraint matrices, updating basis factorizations. Large-scale nonlinear programming: the limitations of classical quasi-Newton and conjugate gradient methods, sparse Hessian approximations, superbasic variables, augmented Lagrangian methods for sparse nonlinear constraints. Applications, examples and case studies from industry: optimal power flow, steam and power plant design, pipeline network optimization and other.

## 18.871G Mathematics of Operations Research

C2

Classical optimization techniques. Convexity. Kuhn-Tucker conditions. Search and gradient methods in one and several dimensions. Probabilistic models and their optimization. Curve fitting, correlation and regression.

## 18.874G Dynamic Programming

C2

The principle of optimality. Structure and formulation of dynamic programming problems. One-dimensional deterministic and probabilistic sequential decisions. Approximations in function and policy space. Multidimensional problems, computational aspects. Applications to allocation problems, inventory theory, replacement.

## 18.875G Geometric Programming

C2

The geometric programming theory is developed for convex and non-convex mathematical programs. The theory is applied to polynomial and posynomial programming. As projects actual polynomial and posynomial programs will be solved.

## 18.876G Advanced Mathematics for Operations Research

C2

A survey of mathematical ideas which are of value in operations research. Topics will be selected from the following areas: set theory, real analysis, matrix theory, topology, function spaces, linear operator theory, inequalities, stability, complex analysis, convex analysis, distribution theory, group theory and measure-theoretic probability theory.

## 18.879G Mathematical Programming Analysis

C3

*Co-requisites: 18.871G; Linear Programming section of 18.571G.*

Methods for the analysis of mathematical programs. Analysis of the properties of linearity, separability, convexity, quasi-convexity and duality, providing the basis of the conversion of mathematical programs to potentially simpler formulations. Includes the areas of geometric programming, convex programming and quasi-convex programming.

## 18.909G Project

C9

## 18.918G Project Report

C18

## 18.936G Thesis

C36

## 18.965G Seminar (Industrial Management)

C0

## 18.967G Advanced Topic in Production Engineering

C2

## 18.968G Advanced Topic in Production Engineering

C2

## 18.969G Advanced Topic in Production Engineering

C2

Allows the presentation of special topics, particularly by visiting academics.

## 18.970G Seminar (Operations Research)

C0

## 18.975G Advanced Topic in Industrial Engineering

C3

## 18.976G Advanced Topic in Industrial Engineering

C3

**18.977G Advanced Topic in Operations Research** C2

**18.978G Advanced Topic in Operations Research** C2

**18.979G Advanced Topic in Operations Research** C2

Allows the presentation of special topics, particularly by visiting academics.

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## Mines

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### Department of Applied Geology

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**25.702G Hydrogeology** S1 L1½T1½ C3

Occurrence of groundwater in sedimentary, igneous and metamorphic rocks; hydrogeology of extreme climatic zones, arid and tropical; aquifer types in porous and fractured rocks. Regional groundwater basins, case histories; Great Artesian basin. Hydrogeological mapping and applications. Exploration for groundwater. Groundwater behaviour and aquifer characteristics; storage and release of water; transmission in permeable and low permeable materials. Groundwater flow; 2 & 3 dimensional, radial, steady and transient flow, pump test analyses, flownets, boundaries. Practical extraction technology (advanced and simple); well design, pumps and testing of wells. Drilling techniques and programs, well completion. Monitoring, data logging technology. Groundwater management, conjunctive use, administration and law.

**25.704G Environmental Geology** S1 L1½T1½ C3

Geological hazards: seismic risk, landslides, subsidence, floods, erosion, volcanic eruptions, discrete and continuous hazards, event return time. Geological resources and their management: types of resources, use and potential environmental conflict, resource economics and policy formulation. Waste disposal and the mineral industry, reclamation and rehabilitation of land used for extractive purposes. Swamp drainage. Geology and urban planning: map preparation, multiple land use principle, aesthetic criteria for landscape evaluation. Environmental impact of dams, roads, explorative and extractive stages of mining, impact statement techniques, case studies. Communication of geological information to technical and non-technical people. Geological legislation for water resources and waste disposal.

**25.707G Geopollution Management** S1 L1½T1½ C3

**25.707X**

Material properties and hydrodynamic factors influencing surface and subsurface flow of pollutants in rocks and soils. Dispersion theory and modelling for pollutants in aquifers. Water quality and the problems of standards. Use of field instruments for quality determination. Geological and technological factors in waste disposal: domestic and industrial wastes, including the Rocky Mountain Arsenal Well case study, deep well injection methods. Management of radioactive wastes, waste disposal problems in limestone areas. Case studies of aquifer pollution and practical measures for preventing pollution. Rational planning of water resources for industrial and domestic use.

**25.715G Sources of Waste and** S1, C3 L2T1;

**25.715X Landfill Disposal** S1, external C3

Sources of solid and liquid wastes, design and operation of landfills, processes within landfills, re-use and planning of sites, transport of waste.

**25.816G Geological Remote Sensing** S1† L4

The physics of various remote sensing techniques; interpretation of conventional aerial photography in exploration; Infra-red remote sensing techniques; side linking airborne radar; theory and applications of Landsat imagery; enhancement techniques for satellite imagery; interpretation of Landsat photographic products and application to several case history areas. Integration of remote sensing information with the overall data base as applied to exploration.

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## Geography

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**27.043G Remote Sensing Applications** S1 L1T2 C3

The application of remotely-sensed data and information in the description, classification and assessment of earth resources and environmental conditions. Different types of remote sensing data and imagery, their attributes, acquisition and uses. Relevance of remote-sensing data and imagery to a range of applications, including assessment of conditions of terrain, soils and surface materials; multitemporal monitoring and inventory of rangelands, croplands and forests; rural and urban land use assessment; surveillance of surface water resources and sedimentation; appraisal of changes in the coastal zone. Use of remote sensing in environmental management and in environmental impact assessment.

## **27.174G Remote Sensing Instrumentation and Satellite Programs** S1 L2T1 C3

Aircraft and satellite platforms; sensor types; image formation and end products including panchromatic, colour, colour IR and thermal IR photographic products, microwave imagery and computer tape products. The organization, acquisition, processing and analysis of imagery obtained from the following satellite programs; Landsat, Skylab, Heat Capacity Mapper Mission, Geodynamics Experimental Ocean Satellite, NOAA-9, Nimbus Coastal Zone Colour Scanner, Seasat, Space Shuttle, Spot and Soyuz-Salyut.

## **27.644G Computer Mapping and Data Display** C3

Introduction to automated cartography and thematic mapping; theoretical and practical problems in displaying and mapping data by computer; review and application of selected computer mapping packages. INFO is used for database management, and ARC-INFO for cartographic manipulation and output.

## **27.672G Geographic Information Systems** C3

Study of selected geographic information systems; problems of data capture and display, data storage and manipulation, system design and development; cartographic displays and computer mapping. INFO is used for database management, and ARC-INFO for spatial data manipulation and display.

## **27.715G**

## **27.911G Soil Erosion and Conservation** S1 or S2 L2T4 C6

Climatic, vegetational, geomorphic and pedologic controls of erosion. Physical processes of sediment transport and deposition. Conservational measures for the prevention of erosion including constructional and management practices. Methods of assessing soil loss risk and erosion hazard evaluation.

## **27.914G Terrain Evaluation**

Principles and techniques for natural resource surveys and land evaluation including: land systems, terrain patterns, land capability and economic aspects of evaluation; examination of mapping, taxonomic and descriptive units; the problem of map scale and accuracy; styles of presentation for practitioners and other uses. Application of principles in selected other contexts.

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# Marketing

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## **28.913G Marketing Management** S1 L3

*Prerequisites: 28.911G and 28.912G.*

Conceptual framework relevant to the practice of marketing

management developing an understanding of the market function. Emergence of a broader concept of marketing; relationship between corporate and marketing strategy; the marketing environment; market segmentation; marketing planning; determination of product, price channel, advertising and salesforce policies; marketing control.

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# Surveying

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## **29.101G Aspects of Electromagnetic Distance Measurement** SS L2T1 C3

New developments in electronic distance measurements including multiple wavelength systems, interferometers, optical transponders. Component properties of instrumental errors. Techniques of instrumental calibration and establishment of calibration facilities. High precision measurement techniques.

## **29.102G Characteristics of Optical Surveying Instrumentation** SS L2T1 C3

Sources of error in modern optical surveying instruments. Methods of testing and calibration. Observational techniques for reducing effects of errors. Developments in circle reading and level sensing systems. Design of instrument testing facilities.

## **29.103G Precise Engineering Surveys** SS L2T1 C3

Techniques and instrumentation for precise surveys. Applications in industry and engineering; deformation and settlement surveys, surveys for large constructions, optical tooling, special measurement problems.

## **29.106G Special Topic in Surveying A** C3

A special subject to be lectured on by visiting professors or other visiting staff.

## **29.107G Special Topic in Surveying B** C3

A special subject taken by an individual student or a small group of students by private study in conjunction with tutorial sessions with the member(s) of staff in charge of the subject.

## **29.151G Adjustment of Control Surveys** SS L2T1 C3

Choice and analysis of adjustment models in geodetic triangulation and control surveys. Detection of outliers. Design optimization and analysis of survey control networks. Methods of carrying out very large continental adjustments.

## **29.210G Satellite Surveying** SS L2T1 C3

Concepts of satellite surveying; nomenclature, TRANSIT system, GPS for point and relative positioning, vertical control. Sur-

veying with GPS: planning a survey, field and office procedures, case studies. Considerations for high-precision applications: aspects of satellite geodesy, modelling the observable, dual frequency observations, orbit determination, short-arc techniques.

**29.211G Introduction to Geodesy S1 L2T1 C3**

Geodesy in the service of mankind. The earth's gravity field. The earth's motion in space. Co-ordinate and time systems used in geodesy. Horizontal and vertical control networks. Earth satellite motion. Principles of satellite positioning. Gravimetric geodesy. Space geodetic methods. Variations of geodetic positions with time.

**29.213G Physical Meteorology S2 L2T1 C3**

Electromagnetic wave propagation, geometrical optics approximation, emission and transfer of radiation. Structure of the earth's atmospheric envelope, surface layer and boundary layer meteorology, structure of the ionosphere, atmospheric turbulence, meteorological measurements. Interaction and propagation of electromagnetic radiation. Refraction, scattering, absorption, dispersion, reflection. Description, models and solutions of geodetic refraction effects. Atmospheric effects on remote sensing (visible, infrared and microwaves). Remote sensing of atmospheric parameters.

**29.217G Gravimetric Geoid Evaluations SS L2T1 C3**

Introduction to the representation of the earth's gravity field Physical model for the earth. Geodetic boundary value problem. Techniques, for evaluating Stokes' integrals. Relative geoid determinations. Combination techniques.

**29.530G Analytical Photogrammetry SS L2T1 C3**

Fundamental relationship, image and object space. Interior orientation, deviations from collinearity. General orientation of one and two images by collinearity. Simultaneous block adjustment by bundles. Additional parameters. Calibration of metric and non-metric cameras. Control requirements in analytical photogrammetry.

**29.532G Computer-Assisted Mapping SS L2T1**

Introduction to principles of Computer Assisted Mapping. Collection and editing of feature coded digital terrain data in vector and raster form. Digital elevation models; acquisition interpolation and processing. Automation of mapping procedures. Archival of digital map data. Mapping systems based on computer assisted techniques.

**29.600G Principles of Remote Sensing S1 L2T1 C3**

History and development. Definition and physics of basic electromagnetic radiation quantities. Basic-energy matter relationship. Spectral signatures of surfaces. Atmospheric considerations and the reduction of atmospheric effects. Sensor concepts including film and electro-optical sensors. An introduction to data processing and enhancement, including image interpretation procedures.

**29.602G Remote Sensing Procedures S2 L2T1 C3**

Review of atmospheric correction procedures and application to multi-temporal Landsat MSS data. Review of image registration, enhancement and classification procedures with particular reference to multi-source remote sensing data sets. Analysis of techniques over a varied land use area. Land use change project and analysis using multi-source and multi-temporal remotely sensed imagery, including Landsat MSS, TM, SPOT and SAR.

**29.603G Statutory Controls of Land Development SS L2T1 C3**

Detailed examination of the subdivision and development process in N.S.W., with particular emphasis on the statutory procedures and controls at the local government level. The Local Government Appeals Tribunal and its major relevant decisions. Local Government and land development law. Case studies in land development.

