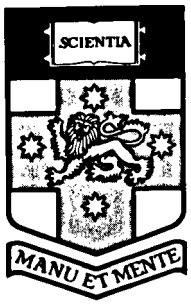
UNSW

Engineering

1993 Handbook

THE UNIVERSITY OF NEW SOUTH WALES



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Subjects, courses and any arrangements for courses including staff allocated as stated in this Handbook are an expression of intent only. The University reserves the right to discontinue or vary arrangements at any time without notice. Information has been brought up to date as at 3 November 1992, but may be amended without notice by the University Council.

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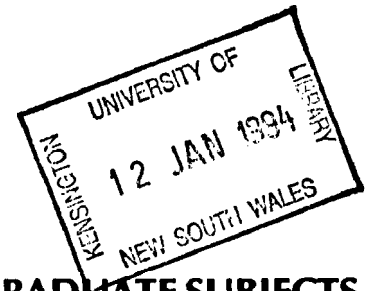
It is University policy to promote equal opportunity in education (refer to EOE Policy Statement, The University of New South Wales Calendar (Summary Volume) and *Student Guide 1993).*

ADDENDUM

ENGINEERING HANDBOOK



CIVIL ENGINEERING POSTGRADUATE SUBJECTS

Please note that some subjects marked 'Not offered in 1993' are in fact, offered. The following table lists all subjects which *are* offered in 1993; incorrectly marked in this handbook.

There may however, have been other changes subsequent to the printing of this book. Please contact the School of Civil Engineering for the Postgraduate Timetable (see below).

CIVL9402 Transport, Environment, Community
CIVL9405 Urban Transport Planning Practice
CIVL9410 Highway Engineering Practice
CIVL9412 Economics for Transportation Studies
CIVL9417 Transport and Traffic Flow Theory
CIVL9418 Statistics for Transport Studies Part 1
CIVL9419 Statistics for Transport Studies Part 2
CIVL9704 Quantitative Engineering Management
CIVL9705 Engineering Management Practice
CIVL9714 Special Topic in Engineering Management
CIVL9723 Contstruction Design
CIVL9724 Construction Engineering and Technology
CIVL9753 Soil Engineering
CIVL9776 Rock Mechanics
CIVL9777 Numerical Methods in Geomechanics
CIVL9781 Advanced Concrete Technology
CIVL9786 Industrial and Heavy Duty Pavements
CIVL9802 Elastic Stability 1
CIVL9803 Elastic Stability 2
CIVL9805 Vibration of Structures 2
CIVL9806 Prestressed Concrete 1
CIVL9807 Prestressed Concrete 2
CIVL9809 Reinforced Concrete 1
CIVL9810 Reinforced Concrete 2
CIVL9814 Analysis of Plates and Shells
CIVL9817 Experimental Structural Analysis
CIVL9818 Bridge Design 1
CIVL9819 Bridge Design 2
CIVL9820 Structural Analysis and Finite Elements 1
CIVL9821 Structural Analysis and Finite Elements 2
CIVL9822 Steel Structures 1
CIVL9823 Steel Structures 2
CIVL9830 Hydromechanics
CIVL9831 Closed Conduit Flow
CIVL9832 Pipe Network and Transients
CIVL9833 Free Surface Flow
CIVL9835 Coastal Engineering 1
CIVL9836 Coastal Engineering 2
CIVL9847 Water Resources Policy
CIVL9848 Water Resource System Design
CIVL9849 Irrigation
CIVL9851 Unit Operations in Public Health Engineering
CIVL9852 Water Distribution and Sewage Collection
CIVL9855 Water and Wastewater Analysis and Quality
CIVL9856 Water Treatment
CIVL9857 Sewage Treatment and Disposal
CIVL9858 Water Quality Management
CIVL9860 Investigation of Groundwater Resources 1
CIVL9861 Investigation of Groundwater Resources 2
CIVL9862 Fluvial Hydraulics
CIVL9863 Estuarine Hydraulics
CIVL9868 Public Health Science
CIVL9870 Hydraulics and Design of Water and Wastewater Treatment Plants
CIVL9871 Water Supply and Sanitation in Developing Countries
CIVL9872 Solid Waste Management
CIVL9875 Hydrological Processes
CIVL9876 Applied Hydrological Modelling
CIVL9877 Flood Design 1
CIVL9878 Flood Design 2
CIVL9880 Groundwater Modelling
CIVL9881 Hazardous Waste Management
CIVL9887 Advanced Topics in Waste Management
CIVL9901 Special Topic in Civil Engineering
CIVL9909 Project
CIVL9915 Project Report