**29.604G Land Information Systems SS L2T1 C3**

Land information as maps and records. Methods of data collection. Integrated surveys and coordinate systems. Legal boundaries. Land tenure. Identifiers. Computerization of land information. Data input methods. Data storage methods. Data processing and manipulation, including management, searching, existing data base languages, and interactive data editing. Data output, including computer graphics, line printer maps, and digital plotters. Application of Arc-Info LIS software.

**29.605G Ground Investigations for Remote Sensing S1 L2T1 C3**

The spectral, temporal and spatial characteristics of various surfaces, and the available sensors to effect maximum differentiation. Ground and image comparisons. Instruments available for field measurements. Field investigation procedures including positioning and sampling considerations.

**29.608G Cadastral Systems SS L2T1 C3**

The cadastral concept. Cadastral surveying and mapping, land registration, valuation of land, land tenure and land administration. Cadastres and land information systems (L.I.S.). Strategies for improving cadastral systems. Cadastral systems in developing countries; legal, technical, administrative, economic and social issues.

**29.909G Project C9**

**29.918G Project Report C18**

**29.936G Thesis C36**

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**Biomedical Engineering**


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**32.009G Project** **C9**

**32.010G Biomedical Engineering Practice** **S2 L2 C2**

Introduction to clinical situations in hospitals. Presentation of guest lectures by eminent people working in this field. Lecture topics include cardiology, neurology, orthopaedics, rehabilitation, etc. Visits to various biomedical engineering units.

**32.012G Biomedical Statistics** **S2 L2½ T1½ C4**

Statistical assessment of normal and diseased states. Statistical relationships between multiple variables used to assess disease; analysis of variance, regression, factor analysis, discriminant analysis. Progression of diseases over time. Diagnosis and assessment of treatments. Experimental design and sampling. Computation methods.

**32.018G Project Report** **C18**

**32.025G Radiation Physics** **S1 L3T2 C5**

Sources, effects and uses of radiation on human tissues. Ultrasonic, X-ray and nuclear radiations are included together with ultraviolet, infrared, laser, microwave and longer wavelength electromagnetic effects.

**32.030G Project Report** **C30**

**32.040G Analogue Electronics for Biomedical Engineers** **S1 L2 T2 C4**

Basic theory of passive components, simple network analysis, small signal amplifiers, feedback and oscillators, operational amplifiers and their uses, analogue integrated circuits. Transistors as logic devices, gates. Safety requirements for medical instruments, circuit diagram analysis and component identification. Laboratory work involves both design and construction of analogue circuits.

**32.050G Microprocessors and Circuit Design for Biomedical Engineers** **S2 L2 T2 C4**

*Prerequisite: 32.040G and 32.501G or equivalents.*

Examination of the fundamental digital and analogue signal conditioning circuits commonly found in medical applications. Emphasis is given to project-oriented practical experience involving aspects of biological signal acquisition by microcomputers. Fundamentals of microprocessor hardware and software.

**32.060G Biomedical Systems Analysis** **S1 L2T1 C3**

Compartmental analysis serves to unify modelling and analysis in many diverse fields. It has wide application in pharmacokinetics, metabolic, ecosystem and chemical kinetic modelling, and in the future will be applied increasingly to engineering systems. Topics include: classes of compartmental structure; fundamental properties; rate processes; inferred parameters; input-dependent kinetics; optimal input design; algorithms for identification and control.

**32.101G Mathematical Modelling for Biomedical Engineers** **S1 L3T1 C4**

Model formulation and validation, solution of ordinary and partial differential equations by analytical and numerical techniques.

**32.311G Mass Transfer in Medicine** **S2 L2T2 C4**

Material and energy balances, modelling of intrabody mass transfer, elementary treatment of diffusion, convection, hydraulic permeability and osmosis in biological and synthetic membranes. Applications to hemodialysis, blood oxygenators, artificial pancreas and slow release drug delivery systems.

**32.321G Physiological Fluid Mechanics** **S2 L2T2 C4**

Fundamentals of biological fluid flow by way of the governing equations. Kinematics and dynamics, viscous and inertial flow, boundary layers, separation, physiological flows (cardiac, vascular, pulmonary, urinary, etc.) and flow in artificial organs.

**32.332G Biocompatibility** **S2 L2T1 C3**

Interaction of biological fluids and cells with foreign surfaces, *in vitro* tests to assess biocompatibility and thrombogenicity, current status of biocompatible materials as applied to extracorporeal systems, surgical implants and prosthetic devices.

**32.501G Computing for Biomedical Engineers** **S1 L2T2 C4**

Algorithm design and documentation, printer plotting, editing, using the VAX/VMS systems. Programming in FORTRAN and PASCAL languages. Overview of computing in biomedical engineering and hospitals. Automated patient monitoring and laboratory testing. Data storage and information retrieval.

**32.510G Introductory Biomechanics** **S1 L2T1 C3**

The principles of the mechanics of solid bodies: force systems; kinematics and kinetics of rigid bodies; stress-strain relationships; stress analysis of simple elements application to musculoskeletal system.

**32.541G Mechanics of the Human Body SS L2T1 C3**

*Prerequisite: 32.510G or equivalent.*

Statics and dynamics of the musculoskeletal system: mathematical modelling and computer simulation, analysis of pathological situations.

**32.551G Biomechanics of Physical Rehabilitation SS L2T1 C3**

*Prerequisite: 32.510G or equivalent.*

The application of biomechanics principles to the areas of: performance testing and assessment, physical therapy, design of rehabilitation equipment, design of internal and external prostheses and orthoses.

**32.561G Mechanical Properties of Biomaterials SS L2T1 C3**

*Prerequisite: 32.510G or equivalent.*

The physical properties of materials having significance to biomedical engineering; human tissues; skin; soft tissues; bone; metals; polymers and ceramics: the effects of degradation and corrosion.

**32.601G Biomedical Applications of Microprocessors 1 S1 L3 C3**

*Prerequisite: 32.050G or equivalent.*

Definitions of the physiological problem, specification of physiological/biological signals. Definition of instrument specification, analysis of signal conditioning in relation to relevant physiological information. Analogue circuit development, techniques of analogue/digital conversion, data acquisition. Technical specifications of host microcomputer and its use as a development tool. Implementation of data manipulation algorithms, software development for assembly routines and compiled applications.

**32.602G Biomedical Applications of Microprocessors 2 S2 L3 C3**

The aim of this subject is to obtain the microcomputer-developed system from the previous subject (32.601G) and to produce a stand-alone printed circuit board. Use of logic analyzer and debugging techniques for machine language programs and hardware design. Exposure to different types of microprocessors by use of simulators and emulators. Definition and selection of microprocessor. Transfer of microcomputer-developed system to specified microprocessor. Implementation of hardware on printed circuit board. Testing of stand-alone device.

**32.603G Static and Flow Cytometry S2 L3 C3**

Technology, techniques and uses of flow and static cytometry. Flow cytometers (analysis and cell sorting), image analysis and cell counting from slides. Preparation and staining of cells. Data acquisition and analysis. Applications in medical research and diagnosis.

**32.611G Medical Instrumentation S2 L2T1 C3**

*Prerequisite: 32.040G or equivalent.*

A critical survey of the theory and practical applications of medical transducers and electromedical equipment in common use in hospitals and research laboratories.

**32.621G Biological Signal Analysis S1 L3C3**

Use of digital computers to extract information from biological signals. Signal processing using filtering, averaging, curve-fitting and related techniques, and analysis using model simulations, correlation, spectral analysis etc.

**32.701G Dynamics of the Cardiovascular System S1 L2T1 C3**

Structure of the heart; organization of the mammalian vasculature; mechanical, electrical and metabolic aspects of cardiac pumping; the solid and fluid mechanics of blood vessels; rheology of blood.

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## Graduate School of the Built Environment

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**39.908G Community Noise Control S1 L1T1 C2**

Introduction; sound and sound propagation, sound power, sound pressure, decibels; sound perception, psychoacoustics loudness, annoyance, phons and dB(A); hearing conservation; acoustic measuring and analysing instruments — sound level meters, filters, analysers, recorders; sound sources, community noise assessment; the NSW Noise Control Act; practical exercises in sound recording, analysis and assessment; noise control — source noise reduction, use of barriers, enclosures, distance, sound absorbing materials; sound transmission through building elements; noise components of environmental impact statements.

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## Biotechnology

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**42.211G Principles of Biology SS L3**

A study of the characteristics of living systems, including a functional treatment of cytology, metabolism, bioenergetics; structure, function and characteristics of single and multicellular systems; growth; cell division; reproduction; heredity and evolution.

**42.212G Principles of Biochemistry**

SS L3

A condensed treatment of biochemistry comprising the following aspects: the elemental and molecular composition of living organisms; the chemistry and roles of the biological elements and molecules; the thermodynamics and enzymatic catalysis of metabolism; catabolic, anabolic, amphibolic and anaplerotic processes, with emphasis on hydrolysis and synthesis of polymers, glycolysis and gluconeogenesis of glucose. O-oxidation and synthesis of fatty acids, deamination and decarboxylation of amino acids, the tricarboxylic acid cycle, electron transport and oxidative phosphorylation; metabolic regulation and integration.

**42.407G Biological Principles**

SS L3

A study of the characteristics of living systems. Biological molecules: carbohydrates, lipids, proteins and nucleic acids. Cell structure and function: prokaryotic and eukaryotic cells. Basic biochemistry: thermodynamics and catalysis of metabolism; catabolic and anabolic processes; properties of enzymes; DNA replication; protein synthesis. Comparative metabolism of viruses, bacteria, fungi, plants and animals. Metabolic regulation. Modes of nutrition and nutrient cycles. Reproduction and genetics: eukaryotic and prokaryotic systems; sexual and asexual reproduction; bacterial genetics; recombinant DNA technology. Microorganisms of commercial significance. Biodeterioration and biodegradation. Pathogenic micro-organisms; aetiology and epidemiology of infection; host defence mechanisms; chemotherapy; mechanisms of drug action; drug resistance.

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**Faculty of Applied Science**


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**46.203G Medical Aspects**

C2

Aspects of medicine bearing upon physiological consequences of pollutants. Synergism and antagonisms, photosynthesis and phytotoxicity, metabolic mechanisms; morbidity and mortality surveys; exposure indices. Particular pollutants aldehydes, nitroolefins, carbon monoxide, sulphur dioxide, oxides of nitrogen, hydrocarbons, ozone and oxidants, particulates, carcinogens.

**46.204G Legislative Aspects**

C2

Resources in law for the preservation of satisfactory environments. Local government, town planning, environmental, common law. History of Australian legislation — consequences in border regions. Types of legislation and machinery measures and actions thereunder. Problems administration of available law. American experience. Economic and sociological factors.

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**Safety Science**


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**47.030G Computing for Safety Science**

C3

Nature and description of information in digital form, processing of information with special reference to the computer, microprocessor and microcomputer. Identification and statement of information flow problems, construction of models for computer solution, flow charts and control node diagrams, basis of a computer high-level language. Programming in BASIC, fundamental statements, loops and arrays, character strings and word processing, graphs, histograms and tables. Peripheral hardware, storage and filing, examples of operating systems. Spread sheets and data base systems with application to health and safety monitoring.

**47.051G Principles of Engineering Mechanics**

C3

*Solid mechanics:* force systems, equilibrium, friction, frames and beams; stress-strain relationships, bending stress, buckling, safe loads; applications in safety and biomechanics. *Fluid flow:* static pressure, continuity of flow, Bernoulli's equation, laminar and turbulent flow, sound wave propagation in air; applications in ventilation and acoustics.

**47.052G Introduction to Safety Engineering**

C3

Basic safety practice; management of dangerous materials; fire and explosion; ventilation; noise control; radiation protection; electrical safety; biological safety; machine dangers and machine guarding; construction safety; transport safety; environmental safety; plant safety assessment.

**47.054G Machines and Structures Safety**

C3

*Prerequisite:* 47.051G or equivalent.

Machinery contact dangers; machine guarding; safety during maintenance. Materials handling safety: cranes, slings, fork-lift trucks, conveyors. Construction safety: ladders, scaffolds, formwork, excavations. Structural failures, fractures, pressure vessels.

**47.060G Electrical Safety**

C3

Electric current; effects of current flow and electric fields; elementary circuit representation, typical supply situations; likely dangerous conditions; static electricity; hazardous location; some special problem areas: codes of safe working; treatment of electric shock.

**47.061G Principles of Ergonomics**

C3

Applied anatomy and kinesiology, anthropometry; application to work place arrangement, seating and bench design, tool and equipment design, lifting techniques, consumer product and architectural design. Physiological and psychological aspects of work and fatigue; measurement of energy consumption, limits to energy expenditure at work, static muscular fatigue, boredom. Environment effects; natural and artificial lighting arrangements, problems of perception, colour; noise and vibration, preventive

measures; heat and ventilation, thermal regulation in humans, criteria for comfort, effects of pollutants, Man-machine interface. Displays, machine controls, reaction times, vigilance. Applications of ergonomics to occupational safety and health. Ergonomic research methodology.

*Note:* A project forms a substantial proportion of the assessment for this subject.

**47.062G Applied Ergonomics C3**

*Prerequisite:* 47.061G at credit level or equivalent.

Cognitive ergonomics. Decision making, vigilance, effects of workload and stress, applications to screen-based equipment. Work systems: the systems approach, practical evaluation and re-design of work systems. Experimental methodology: experimental design in ergonomics, critical evaluation of the literature.

**47.070G Ventilation C3**

*Prerequisite:* 47.051G or equivalent.

Nature of airborne contaminants: gases, vapours, dusts, heat and fumes. Assessment criteria. Ventilation systems for contaminant control: booths, enclosures, receiving and capture hoods, general dilution systems and natural ventilation. Design methods based on capture velocity, face velocity, control velocity and flow ratio principles. Properties of fan and duct systems. Alternatives to ventilation. Three laboratory sessions: air flow measurement, fans, capture hoods.

**47.090G Introduction to Occupational Health and Safety Law C3**

The concept of law; the creation and interpretation of statutes; the judicial and court systems; locus standi; common law and equity; basic principles of legal liability (civil and criminal); basic principles of administrative law and the liability of the Crown; the common law of employment; statutory regulation of employment; compulsory arbitration of industrial disputes. Outline of occupational health, safety and compensation legislation of the Australian States. Actions under the common law.

**47.120G Human Behaviour and Safety Science C3**

Industrial relations and implementation of a safety program. Learning and safety programs. Attitudes and attitude change. Safety compliance — individual and group factors affecting compliance. Work motivation and safety practice. Accident proneness and personnel selection. Individual differences in attitudes to work.

**47.180G Management for Safety C3**

*Prerequisite:* 47.120G.

Accounting for accident costs; risk management; safety management and loss control; organization and management for safety;

cost effectiveness of safety programs. Selection and training of personnel. Communication; modes of communication; preparation of safety and accident reports; presentation of evidence. Management of occupational health problems through prevention, early reporting and rehabilitation.

**47.230G Radiation Protection C3**

Radiation physics; radiation dosimetry; radiation biology; shielding and control of radiation; administration; waste management; emergency procedures; environmental impact, non-ionizing radiation. Special topics; practical work and site visit.

**47.330G The Accident Phenomenon C3**

*Assumed knowledge:* 10.331 or equivalent.

Causes of accidents and defensive strategies; energy storage and transfer; risk benefit concepts; epidemiology of accidents; reduction of loss from accidental injury; human factors; the environment and accidents; system reliability and fault-tree analysis in the study and control of accidents; study of some major accidents; accident investigation and analysis; case studies in transport, industry, recreation and the home.

**47.480G Fire and Explosion C3**

Chemistry and physics of combustion reactions; types of flames; deflagration and detonation. Properties of flammable materials: gases, vapours, liquids, dusts and solids. Ignition, self heating and pyrophoric substances. Fire behaviour in buildings, detection, control and extinguishment. Smoke: properties and control. Building regulations and application of appropriate fire and explosion standards. Process industry fires, thermal radiation estimation and assessment. Explosion prevention and suppression and venting. Detonation and blast waves: overpressure, impulse, scaled distance and blast damage estimation. Hazard analysis.

**47.481G Management of Dangerous Materials C3**

Introduction. Measurement of environmental concentration of gases and particulate hazardous materials. Atmospheric dispersion of gaseous and particulate materials. Protection against dangerous materials for operators and other personnel. Respiratory protection and protective clothing. Storage, handling and transport of flammable liquids, dangerous goods and cryogenic material. Storage and transport of compressed gases. Disposal of dangerous materials; incinerators; flare stacks, landfill, dispersal. Relevant legislation. Field excursion.

**47.903G Special Report in Safety Science C3**

Only for students enrolled in the Graduate Diploma course in Safety Science.

**47.909G Project C9**

**47.918G Project Report C18**

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## Chemical Engineering and Industrial Chemistry

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**48.063G Industrial Water and Wastewater Engineering** S1 or S2 L3

Environmental consequences of water pollution. Water quality criteria and regulations related to industrial use and disposal. Water sources and requirements of industry. Theoretical and practical aspects of treatment methods, including screening, sedimentation, oil separation, coagulation and flocculation, filtration, biological treatment, adsorption, ion exchange, membrane processes. Strategies for industry including waste surveys, prevention at source, correction before discharge water reuse. Economic aspects. Seminars. Factory visits/laboratory.

**48.391G Atmospheric Pollution and Control (Theory)** S1 or S2 L3

Causes, properties, dispersion, measurement and monitoring control and legislation of air pollution in ambient and industrial environments.

**48.391X Atmospheric Pollution and Control (Theory)** S1 or S2 L3

Causes, properties, dispersion, measurement and monitoring, control and legislation of air pollution in ambient and industrial environments.

**48.392G Practical Aspects of Air Pollution Measurement and Control** S1 or S2 T3

*Prerequisite:* 48.391G.

Laboratory and tutorial programs in the measurement and analysis of ambient and industrial air pollutants. Computation tutorials in advanced dispersion models, aerosol dynamics and control equipment design parameters.

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## Librarianship

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**55.817G Information Storage and Retrieval Systems**

Role of thesauri and other indexing language structures. Automated thesaurus design and maintenance. Automatic indexing

and classification systems. Concept co-ordination, use of Boolean operators and search strategy design. Systems analysis, design and costing. Design of user and interactive cueing tutorials. Choice criteria for on-line and batch systems. Testing, analysis and evaluation of systems. Advanced technologies for information storage and retrieval.

**55.823G Files and Database Systems** S1

File structures, database management systems and file interrogation systems in a text processing or bibliographical environment. *Topics:* relations, their mapping and normalization; access methods; data organization; independence, integrity and security; CODASYL databases, relational databases and query languages.

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## Anatomy

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**70.201G Introductory Functional Anatomy**

An overview of basic human anatomy and physiology with an emphasis on structures and systems such as the eye, ear and skin, which are most vulnerable to chemical and physical trauma under industrial conditions. Other systems studied include the musculo skeletal system, central and peripheral nervous systems, circulatory, respiratory, gastrointestinal, endocrine and urogenital systems.

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## Pathology

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**72.402G Principles of Disease Processes** S1 L3 C3

*Prerequisites:* 73.111 or equivalent, 70.011C or equivalent.

Not offered in 1988.

The reaction of cells to injury, the inflammatory reaction; necrosis-vascular changes and infarction; reparative processes; frac-

ture healing; neoplasia; reaction to implants; specific processes requiring prosthetic assistance.

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## Physiology and Pharmacology

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### 73.111 Physiology 1 F L2T4

*Prerequisites:* 17.031 & 17.041; 2.121 & 2.131, or 2.141; 10.001 or 10.011 or 10.021 B & C. *Excluded:* 73.121, 73.011. *Co-requisite:* 41.101.

Introduction to fundamental physiological principles, dealing first with basic cellular function in terms of chemical and physical principles, and, second, with the operation of the various specialized systems in the body, for example, the cardiovascular system, whose function it is to transport materials to and from the tissues of the body; the respiratory system which must maintain the exchange of oxygen and carbon dioxide between the atmosphere and the blood; the gastrointestinal system which enables food materials to be modified by digestion and absorbed into the circulation; the kidney which is involved in the regulation of body fluid and electrolyte balance and with the excretion of the waste products of metabolism; the endocrine system which releases chemical messengers, called hormones, that are carried in the blood stream to regulate a great variety of body functions, eg metabolism and reproductive activity; the nervous system which by means of very rapidly propagated electrical impulses is responsible for all our movements, sensations, memories, emotions and consciousness itself. A substantial series of practical class experiments on these different areas of physiology is included in the course. This subject is taken by students enrolled in any of the Physiology program.

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## Medicine

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### 79.616G Occupational Epidemiology S1 L3 C3

*Prerequisite:* 16.901G or equivalent. *Prerequisite or co-requisite:* 80.701G or equivalent.

Epidemiology — the narrow sense, historical development. Genes and environment in human variation. Basic demography. Perceptions of 'disease' — professional and lay. Sources of data in occupational epidemiology. Survey design and applications. Screening. Recording of data — graphical, tabular, parametric. Registers. Computer hardware and software in occupational epidemiology. Bias and its control. Confounding factors. Morbidity, mortality, life tables. Analysis of epidemiological data. Interpretation of results. Quantification of risk. Investigation of observed associations. Causation.

### 79.617G Occupational Medicine Practice F C6

*Prerequisite:* Approved medical degree, 80.702G and 79.616G or equivalent

Provides experiential learning for those medical graduates undertaking the MSafetySc course who intend to join the College of Occupational Medicine. Students visit industrial sites and centres for occupational Medicine. Students visit industrial sites and centres for occupational health control. A comprehensive series of reports on investigations at these visits is required. It is expected that this subject will be taken towards the end of the MSafetySc course.

### 80.701G Occupational Disease S2L3 C3

*Prerequisite:* 70.201G or equivalent.

*Physical environment and disease:* Musculoskeletal system, physical trauma; heat and cold, burns, electric shock; radiation; pressure, vibration, noise, hearing. *Chemical environment and disease:* Metallic poisons, toxic compounds, gaseous poisons, carcinogens, allergens. *Microbial environment and disease.* *Systems approach:* Gastrointestinal tract; renal system; central and peripheral nervous systems; visual system, respiratory system, airborne particulates; skin.

### 80.702G Occupational Health Control S1L3 C3

*Prerequisite:* 80.701G or equivalent.

Introduction; dose response; risk, codes of safe practice; protection of the worker; design of safe workplace; protective equipment; occupational health surveillance; epidemiology; occupational safety program; emergency arrangements; environmental health; non-occupational safety; safety services.

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## Faculty of Engineering

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### 97.580G Image Analysis in Remote Sensing C3

*Prerequisite:* 10.361 or similar.

Techniques for extracting information from remotely sensed data with particular emphasis on satellite imagery. Topics taken from: nature and characteristics of earth resources and related satellites; satellite sensors and data formats; image enhancement techniques; image classification methods, including clustering, classification and feature selection; image classification methodologies; new horizons in remote sensing image analysis.

### 97.581G Microwave Remote Sensing C3

Use of passive and active (radar) microwave techniques in remote sensing of earth resources. Topics include: real and

synthetic aperture radar systems; passive microwave radiometry; energy-surface interactions; interpretation of microwave image data: applications in agriculture, geology, oceanography and hydrology; issues in signal and image processing; characteristics of airborne and spaceborne microwave sensors.

### **97.601G Computer Aided Design for Manufacture C3**

Principles underlying the interactive computer graphics packages such as AUTOCAD, CADAM, CATIA. Applications to design and engineering processes. Projects on building packages for design or upgrading the existing packages.

### **97.602G Computer Integrated Manufacturing C3**

*Prerequisite: 18.465G.*

Systems analysis and design of computer integrated manufacturing, including flexible manufacturing systems and automated factories.

### **97.603G Product Design and Technological Innovation C3**

Definitions of design and innovation. Product design. Technological innovation. The creative process. Organizational strategies and practices for innovation. Design, marketing and the consumer. Diffusion of innovations. Government policies for design and innovation. Design evolution, technological innovation and economic growth. Innovation projects.

### **97.604G Flexible Manufacturing Systems C3**

*Prerequisite: 18.465G.*

Technical aspects of FMS components, including automated material-handling devices, job selection/design and their aggregation. Hierarchical structure of FMS; mathematical models of FMS.

### **97.605G CAD for Manufacture 2 C3**

*Prerequisite: 97.601G.*

Topics related to methods of geometric modelling for curves, surfaces and solid models, and their applications to computer-aided design problems in manufacturing industry. Finite element methods in CAD. Intelligent CAD systems: principles and applications.

**Graduate Study**

# Conditions for the Award of Higher Degrees

## First Degrees

Rules, regulations and conditions for the award of first degrees are set out in the appropriate **Faculty Handbooks**.

For the list of undergraduate courses and degrees offered see **Table of Courses (By Faculty): Undergraduate Study**, in the Calendar.

## Higher Degrees

The following is the list of higher degrees and graduate diplomas of the University, together with the publication in which the conditions for the award appear.

For the list of graduate degrees by research and course work, arranged in faculty order, see **Table of Courses (by faculty): Graduate Study** in the Calendar.

For the statements **Preparation and Submission of Project Reports and Theses for Higher Degrees** and **Policy with respect to the Use of Higher Degree Theses** see later in this section.

	Title	Abbreviation	Calendar/Handbook
<b>Higher Degrees</b>	Doctor of Science	DSc	Calendar
	Doctor of Letters	DLitt	Calendar
	Doctor of Laws	LLD	Calendar
	Doctor of Medicine	MD	Calendar Medicine
	<b>Doctor of Philosophy</b>	<b>PhD</b>	Calendar <b>and all handbooks</b>
	Master of Applied Science	MAppSc	Applied Science

# Engineering

Title	Abbreviation	Calendar/Handbook
Master of Architectural Design	MArchDes	Architecture
Master of Architecture	MArch	Architecture
Master of Archives Administration	MArchivAdmin	Professional Studies
Master of Arts	MA	Arts University College
<b>Master of Biomedical Engineering</b>	<b>MBiomedE</b>	<b>Engineering</b>
Master of Building	MBuild	Architecture
Master of the Built Environment	MBEEnv	Architecture
Master of the Built Environment (Building Conservation)		
Master of Business Administration	MBA	AGSM
Master of Chemistry	MChem	Sciences*
Master of Cognitive Science	MCogSc	Arts
Master of Commerce (Honours)	MCom(Hons)	Commerce
Master of Commerce	MCom	Commerce
Master of Community Health	MCH	Medicine
Master of Construction Management	MConstMgt	Architecture
Master of Education	MEd	Professional Studies
Master of Educational Administration	MEdAdmin	Professional Studies
<b>Master of Engineering</b>	<b>ME</b>	<b>Engineering</b> Applied Science University College
<b>Master of Engineering without supervision</b>		<b>Engineering</b> Applied Science
<b>Master of Engineering Science</b>	<b>MEngSc</b>	<b>Engineering</b> University College Applied Science
Master of Environmental Studies	MEnvStudies	Professional Studies
Master of Health Administration	MHA	Professional Studies
Master of Health Personnel Education	MHPed	Medicine
Master of Health Planning	MHP	Professional Studies
Master of Industrial Design	MID	Architecture
Master of Landscape Architecture	MLArch	Architecture
Master of Landscape Planning	MLP	Architecture
Master of Laws	LLM	Law
Master of Librarianship	MLib	Professional Studies
Master of Mathematics	MMath	Sciences*
Master of Management Economics	MMgtEc	University College
Master of Music	MMus	Arts
Master of Nursing Administration	MNA	Professional Studies
Master of Optometry	MOptom	Sciences*
Master of Paediatrics	MPaed	Medicine
Master of Physics	MPhysics	Sciences*
Master of Project Management	MPM	Architecture
Master of Psychology (Clinical)	MPsychol	Sciences§
Master of Psychology (Applied)	MPsychol	Sciences§
<b>Master of Safety Science</b>	<b>MSafetySc</b>	<b>Engineering</b>
<b>Master of Science</b>	MSc	Applied Science Architecture <b>Engineering</b> Medicine University College Sciences*§ Applied Science Architecture <b>Engineering</b> Medicine Science
<b>Master of Science without supervision</b>		Applied Science Architecture <b>Engineering</b> Medicine Science
Master of Science (Acoustics)	MSc(Acoustics)	Architecture
Master of Science (Industrial Design)	MSc(IndDes)	Architecture

**Higher Degrees  
(continued)**

	Title	Abbreviation	Calendar/Handbook
<b>Higher Degrees (continued)</b>	Master of Science and Society	MScSoc	Arts
	Master of Social Work	MSW	Professional Studies
	Master of Statistics	MStats	Sciences*
	Master of Surgery	MS	Medicine
	<b>Master of Surveying</b>	<b>MSurv</b>	<b>Engineering</b>
	<b>Master of Surveying without supervision</b>		<b>Engineering</b>
	<b>Master of Surveying Science</b>	<b>MSurvSc</b>	<b>Engineering</b>
	Master of Town Planning	MTP	Architecture
Master of Welfare Policy	MWP	Professional Studies	
<b>Graduate Diplomas</b>	<b>Graduate Diploma</b>	<b>GradDip</b>	Applied Science Architecture <b>Engineering</b> Sciences*§
		DipPaed	Medicine
		DipEd	Professional Studies
		DipIM-ArchivAdmin	
		DipIM-Lib	
		DipFDA	Sciences
*Faculty of Science.			
§Faculty of Biological and Behavioural Sciences.			

## Higher Degrees

### Doctor of Philosophy (PhD)

#### Qualifications

1. The degree of Doctor of Philosophy may be awarded by the Council on the recommendation of the Higher Degree Committee of the appropriate faculty or board (hereinafter referred to as the Committee) to a candidate who has made an original and significant contribution to knowledge.

2. (1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor with Honours from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Committee.

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment as a candidate for the degree.

#### Enrolment and Progression

3. (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar at least one calendar month before the commencement of the session in which enrolment is to begin.

(2) In every case, before permitting a candidate to enrol, the head of the school\* in which the candidate intends to enrol shall be satisfied that adequate supervision and facilities are available.

(3) An approved candidate shall be enrolled in one of the following categories:

- (a) full-time attendance at the University;
- (b) part-time attendance at the University.

\*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

(4) A full-time candidate shall be fully engaged in advanced study and research except that the candidate may undertake not more than five hours per week or a total of 240 hours per year on work which is not related to the advanced study and research.

(5) Before permitting a part-time candidate to enrol, the Committee shall be satisfied that the candidate can devote at least 20 hours each week to advanced study and research for the degree which (subject to (8)) shall include regular attendance at the school\* on an average of at least one day per week for 48 weeks each year.

(6) A candidate shall be required to undertake an original investigation on an approved topic. The candidate may also be required to undergo such assessment and perform such other work as may be prescribed by the Committee.

(7) The work shall be carried out under the direction of a supervisor appointed from the full-time academic members of the University staff.

(8) The work, other than field work, shall be carried out in a school\* of the University except that the Committee:

(a) may permit a candidate to spend not more than one calendar year of the program in advanced study and research at another institution provided the work can be supervised in a manner satisfactory to the Committee;

(b) may permit a candidate to conduct the work at other places where special facilities not possessed by the University may be available provided the direction of the work remains wholly under the control of the supervisor;

(c) may permit a full-time candidate, who has been enrolled as a full-time candidate for at least six academic sessions, who has completed the research work and who is writing the thesis, to transfer to part-time candidature provided the candidate devotes at least 20 hours each week to work for the degree and maintains adequate contact with the supervisor.

(9) The progress of a candidate shall be reviewed annually by the Committee following a report by the candidate, the supervisor and the head of the school\* in which the candidate is enrolled and as a result of such review the Committee may cancel enrolment or take such other action as it considers appropriate.

(10) No candidate shall be awarded the degree until the lapse of six academic sessions from the date of enrolment in the case of a full-time candidate or eight academic sessions in the case of a part-time candidate. In the case of a candidate who has had previous research experience the committee may approve remission of up to two sessions for a full-time candidate and four sessions for a part-time candidate.

(11) A full-time candidate for the degree shall present for examination not later than ten academic sessions from the date of enrolment. A part-time candidate for the degree shall present for examination not later than twelve academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

4. (1) On completing the program of study a candidate shall submit a thesis embodying the results of the investigation.

Thesis

(2) The candidate shall give in writing to the Academic Registrar two months notice of intention to submit the thesis.

(3) The thesis shall comply with the following requirements:

(a) it must be an original and significant contribution to knowledge of the subject;

(b) the greater proportion of the work described must have been completed subsequent to enrolment for the degree;

(c) it must be written in English except that a candidate in the Faculty of Arts may be required by the Committee to write a thesis in an appropriate foreign language;

(d) it must reach a satisfactory standard of expression and presentation;

(e) it must consist of an account of the candidate's own research but in special cases work done conjointly with other persons may be accepted provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may not submit as the main content of the thesis any work or material which has previously been submitted for a university degree or other similar award but may submit any work previously published whether or not such work is related to the thesis.

(5) Four copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of theses for higher degrees.

(6) It shall be understood that the University retains the four copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

- Examination**
- 5.** (1) There shall be not fewer than three examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least two of whom shall be external to the University.
- (2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the thesis and shall recommend to the Committee that:
- (a) the candidate be awarded the degree without further examination; or
  - (b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school\*; or
  - (c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or
  - (d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or
  - (e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.
- (3) If the performance at the further examination recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to further examination as determined by the Committee within a period specified by it but not exceeding eighteen months.
- (4) The Committee shall, after consideration of the examiners' reports and the results of any further examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate be permitted to resubmit the thesis after a further period of study and/or research.
- Fees**
- 6.** A candidate shall pay such fees as may be determined from time to time by the Council.

## **Master of Biomedical Engineering (MBiomedE)**

- 1.** The degree of Master of Biomedical Engineering may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.
- Qualifications**
- 2.** (1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Higher Degree Committee of the Faculty of Engineering (hereinafter referred to as the Committee).
- (2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.
- (3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.
- Enrolment and Progression**
- 3.** (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar at least two calendar months before the commencement of the session in which the enrolment is to begin.
- (2) A candidate for the degree shall be required to undertake such formal subjects and pass such assessment as prescribed, and shall submit a project report. The program of advanced study, including the preparation of the project report, shall total a minimum of 60 credits. The number of credits allocated for each subject shall be determined by the Committee on the recommendation of the Director of the Centre for Biomedical Engineering (hereinafter referred to as the head of the school).

\*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

(3) The progress of the candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(4) No candidate shall be awarded the degree until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or five sessions in the case of a part-time candidate. The maximum period of candidature shall be five academic sessions from the date of enrolment for a full-time candidate and eight sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee.

4. (1) A candidate shall be required to undertake a project on an approved topic.

## Project Report

(2) The work shall be carried out under the direction of a supervisor appointed from the full-time academic members of the University staff.

(3) The candidate shall give in writing to the Academic Registrar two months notice of intention to submit a report on the project.

(4) Three copies of the project report shall be presented in a form which complies with the requirements of the University for the preparation and submission of project reports for higher degrees.

(5) It shall be understood that the University retains three copies of the project report submitted for examination and is free to allow the project report to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the project report in whole or in part, in microfilm or other copying medium.

5. (1) There shall be not fewer than two examiners of the project report, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

## Examination

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the project report and shall recommend to the Committee that:

(a) the project report be noted as satisfactory; or

(b) the project report be noted as satisfactory subject to minor corrections being made to the satisfaction of the head of the school; or

(c) the project report be noted as unsatisfactory but that the candidate be permitted to resubmit it in a revised form after a further period of study and/or research; or

(d) the project report be noted as unsatisfactory and that the candidate be not permitted to resubmit it.

(3) The Committee shall, after considering the examiners' reports and the candidate's results of assessment in the prescribed formal subjects, recommend whether or not the candidate may be awarded the degree. If it is decided that the project report is unsatisfactory the Committee shall determine whether or not the candidate may resubmit it after a further period of study and/or research.

6. A candidate shall pay such fees as may be determined from time to time by the Council.

## Fees

1. The degree of Master of Engineering or Master of Science by research may be awarded by the Council on recommendation of the Higher Degree Committee of the appropriate faculty (hereinafter referred to as the Committee) to a candidate who has demonstrated ability to undertake research by the submission of the thesis embodying the results of an original investigation.

## Master of Engineering (ME) and Master of Science (MSc)

2. (1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Committee.

## Qualifications

(2) An applicant who submits evidence of such other academic or professional attainments as may be approved by the Committee may be permitted to enrol for the degree.

(3) When the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant, before being permitted to enrol, to undergo such examination or carry out such work the Committee may prescribe.

**Enrolment and Progression**

3. (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar at least one calendar month before the commencement of the session in which enrolment is to begin.
- (2) In every case, before permitting a candidate to enrol, the head of the school\* in which the candidate intends to enrol shall be satisfied that adequate supervision and facilities are available.
- (3) An approved candidate shall be enrolled in one of the following categories:
  - (a) full-time attendance at the University;
  - (b) part-time attendance at the University;
  - (c) external — not in regular attendance at the University and using research facilities external to the University.
- (4) A candidate shall be required to undertake an original investigation on an approved topic. The candidate may also be required to undergo such examination and perform such other work as may be prescribed by the Committee.
- (5) The work shall be carried out under the direction of a supervisor appointed from the full-time members of the University staff.
- (6) The progress of a candidate shall be reviewed annually by the Committee following a report by the candidate, the supervisor and the head of the school\* in which the candidate is enrolled and as a result of such review the Committee may cancel enrolment or take such other action as it considers appropriate.
- (7) No candidate shall be granted the degree until the lapse of three academic sessions in the case of a full-time candidate or four academic sessions in the case of a part-time or external candidate from the date of enrolment. In the case of a candidate who has been awarded the degree of Bachelor with Honours or who has had previous research experience the Committee may approve remission of up to one session for a full-time candidate and two sessions for a part-time or external candidate.
- (8) A full-time candidate for the degree shall present for examination not later than six academic sessions from the date of enrolment. A part-time or external candidate for the degree shall present for examination not later than ten academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

**Thesis**

4. (1) On completing the program of study a candidate shall submit a thesis embodying the results of the original investigation.
- (2) The candidate shall give in writing two months notice of intention to submit the thesis.
- (3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.
- (4) The candidate may also submit any work previously published whether or not such work is related to the thesis.
- (5) Three copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of higher degree theses.
- (6) It shall be understood that the University retains the three copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

**Examination**

5. (1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.
- (2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the merits of the thesis and shall recommend to the Committee that:
  - (a) the candidate be awarded the degree without further examination; or
  - (b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school\*; or
  - (c) the candidate be awarded the degree subject to further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or

\*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

(d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or

(e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(3) If the performance at the further examination recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to a further oral, practical or written examination within a period specified by it but not exceeding eighteen months.

(4) The Committee shall, after consideration of the examiners' reports and the reports of any oral or written or practical examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate may resubmit the thesis after a further period of study and/or research.

6. A candidate shall pay such fees as may be determined from time to time by the Council.

Fees

1. The degree of Master of Engineering or Master of Science or Master of Surveying without supervision may be awarded by the Council on the recommendation of the Higher Degree Committee of the appropriate faculty (hereinafter referred to as the Committee) to a candidate who has demonstrated ability to undertake research by the submission of a thesis embodying the results of an original investigation.

**Master of Engineering (ME), Master of Science (MSc) and Master of Surveying (MSurv) without supervision**

2. A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales with at least three years relevant standing in the case of Honours graduates and four years relevant standing in the case of Pass graduates, and at a level acceptable to the Committee.

Qualifications

3. An application to enrol as candidate for the degree without supervision shall be made on the prescribed form which shall be lodged with the Academic Registrar not less than six months before the intended date of submission of the thesis. A graduate who intends to apply in this way should, in his or her own interest, seek at an early stage the advice of the appropriate head of school\* with regard to the adequacy of the subject matter and its presentation for the degree. A synopsis of the work should be available.

Enrolment

4. (1) A candidate shall submit a thesis embodying the results of the investigation.

Thesis

(2) The candidate shall give in writing to the Academic Registrar two months notice of intention to submit the thesis.

(3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not related to the thesis.

(5) Three copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of theses for higher degrees.

(6) It shall be understood that the University retains the three copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

5. (1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

Examination

(2) Before the thesis is submitted to the examiners the head of the school\* in which the candidate is enrolled shall certify that it is *prima facie* worthy of examination.

(3) At the conclusion of the examination each examiner shall submit to the Committee that:

\*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

- (a) the candidate be awarded the degree without further examination; or
  - (b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school\*; or
  - (c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or
  - (d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or
  - (e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.
- (4) If the performance at the further examination recommended under (3)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to further examination as determined by the Committee within a period specified by it but not exceeding eighteen months.
- (5) The Committee shall, after consideration of the examiners' reports and the results of any further examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate may resubmit the thesis after a further period of study and/or research.

**Fees** 6. A candidate shall pay such fees as may be determined from time to time by the Council.

## **Master of Engineering Science (MEngSc) and Master of Surveying Science (MSurvSc)**

### **Qualifications**

1. The degree of Master of Engineering Science or Master of Surveying Science may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

2. (1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Higher Degree Committee of the Faculty of Engineering (hereinafter referred to as the Committee).

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.

### **Enrolment and Progression**

3. (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar two calendar months before the commencement of the session in which the enrolment is to begin.

(2) A candidate for the degree shall:

(a) undertake such formal subjects and pass such assessment as prescribed, or

(b) demonstrate ability to undertake research by the submission of a thesis embodying the results of an original investigation of an approved topic, or

(c) undertake an approved combination of the above in which case the thesis component shall be referred to as a project report.

(3) The program of advanced study shall total a minimum of 36 credits. The number of credits allocated for each subject shall be determined by the Committee on the recommendation of the appropriate head of school\*. A 9 credit project report shall be submitted for examination in accordance with the requirements of the appropriate head of the school\* and shall be assessed as a formal subject.

(4) A candidate's proposed program shall be approved by the appropriate head of school\* prior to enrolment. For the purposes of this requirement the appropriate head of school\* shall normally be the head of the school\* providing supervision of the project report or thesis or, if there is no project report or thesis, the major field of study.

\*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

(5) The progress of a candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(6) No candidate shall be awarded the degree until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or four sessions in the case of a part-time candidate. The maximum period of candidature shall be four academic sessions from the date of enrolment for a full-time candidate and eight sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee.

4. (1) A candidate who undertakes an 18 credit project or a 36 credit thesis shall carry out the work on an approved topic under the direction of a supervisor appointed from the full-time academic members of the University staff.

**18 Credit Project Report/  
36 Credit Thesis**

(2) The candidate shall give in writing to the Academic Registrar two months notice of intention to submit a project report or thesis.

(3) The project report or thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not such work is related to the thesis.

(5) Three copies of the project report or thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of project reports and theses for higher degrees.

(6) It shall be understood that the University retains the three copies of the project report or thesis submitted for examination and is free to allow the project report or thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the project report or thesis in whole or in part, in microfilm or other copying medium.

5. (1) There shall be not fewer than two examiners of the project report, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

**Examination of 18 Credit  
Project Report**

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the project report and shall recommend to the Committee that:

(a) the project report be noted as satisfactory; or

(b) the project report be noted as satisfactory subject to minor corrections being made to the satisfaction of the head of the school\*; or

(c) the project report be noted as unsatisfactory but that the candidate be permitted to resubmit it in a revised form after a further period of study and/or research; or

(d) the project report be noted as unsatisfactory and that the candidate be not permitted to resubmit it.

(3) The Committee shall, after considering the examiners' reports and the candidate's results of assessment in the prescribed formal subjects, recommend whether or not the candidate may be awarded the degree. If it is decided that the project report is unsatisfactory the Committee shall determine whether or not the candidate may resubmit it after a further period of study and/or research.

6. (1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

**Examination of 36 Credit  
Thesis**

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the thesis and shall recommend to the Committee that:

(a) the candidate be awarded the degree without further examination; or

(b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school\*; or

(c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or

(d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or

\*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

(e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(3) If the performance at the further examination recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to further examination as determined by the Committee within a period specified by it but not exceeding eighteen months.

(4) The Committee shall, after consideration of the examiners' reports and the results of any further examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate may resubmit the thesis after a further period of study and/or research.

**Fees** 7. A candidate shall pay such fees as may be determined from time to time by the Council.

**Master of Safety Science  
(MSafetySc)**

1. The degree of Master of Safety Science may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

**Qualifications**

2. (1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Higher Degree Committee of the Faculty of Engineering (hereinafter referred to as the Committee).

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.

**Enrolment and  
Progression**

3. (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar at least two calendar months before the commencement of the session in which enrolment is to begin.

(2) A candidate for the degree shall be required to undertake such formal subjects and pass such assessment as prescribed. The program of advanced study shall total a minimum of 54 credits. The number of credits allocated for each subject shall be determined by the Committee on the recommendation of the Course Director (hereinafter referred to as the head of the school).

(3) The progress of a candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(4) No candidate shall be awarded the degree until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or four sessions in the case of a part-time candidate. The maximum period of candidature shall be four academic sessions from the date of enrolment for a full-time candidate and eight sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee.

**18 Credit Project Report**

4. (1) The program of advanced study may include an 18 credit project on an approved topic.

(2) The work shall be carried out under the direction of a supervisor appointed from the full-time academic members of the University staff.

(3) The candidate shall give in writing to the Academic Registrar two months notice of intention to submit a report on the project.

(4) Three copies of the project report shall be presented in a form which complies with the requirements of the University for the preparation and submission of project reports for higher degrees.

(5) It shall be understood that the University retains the three copies of the project report submitted for examination and is free to allow the project report to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the project report in whole or in part, in microfilm or other copying medium.

**Examination of 18 Credit  
Project Report**

5. (1) There shall be not fewer than two examiners of the project report, appointed by the Academic Board on the recommendation of the Committee.

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the project and shall recommend to the Committee that:

- (a) the project report be noted as satisfactory; or
  - (b) the project report be noted as satisfactory subject to minor corrections being made to the satisfaction of the head of the school; or
  - (c) the project report be noted as unsatisfactory but that the candidate be permitted to resubmit it in a revised form after a further period of study and/or research; or
  - (d) the project report be noted as unsatisfactory and that the candidate be not permitted to resubmit it.
- (3) The Committee shall, after considering the examiners' reports and the candidate's results of assessment in the prescribed formal subjects, recommend whether or not the candidate may be awarded the degree. If it is decided that the project report is unsatisfactory the Committee shall determine whether or not the candidate may resubmit it after a further period of study and/or research.

6. A candidate shall pay such fees as may be determined from time to time by the Council.

**Fees**

1. The degree of Master of Surveying by research may be awarded by the Council on the recommendation of the Higher Degree Committee of the Faculty of Engineering (hereinafter referred to as the Committee) to a candidate who has demonstrated ability to undertake research by the submission of a thesis embodying the results of an original investigation.

**Master of Surveying  
(MSurv)**

2. (1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Committee.

**Qualifications**

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) When the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant, before being permitted to enrol, to undergo such examination or carry out such work as the Committee may prescribe.

3. (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar at least one calendar month before the commencement of the session in which enrolment is to begin.

**Enrolment and  
Progression**

(2) In every case, before permitting a candidate to enrol, the Head of the School of Surveying (hereinafter referred to as the head of the school) shall be satisfied that adequate supervision and facilities are available.

(3) An approved candidate shall be enrolled in one of the following categories:

- (a) full-time attendance at the University;
- (b) part-time attendance at the University;
- (c) external — not in regular attendance at the University and using research facilities external to the University.

(4) A candidate shall be required to undertake an original investigation on an approved topic. The candidate may also be required to undergo such examination and perform such other work as may be prescribed by the Committee.

(5) The work shall be carried out under the direction of a supervisor appointed from the full-time members of the University staff.

(6) The progress of a candidate shall be reviewed annually by the Committee following a report by the candidate, the supervisor and the head of the school and as a result of such review the Committee may cancel enrolment or take such other action as it considers appropriate.

(7) No candidate shall be granted the degree until the lapse of three academic sessions in the case of a full-time candidate or four academic sessions in the case of a part-time or external candidate from the date of enrolment. In the case of a candidate who has been awarded the degree of Bachelor with Honours or who has had previous research experience the Committee may approve remission of up to one session for a full-time candidate and two sessions for a part-time or external candidate.

(8) A full-time candidate for the degree shall present for examination not later than six academic sessions from the date of enrolment. A part-time or external candidate for the degree shall present for examination not later than ten academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

**Thesis** 4. (1) On completing the program of study a candidate shall submit a thesis embodying the results of the original investigation.

(2) The candidate shall give in writing two months notice of intention to submit the thesis.

(3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not such work is related to the thesis.

(5) Three copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of higher degree theses.

(6) It shall be understood that the University retains the three copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

**Examination** 5. (1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the merits of the thesis and shall recommend to the Committee that:

(a) the candidate be awarded the degree without further examination; or

(b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school; or

(c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or

(d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or

(e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(3) If the performance at the further examination recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to a further oral, practical or written examination within a period specified by it but not exceeding eighteen months.

(4) The Committee shall, after consideration of the examiners' reports and the reports of any oral or written or practical examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate may resubmit the thesis after a further period of study and/or research.

**Fees** 6. A candidate shall pay such fees as may be determined from time to time by the Council.

**Master of Surveying  
without supervision  
(MSurv)**

See Master of Engineering.

**Master of Surveying  
Science (MSurvSc)**

See Master of Engineering Science.

**Graduate Diploma**

1. A Graduate Diploma may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

**Graduate Diploma  
(Grad Dip)**

2. (1) A candidate for the diploma shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Higher Degree Committee of the appropriate faculty (hereinafter referred to as the Committee).

(2) An applicant who submits evidence of such other academic or professional attainments as may be approved by the Committee may be permitted to enrol for the diploma.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.

3. (1) An application to enrol as a candidate for the diploma shall be made on the prescribed form which shall be lodged with the Academic Registrar at least two calendar months before the commencement of the session in which enrolment is to begin.

**Enrolment and  
Progression**

(2) A candidate for the diploma shall be required to undertake such formal subjects and pass such assessment as prescribed.

(3) The progress of a candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(4) No candidate shall be awarded the diploma until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or four sessions in the case of a part-time candidate. The maximum period of candidature shall be four academic sessions from the date of enrolment for a full-time candidate and six sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee.

4. A candidate shall pay such fees as may be determined from time to time by the Council.

**Fees**

## Scholarships and Prizes

The scholarships and prizes listed below are available to students whose courses are listed in this handbook. Each faculty handbook contains in its **Scholarships and Prizes** section the scholarships and prizes available with that faculty. The **General Information** section of the Calendar contains a comprehensive list of scholarships and prizes offered throughout the University.

### Scholarships

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#### Undergraduate Scholarships

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Listed below is an outline only of a number of scholarships available to students. Full information may be obtained from Room G20, located on the Ground Floor of the Chancellery.

Unless otherwise indicated in footnotes, applications for the following scholarships should be made to the Registrar by 14 January each year. Please note that not all of these awards are available every year.

Donor	Value	Year/s of Tenure	Conditions
<b>General</b>			
Bursary Endowment Board*	\$200 pa	Minimum period of approved degree/combined degree course	Merit in HSC and total family income not exceeding \$6000
Sam Cracknell Memorial	Up to \$3000 pa payable in fortnightly instalments	1 year	Prior completion of at least 2 years of a degree or diploma course and enrolment in a full-time course during the year of application; academic merit; participation in sport both directly and administratively; and financial need

\*Apply to The Secretary, Bursary Endowment Board, PO Box 460, North Sydney 2060, immediately after sitting for HSC.

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**Undergraduate Scholarships (continued)**


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Donor	Value	Year/s of Tenure	Conditions
<b>General (continued)</b>			
Girls Realm Guild	Up to \$1500 pa	1 year renewable for the duration of the course subject to satisfactory progress and continued demonstration of need	Available only to female students under 35 years of age who are permanent residents of Australia enrolling in any year of a full-time undergraduate course on the basis of academic merit and financial need.
W.S. and L.B. Robinson**	Up to \$4200 pa	1 year renewable for the duration of the course subject to satisfactory progress	Available only to students who have completed their schooling in Broken Hill or whose parents reside in Broken Hill; for a course related to the mining industry. Includes courses in mining engineering, geology, electrical and mechanical engineering, metallurgical process engineering, chemical engineering and science.
Universities Credit Union	\$500 pa	1 year with the possibility of renewal	Prior completion of at least 1 year of any undergraduate degree course. Eligibility limited to members of the Universities Credit Union Ltd of more than one year's standing of members of the family of such members.

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**Engineering**
**Electrical Engineering and Computer Science**

They Tyree Westinghouse Electrical Company Pty Ltd	Up to \$6720 over 4 years	1 year renewable for the duration of the course, subject to satisfactory progress	Eligibility for admission to the full-time degree course in Electrical Engineering
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**Mechanical and Industrial Engineering**

James Howden & Co Australia Pty Ltd	Up to \$1000 pa	1 year	Permanent residence in Australia and eligibility for admission to the full-time degree course in Mechanical Engineering
Shell Refining Australia Pty Ltd	Up to \$1500 pa	1 year renewable for the duration of the course, subject to satisfactory progress	Eligibility for admission to Year 2 of the full-time degree course in Mechanical Engineering

**Surveying**

The Institution of Surveyors NSW, Incorporated	Up to \$500 pa	1 year renewable for the duration of the course, subject to satisfactory progress	Permanent residence in Australia and eligibility for admission to the full-time degree course in Surveying. Selection is based on academic merit, personal qualities and financial need
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\*\*Applications close 30 September each year.

**The UNSW Co-op Program**

The University of New South Wales has industry-linked education scholarship programs to the value of \$8000 per annum in the following areas: Business Information Technology, Chemical Engineering, Civil Engineering, Electrical and Computer Engineering, Industrial Chemistry, Mechanical and Industrial Engineering, Mining/mineral Engineering and Applied Geology.

Further information can be obtained by writing to The Co-ordinator, UNSW Co-op Programs Industry-Linked Education Office, C/-Vice-Chancellors Unit.

**Graduate Scholarships**

Application forms and further information are available from the Student Enquiry Counter, located on the Ground Floor of the Chancellery unless an alternative contact address is provided. Information is also available on additional scholarships which may become available from time to time, mainly from funds provided by organizations sponsoring research projects.

The following publications may also be of assistance: 1. *Awards for Postgraduate Study in Australia and Awards for Postgraduate Study Overseas*, published by the Graduate Careers Council of Australia. PO Box 28, Parkville, Victoria 3052\*; 2. *Study Abroad*, published by UNESCO\*; 3. *Scholarships Guide for Commonwealth Postgraduate Students*, published by the Association of Commonwealth Universities\*.

Details of overseas awards and exchanges administered by the Department of Employment, Education and Training can be obtained from: Awards and Exchanges Section, Department of Employment, Education and Training, PO Box 826, Woden, ACT 2606.

Where possible, the scholarships are listed in order of faculty.

\*Available for reference in the University Library.

Donor	Value	Year/s of Tenure	Conditions
<b>General</b>			
University Postgraduate Research Scholarships	Living allowance of \$7600 pa. Other allowances may also be paid.	1-2 years for a Masters and 3-4 years for a PhD degree	Applicants must be honours graduates (or equivalent). Applications to Dean of relevant Faculty.
Commonwealth Postgraduate Research Awards			Applicants must be honours graduates (or equivalent) or scholars who will graduate with honours in current academic year, and who are domiciled in Australia. Applications to Academic Registrar by 31 October.
Commonwealth Postgraduate Course Awards	Living allowance of \$8882 pa. Other allowances may also be paid.	1-2 years; minimum duration of course	Applicants must be graduates or scholars who will graduate in current academic year, and who have not previously held a Commonwealth Post-graduate Award. Applicants must be domiciled in Australia. Preference is given to applicants with employment experience. Applications to Academic Registrar by 30 September.
Australian American Educational Foundation Fulbright Award	Travel expenses and \$A2000 as establishment allowance.	1 year, renewable	Applicants must be graduates who are domiciled in Australia and wish to undertake research or study for a higher degree in America. Applications close 30 September with The Secretary, DEET, AAEF Travel Grants, PO Box 826, Woden ACT 2606.
Australian Federation of University Women	Amount varies, depending on award	Up to 1 year	Applicants must be female graduates who are members of the Australian Federation of University Women.

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**Graduate Scholarships (continued)**


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Donor	Value	Year/s of Tenure	Conditions
<b>General (continued)</b>			
Commonwealth Scholarship and Fellowship Plan	Varies for each country. Generally covers travel, living, tuition fees, books and equipment, approved medical expenses. Marriage allowance may be payable.	Usually 2 years, sometimes 3	Applicants must be graduates who are Australian citizens and who are not older than 35 years of age. Applications close with Academic Registrar in September or October each year.
The English-Speaking Union (NSW Branch)	\$5000	1 year	Applicants must be residents of NSW or ACT. Awarded to young graduates to further their studies outside Australia. Applications close mid-April with The Secretary, Ground Floor, Sydney School of Arts, 275c Pitt Street, Sydney NSW 2000.
Frank Knox Memorial Fellowships tenable at Harvard University	Stipend of US\$7000 pa plus tuition fees	1, sometimes 2 years	Applicants must be British subjects and Australian citizens, who are graduates or near graduates of an Australian university. Applications close with the Academic Registrar mid-October.
Robert Gordon Menzies Scholarship to Harvard	Up to \$US 15,000	1 year	Tenable at Harvard University. Applicants must be Australian citizens and graduates of an Australian tertiary institution. Applications close 31 December with the Registrar, A.N.U., GPO Box 4, Canberra ACT 2601.
Gowrie Scholarship Trust Fund	\$4000 pa. Under special circumstances this may be increased.	2 years	Applicants must be members of the Forces or children of members of the Forces who were on active service during the 1939-45 War. Applications close with the Academic Registrar by 31 October.
Harkness Fellowships of the Commonwealth Fund of New York	Living and travel allowances, tuition and research expenses, health insurance, book and equipment and other allowances for travel and study in the USA	12 to 21 months	Candidates must be Australian citizens and <b>1.</b> Either members of the Commonwealth or a State Public Service or semi-government Authority. <b>2.</b> Either staff or graduate students at an Australian university. <b>3.</b> Individuals recommended for nomination by the Local Correspondents. The candidate will usually have an honours degree or equivalent, or an outstanding record of achievement, and be not more than 36 years of age. Applications close 29 August with the Academic Registrar. Forms available from Mr J Larkin, Bureau of Agriculture and Resource Economics, GPO Box 1563, Canberra ACT 2601.
The Packer, Shell and Barclays Scholarships to Cambridge	Living and travel allowances, tuition expenses.	1-3 years	Applicants must be Australian citizens who are honours graduates or equivalent, and under 26 years of age. Applications close 15 October with The Secretary, Cambridge Commonwealth Trust, PO Box 252, Cambridge CB2 1TZ England.

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**Graduate Scholarships (continued)**


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Donor	Value	Year/s of Tenure	Conditions
<b>General (continued)</b>			
The Rhodes Scholarship to Oxford University	*Approximately £4200 stg pa	2 years, may be extended for a third year	Unmarried Australian citizens aged between 19 and 25 who have an honours degree or equivalent. Applications close in August each year with The Secretary, University of Sydney, NSW, 2006. Applications close in mid-September each year.
<b>Engineering</b>			
Australian Institute of Nuclear Science and Engineering Studentships	Basic stipend \$11,103 pa plus allowances and some University expenses.	1-3 years	Applicants must be honours graduates in Science or Engineering. At least one quarter of the period of tenure must be spent at the Institute at Lucas Heights, NSW. Applications close late October with the Academic Registrar.
Harold G. Conde Memorial Fellowship	\$5000 pa	Maximum of 3 years	Applicants should be honours graduates permanently domiciled in Australia. The Fellowship is a supplementary award to be held in conjunction with another scholarship and is for graduate study or research in a field related to the electricity industry. Applications close with the Academic Registrar by 10 April.
IBM Research Scholarship in Microelectronics	\$12000 pa where only scholarship held. \$5000 pa where it supplements another scholarship.	Up to 3 years	To enable a suitable graduate to undertake a research degree in the Joint Microelectronics Research Centre. Applications close 31 October with the Academic Registrar.
The Joseph Barling Fellowship	Not less than \$8500	Maximum of 3 years	Candidates should be electrical engineering graduates of the University of New South Wales (in special circumstances mechanical and industrial engineering graduates may apply.) The Fellowship is for full-time study for the award of the degree of Master of Business Administration or Doctor of Philosophy at the University. Applications close 31 December with the Academic Registrar.
Medical Engineering Research Association	Variable	1-3 years	Awarded for postgraduate study or research in the field of Biomedical Engineering. Applications to The Secretary, MERA, PO Box 218, Lindfield, NSW 2070.
Water Industry Research Award	\$17,764 pa	2-4 years	Applications close with the Academic Registrar 10 January.
Shell Scholarship in Science or Engineering	See under <b>Science</b>		
Australian Telecommunications and Electronics Research Board			
Science Research Scholarship of the Royal Commission of the Exhibition of 1851			

## Prizes

### Undergraduate University Prizes

The following table summarizes the undergraduate prizes awarded by the University. Prizes which are not specific to any School are listed under General. All other prizes are listed under the Faculty or Schools in which they are awarded.

Information regarding the establishment of new prizes may be obtained from the Examinations Section located on the Ground Floor of the Chancellery.

Donor/Name of Prize	Value \$	Awarded for
<b>General</b>		
Sydney Technical College Union Award	300.00 and medal	Leadership in the development of student affairs, and academic proficiency throughout the course
University of New South Wales Alumni Association	Statuette	Achievement for community benefit — students in their final or graduating year

### Faculty of Engineering

Institution of Engineers, Australia	Medal and 200.00	The most proficient final year (or last 2 years part-time) student in the Bachelor of Engineering (or Bachelor of Science (Engineering)) degree courses offered by the following Schools:  Civil Engineering Electrical Engineering and Computer Science Mechanical and Industrial Engineering Chemical Engineering and Industrial Chemistry Mining Engineering Textile Technology (Engineering option only)
The John Fraser Memorial Award	130.00	Excellence in the first year or equivalent part-time years of a bachelor degree course offered by the Faculty of Engineering

### School of Chemical Engineering and Industrial Chemistry

Abbott Laboratories Pty Ltd	150.00	Best performance in Bachelor of Engineering degree course in Chemical Engineering — Year 4
Australasian Corrosion Association (NSW Branch)	150.00 and one year's membership of the Association	Best performance in 48.121 Corrosion in the Chemical Industry
AGL Sydney Limited	200.00	Subject selected by Head of School
Australian Paper Manufacturers Ltd	150.00	48.163 Instrumentation and Process Control in Industrial Engineering

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**Undergraduate University Prizes (continued)**


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Donor/Name of Prize	Value \$	Awarded for
<b>School of Chemical Engineering and Industrial Chemistry (continued)</b>		
	150.00	48.163 Instrumentation and Process Control in Chemical Engineering
Chemical Technology Society	25.00	Best graduate in Bachelor of Science degree in Industrial Chemistry
	25.00	Best graduate in Bachelor of Science degree course in Industrial Chemistry, Years 1 and 2 or Stages 1 to 4
CSR Limited	50.00	Subject with the discipline of Industrial Chemistry, selected by Head of School
Esso Australia Ltd	200.00	Best performance in Year 2 Chemical Engineering
Institution of Chemical Engineers	100.00 and medal	Best result for the thesis in the final year, or equivalent part time stage, of the Bachelor of Engineering degree course
Shell	100.00	General proficiency in Year 2 or its part-time equivalent in either the Chemical Engineering course or the Industrial Chemistry course
	100.00	General proficiency in Year 3 or its part-time equivalent in either the Chemical Engineering course or the Industrial Chemistry course
	100.00	General proficiency in Year 4 or its part-time equivalent in either the Chemical Engineering course or the Industrial Chemistry course
	100.00	For a student who, in the opinion of the Head of School, has performed some meritorious activity of note either inside or outside the University
Simon-Carves Australia	100.00	48.135 Thermodynamics
Stauffer Australia Limited	100.00	Subject selected by Head of School
Western Mining Corporation Ltd	150.00	48.036 Chemical Engineering Laboratory 1
	150.00	48.044 Chemical Engineering Laboratory 2

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**Department of Fuel Technology**

Australian Institute of Energy	50.00	For a fuel subject or allied subject project
Fuel Technology Staff	200.00	Best performance in Year 3 or 4 Fuel Technology subject in the Bachelor of Engineering degree course in Chemical Engineering
Shell	200.00	Subject selected by Head of School

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**Undergraduate University Prizes (continued)**


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Donor/Name of Prize	Value \$	Awarded for
<b>School of Civil Engineering</b>		
Association of Consulting Structural Engineers of New South Wales	225.00	Best performance in 8.4430 Structural Design 4 in the Bachelor of Engineering degree course in Civil Engineering
	175.00	Best performance in 8.3440 Structural Design 3 in the Bachelor of Engineering degree course in Civil Engineering
Australian Conservation Foundation	50.00	Best performance in the subjects which develop environmental management concepts for the Civil Engineer
Australian Institute of Traffic Planning and Management	150.00	Best performance in 8.4510 Transport Engineering major in the Bachelor of Engineering degree course in Civil Engineering
Australian Welding Institute	Books to the value of 60.00	Best design which incorporates a welding process for students in Years 2, 3 or 4 of the Bachelor of Engineering degree course in Civil Engineering
Crawford Munro Memorial	150.00	Best performance in 8.3640 Engineering Hydrology in the Bachelor of Engineering degree course in Civil Engineering
James Hardie & Co. Pty Ltd	225.00	Best performance in 8.2610 Hydraulics 1 in the Bachelor of Engineering degree course in Civil Engineering
Boulderstone Hornibrook	500.00	Best performance in Engineering Construction and Management in the Bachelor of Engineering degree course in Civil Engineering
Hardie's Pipeline Award	250.00 and Plaque	Best performance in 8.3630 Water Supply and Wastewater Disposal in the Bachelor of Engineering degree course in Civil Engineering
Jeffrey and Katauskas	500.00	Best performance in 8.4310 Materials Major in the Bachelor of Engineering degree course in Civil Engineering
Water Board Gold Medal	Medal	Highest aggregate in 8.3630 Water Supply and Wastewater Disposal and 8.4620 Water Resources Engineering in the Bachelor of Engineering degree course in Civil Engineering

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**School of Electrical Engineering and Computer Science**

Austral Crane	37.50	Bachelor of Engineering degree course in Electrical Engineering, Year 3
	37.50	Power or Control elective
Electricity Supply Engineers Association of New South Wales	100.00	Overall performance including proficiency in Electric Power Distribution in Year 3 full-time or equivalent part-time degree course
IBM	200.00	Best performance in 6.611 Computing 1

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**Undergraduate University Prizes (continued)**


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Donor/Name of Prize	Value \$	Awarded for
<b>School of Electrical Engineering and Computer Science (continued)</b>		
Institution of Electrical Engineers	100.00	Best performance in Year 3 Electrical Engineering
J. Douglas Maclurcan	60.00 Book order	Outstanding performance in the field of control systems
Lionel Singer Corporation — in Computer Science	1500.00	Best performance in core subjects in Year 3 leading to Honours degree
Logica Pty Limited	1000.00	Best performance by a graduand in a Computer Science honours degree course

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**School of Geography**

Jack Mabbutt Medal	Medal	Best performance in Fourth Year Project in Applied Geography by a student proceeding to Bachelor of Science
Jack Mabbutt Prize	150.00	Best performance by a third year student proceeding to Honours in Geography

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**School of Mathematics**

Amatil Limited	200.00	Best performance in Theory of Statistics 3 or Higher Theory of Statistics 3
Applied Mathematics	50.00	Excellence in Level III Applied Mathematics subjects
C. H. Peck	50.00	Best performance in Year 2 Mathematics proceeding to Year 3 in the School of Mathematics
Head of School's	50.00	Excellence in 4 or more Mathematics units in Year 2
IBM	200.00	Final year of an honours degree course
ICI Theory of Statistics IV	100.00	Best performance in 10.323 Theory of Statistics 4
I. P. Sharp Associates	100.00	Excellence in Higher Theory of Statistics 2
J. R. Holmes	75.00	Excellent performance in at least 4 pass-level (up to 1 pass-level unit may be replaced by a higher-level unit) Pure Mathematics Level III units taken over no more than two consecutive years
Michael Mihailavitch Erihman	750.00	Best performance by a student enrolled in a Mathematics Program, in examinations conducted by the School of Mathematics in any one year

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**Undergraduate University Prizes (continued)**


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Donor/Name of Prize	Value \$	Awarded for
<b>School of Mathematics (continued)</b>		
Pure Mathematics	50.00	Best performance in Level III Pure Mathematics subjects
School of Mathematics	50.00	Best performance in 10.001 Higher Mathematics 1
	50.00	Best performance in basic Year 2 Higher Mathematics units
	50.00	Excellence in 4 or more Mathematics units in Year 2
Statistical Society of Australia (New South Wales Branch)	100.00	General proficiency — Theory of Statistics subjects

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**School of Materials Science and Engineering**

Alcan Australia Ltd	200.00	Subject selected by Head of School
Austral Crane	150.00	
Australasian Corrosion Association (NSW Branch)	150.00	Best performance in 4.623B Metallurgical Engineering by a Metallurgical Engineering student
Institute of Metals and Materials Australasia	100.00 and one years' membership of the Institute	Subject selected by Head of School
Australian Welding Institute	30.00 Book order	
The Broken Hill Proprietary Co Ltd	150.00	
The Max Hatherly	275.00	Best performance in the final year practical examination or an outstanding effort in Metallography
The Hugh Muir	275.00	Best performance in the final year seminar class or, by a student who in the Head of School's opinion has contributed most to the corporate life of the School of Materials Science and Engineering
Western Mining Corporation Ltd	150.00	Best overall performance in Year 3 full-time (or its equivalent part-time) in Bachelor of Engineering (or Bachelor of Science (Technology)) degree course
	150.00	Best overall performance in Year 4 full-time (or its equivalent part-time) in the Bachelor of Engineering (or Bachelor of Science (Technology)) degree course
The Z.C. Mines	200.00	Subject selected by Head of School

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**School of Mechanical and Industrial Engineering**

Ansett Airlines of Australia	200.00 and bronze medal	Best overall performance in the Bachelor of Engineering degree course in Aeronautical Engineering
Atlas Copco	125.00	General proficiency in Bachelor of Engineering degree course in Mechanical Engineering

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**Undergraduate University Prizes (continued)**


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Donor/Name of Prize	Value \$	Awarded for
<b>School of Mechanical and Industrial Engineering (continued)</b>		
Austral Crane	75.00	General proficiency in full-time Year 3 Mechanical Engineering
Australian Institute of Refrigeration, Air Conditioning and Heating	Student membership of the Institute for 1 year plus Design Aid and Data Book	Best performance in subject selected by Head of School in field of refrigeration and air conditioning
Babcock Aust Ltd	100.00	Subject selected by Head of School
Carrier Air Conditioning	250.00	Best performance by a Mechanical Engineering student in a subject selected by Head of School
David Carment Memorial	500.00 and medal	Highest proficiency in final year of Naval Architecture degree course
Elcom Award	250.00	Best performance in 5.641 Thermal Power Plants
Hawker de Havilland Victoria Limited	300.00 and medal	Best performance in Year 4 of the Aeronautical Engineering degree course
Computer-Based Engineering Design	100.00	Best undergraduate or graduate thesis making a contribution to Computer-Based Engineering Design in the School of Mechanical and Industrial Engineering
Harbin Polytechnical Alumni Association	100.00	Subject selected by Head of School
Jeremy Hirschhorn	100.00	Best performance by a final year student in Mechanics of Machines
The John Harrison	100.00	Best performance in Mechanics of Machines in Year 3
The Hawker de Havilland Ltd	500.00	Best thesis in aeronautical engineering in the Bachelor of Engineering degree course
Royal Institution of Naval Architects	200.00	Best ship design in the final year
Shell Refining (Australia) Pty Ltd	100.00	General proficiency in Year 1 of full-time Mechanical Engineering degree course
	100.00	Best undergraduate thesis in Year 4 of the Mechanical Engineering degree course
	100.00	Best performance in a subject selected by Head of School in an area relevant to refinery or oil industry practice.
Staedtler (Pacific) Pty Ltd	100.00 (open order)	General proficiency in Bachelor of Engineering degree course in Mechanical Engineering, year 2.

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**Undergraduate University Prizes (continued)**


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Donor/Name of Prize	Value \$	Awarded for
<b>Department of Industrial Engineering</b>		
Austral Crane	75.00	Bachelor of Engineering degree course in Industrial Engineering, Year 3
R. E. Jefferies Memorial	500.00	Performance in final year/stage of Bachelor of Engineering degree course in Industrial Engineering
Shell Refining (Australia) Pty Ltd	100.00	Best performance in the subject 18.603 Management/Economics in the Bachelor of Engineering degree course
TRW Australia Ltd	100.00	Best performance in a final year subject in the Industrial Engineering course selected by Head of School
<b>School of Mines</b>		
Joint Coal Board	200.00	Bachelor of Engineering degree course in Mining Engineering, Year 2
	200.00	Bachelor of Engineering degree course in Mining Engineering, Year 3
	300.00	Bachelor of Engineering degree course in Mining Engineering — general proficiency throughout course
Western Mining Corporation Ltd	150.00	Best overall performance in final year of Bachelor of Engineering degree course
	200.00	General proficiency throughout the Bachelor of Engineering degree course
	150.00	Best overall performance in penultimate year of Bachelor of Engineering degree course
<b>School of Surveying</b>		
Australian Photogrammatic and Remote Sensing Society (NSW)	80.00	Subjects in photogrammetry including electives
Board of Surveyors Medal	Medal	Bachelor of Surveying degree course, Final year
R. S. Mather Memorial	250.00	Most outstanding student in Geodesy
School of Surveying	2000.00	Best overall performance by a woman student proceeding to Year 2
Surveying and Mapping Industry	2000.00	Best overall performance by a Year 2 student proceeding to Year 3

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**Graduate University Prizes**


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The following table summarizes the graduate prizes awarded by the University.

Donor/Name of Prize	Value \$	Awarded for
<b>Faculty of Engineering</b>		
<b>Centre for Safety Science</b>		
Grace Bros Safety Science Merit	250.00	Best performance in 47.330G The Accident Phenomenon, in the Graduate Diploma course in Safety Science
	250.00	Best performance in 47.330G The Accident Phenomenon, in the Master of Safety Science degree course
Manufacturers Mutual Insurance Prize for Ergonomics Principles	200.00	Best performance in 47.061G Principles of Ergonomics in the masters degree or graduate diploma in Safety Science
Manufacturers Mutual Insurance Prize for Occupational Disease	150.00	Best Performance in 80.701G Occupational Disease in the masters degree or graduate diploma in Safety Science
Manufacturers Mutual Insurance Prize for Occupational health	150.00	Best performance in 80.702G Occupational Health Control in the masters degree or graduate diploma in Safety Science
National Safety Council	100.00	Best performance in 47.052G Introduction to Safety Engineering in the Master Degree course or Graduate Diploma course in Safety Science
Safety Institute of Australia (NSW Division)	150.00 book order	Best overall performance in the Master of Safety Science degree course
	150.00 book order	Best overall performance in the Graduate Diploma course in Safety Science

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**School of Chemical Engineering and Industrial Chemistry**

The Clean Air Society of Australia and New Zealand	100.00	48.391G Atmospheric Pollution Control and 48.392G Practical Aspects of Air Pollution Measurement and Control
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**School of Civil Engineering**

Institute of Advanced Motorists	50.00	Traffic Planning and Control
Maunsells Waste Management	500.00	Best aggregate performance in the Master of Engineering Science or Master of Applied Science course in 8.872G/8.872X Management of Waste, 8.873G/8.873X Waste and Waste Water Analysis and Environmental Requirements, 8.874G/8.874X Waste Management Science, 25.715G/25.2715X Sources of Waste and Landfill Disposal, 48.386G/48.386X Sludge and Solid Waste, 48.067G/48.067X Treatment Disposal and Resource Recovery of solid and Liquid Wastes
Maunsells Project Report	500.00	Best performance in the Master of Engineering Science or Master of Applied Science course in 8.909G/8.909X Project Report (9 credits) OR 8.918G/8.918X Project Report (18 credits) OR 46.512G/46.512X Project Report (9 credits) OR 46.513G/46.513X Project Report (18 credits)

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**School of Fibre Science and Technology**
**Department of Textile Technology**

Malcolm Chaikin	200.00 and bronze medal	For the most outstanding thesis for the degree of Doctor of Philosophy in the Department of Textile Technology
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# The University of New South Wales Kensington Campus

## Theatres

Biomedical Theatres E27  
Central Lecture Block E19  
Classroom Block (Western Grounds) H3  
Rex Vowels Theatre F17  
Keith Burrows Theatre J14  
Main Building (Physics) Theatre K14  
Mathews Theatres D23  
Parade Theatre E3  
Science Theatre F13  
Sir John Clancy Auditorium C24

## Buildings

Affiliated Residential Colleges  
*New (Anglican)* L6  
*Shalom (Jewish)* N9  
*Warrane* M7  
Applied Science F10  
Architecture H14  
Arts (Morven Brown) C20  
Banks F22  
Barker Street Gatehouse N11  
Basser College C18  
Biological Sciences D26  
Central Store B13  
Chancellery C22  
Chemistry  
*Dalton* F12  
*Robert Heffron* E12  
Civil Engineering H20  
Commerce and Economics (John Goodsell) F20  
*Dalton (Chemistry)* F12  
Electrical Engineering G17  
Geography and Surveying K17  
*Goldstein College* D16  
*Golf House* A27  
Gymnasium B5  
House at Pooh Corner N8  
International House C6  
*Io Myers Studio* D9  
John Goodsell (Commerce and Economics) F20  
*Kanga's House* O14  
Kensington Colleges C17 (Office)  
*Basser* C18  
*Goldstein* D16  
*Philip Baxter* D14

Link B6  
Maintenance Workshop B13  
Materials Science and Engineering E8  
Mathews F23  
Mechanical and Industrial Engineering J17  
Medicine (Administration) B27  
Menzies Library E21  
Morven Brown (Arts) C20  
New College (Anglican) L6  
Newton J12  
NIDA D2  
Parking Station H25  
Philip Baxter College D14  
Robert Heffron (Chemistry) E12  
Sam Cracknell Pavilion H8  
Shalom College (Jewish) N9  
Sir Robert Webster (Textile Technology) G14  
Squash Courts B7  
Swimming Pool B4  
Unisearch House L5  
University Regiment J2  
University Union (Roundhouse) – Stage I E6  
University Union (Blockhouse) – Stage II G6  
University Union (Squarehouse) – Stage III E4  
Wallace Wurth School of Medicine C27  
Warrane College M7

## General

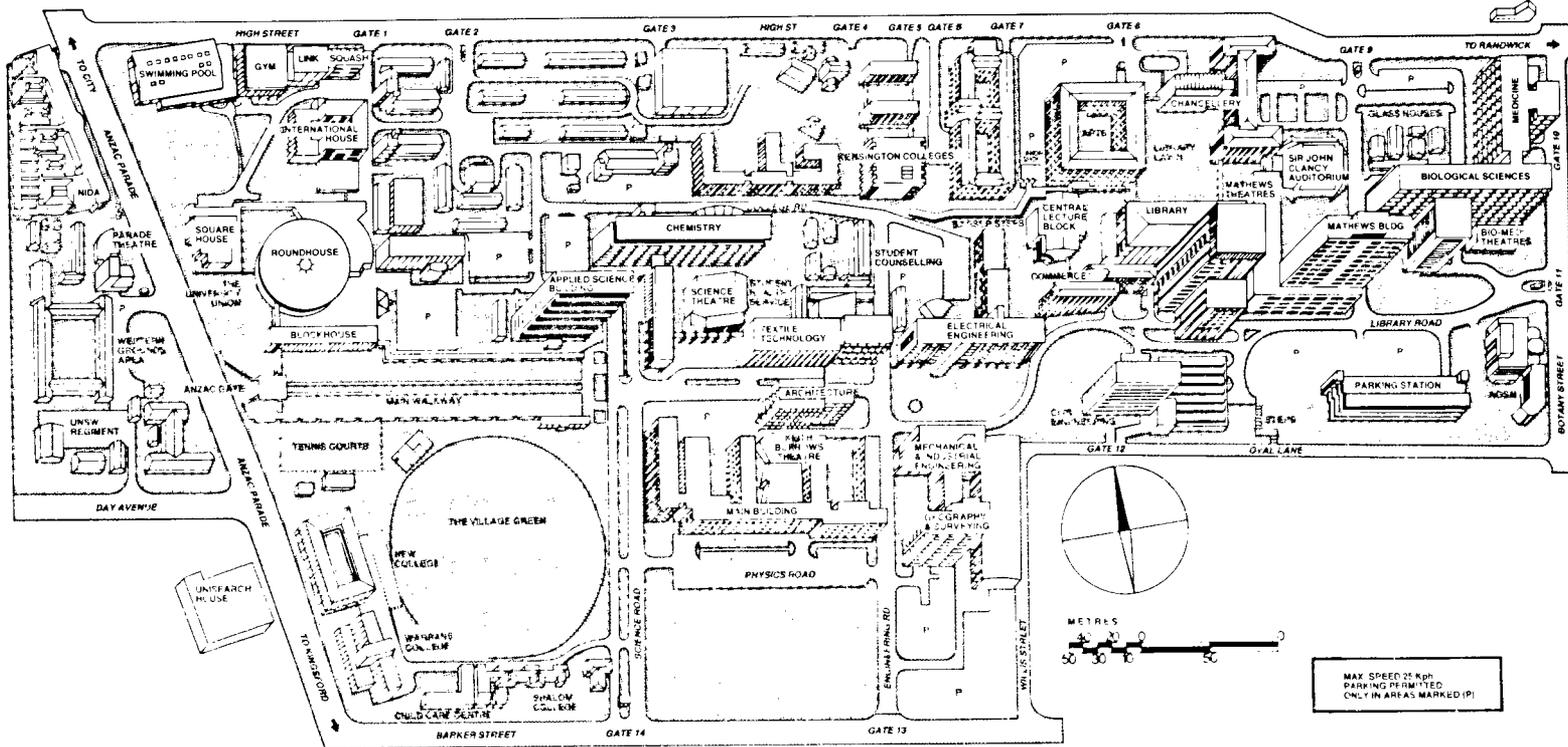
Academic Staff Office C22  
Accounting F20  
Admissions C22  
Adviser for Prospective Students F15  
Anatomy C27  
Applied Economic Research G14  
Applied Geology F10  
Applied Science (Faculty Office) F10  
Architecture (including Faculty Office) H14  
Arts (Faculty Office) C20  
Audio Visual Unit F20  
Australian Graduate School of Management G27  
Banking and Finance F20  
Biochemistry D26  
Biological and Behavioural Sciences (Faculty Office) D26  
Biomedical Engineering A28  
Biomedical Library F23  
Biotechnology D26  
Bookshop G17  
Building H14  
Careers and Employment F15  
Cashier's Office C22  
Chaplains E15  
Chemical Engineering and Industrial Chemistry F10  
Chemistry E12  
Child Care Centres N8, O14  
Civil Engineering H20  
Commerce and Economics (Faculty Office) F20  
Community Medicine D26  
Computing Services Department F21, D26  
Continuing Education Support Unit F23  
Counselling and Careers Service F15  
Economics F20  
Education G2  
Education Testing Centre E15  
Electrical Engineering and Computer Science G17  
Energy Research, Development and Information Centre F10  
Engineering (Faculty Office) K17  
English C20  
Ethics Committees Secretariat B8  
Examinations C22  
Fees Office C22  
Food Science and Technology F10  
French C20  
General Staff Office C22  
Geography K17  
German Studies C20  
Graduate Office and Alumni Centre E4  
Graduate School of the Built Environment H14  
Groundwater Management and Hydrogeology F10  
Health Administration C22  
History C20  
Industrial Arts H14  
Industrial Relations and Organizational Behaviour F20  
Information Systems F20  
Kanga's House O14  
Kindergarten (House at Pooh Corner) N8  
Landscape Architecture K15  
Law (Faculty Office) F21  
Law Library F21  
Legal Studies and Taxation F20  
Liberal and General Studies C20  
Librarianship F23  
Library E21

Lost Property C22  
Marine Science D26  
Marketing F20  
Materials Science and Engineering E8  
Mathematics F23  
Mechanical and Industrial Engineering J17  
Medical Education C27  
Medicine (Faculty Office) B27  
Microbiology D26  
Mineral Processing and Extractive Metallurgy E8  
Mining Engineering K15  
Music B11  
National Institute of Dramatic Art D2  
Off-campus Housing C22  
Optometry J12  
Pathology C27  
Patrol and Cleaning Services C22  
Petroleum Engineering D12  
Philosophy C20  
Physics K15  
Physiology and Pharmacology C27  
Political Science C20  
Printing Unit C22  
Psychology F23  
Public Affairs Unit C22  
Publications Section C22  
Remote Sensing K17  
Russian Studies C20  
Safety Science J17  
Science and Mathematics Course Office D26  
Science and Technology Studies C20  
Social Work G2  
Sociology C20  
Spanish and Latin American Studies C20  
Sport and Recreation Centre B6  
Student Health E15  
Student Records C22  
Students' Union E4 and C21  
Surveying K17  
Tertiary Education Research Centre E15  
Textile Technology G14  
Theatre Studies B10  
Town Planning K15  
Union Shop (Upper Campus) D19  
University Archives E21  
University Press A28  
University Union (Blockhouse) G6  
Waste Management H20  
WHO Regional Training Centre C27  
Wool and Animal Science B8

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CHILD CARE CENTRE