Enquiries:
The School of Civil Engineering
Telephone 697 5033
4th Floor, Civil Engineering Building

Contents

Introduction

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, Computer Science and Engineering, Electrical Engineering, Mechanical and Manufacturing Engineering, Surveying and the Centres for Biomedical Engineering, Photovoltaic Devices and Systems, and Wastewater Treatment. The Faculty is also closely associated with the Centre for Groundwater Management and Hydrogeology, and the Centre for Remote Sensing and Geographic Information Systems both of which are joint multidisciplinary enterprises with the Faculty of Applied Science.

The Faculty is also actively involved with two of the 15 Cooperative Research Centres (CRCs) established under the Commonwealth Government's program of CRCs announced in 1991. These are the CRC for Waste Management and Pollution Control and the CRC for Aerospace Structures.

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) and Bachelor of Surveying (BSurv). There are also a number of combined degree courses available which lead to the award of two degrees. Through its schools and centres, the Faculty offers an active graduate program through formal graduate courses both at degree and graduate diploma level, and research degrees.

The Faculty has a commitment to developing in students the technical, scientific and creative skills required to solve all aspects of engineering problems, and to direct and manage engineering activities. Critical to this is an understanding of human interaction with the environment so that the impact of engineering activity can be assessed together with the ability to communicate with other members of the profession, with industrial personnel, administrators and with members of the public.

Other important attributes for a succcessful engineer include the desire and ability for continuing self-education and reappraisal of current practice including the ability to innovate. Concomitant with this is the ability to evaluate independently and to criticise constructively their own work and the work of other engineers.

It is also important for students to join in the development of themselves as professional engineers. Engineering is a cooperative 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

Calendar of Dates

The academic year is divided into two sessions, each containing 14 weeks for teaching. There is a recess of approximately six weeks between the two sessions and there are short recesses of one week within each of the sessions.

Session 1 commences on the Monday nearest 1 March.

All Faculties (other than Medicine)

	1993	1994
Session 1		
(14 weeks)	1 March to 8 April	28 February to 31 March
Recess:	9 April to 18 April 19 April to 11 June	1 April to 10 April 11 April to 10 June
Study Recess:	12 June to 17 June	11 June to 16 June
Examinations	18 June to 6 July	17 June to 5 July
Midyear Recess:	7 July to 25 July	6 July to 24 July
Session 2		
(14 weeks)	26 July to 24 September	25 July to 23 September
Recess:	25 September to 4 October 5 October to 5 November	24 September to 3 October 4 October to 4 November
Study Recess:	6 November to 11 November	5 November to 10 November
Examinations	12 November to 30 November	11 November to 29 November

Important Dates for 1993

January 1993

F 1 New Year's Day - Public Holiday
M 11 Term 1 begins - Medicine IV
Term 1 begins - Medicine VI
M 18 Term 1 begins - Medicine V
T 26 Australia Day - Public Holiday

February 1993

T 2 Enrolment period begins for new undergraduate students and undergraduate students repeating first year
M 8 Re-enrolment period begins for second and later year undergraduate and graduate students enrolled in formal courses. Students should consult the *Re-enrolling 1993* leaflet for their course for details.
F 26 Last day for acceptance of enrolment by new and re-enrolling students. (Late fee payable thereafter if enrolment approved.)

March 1993

M 1 Session 1 begins - all courses except Medicine IV, V, VI
Term 1 begins - Australian Graduate School of Management
Su 7 Term 1 ends - Medicine VI
M 8 Session 1 begins - University College, Australian Defence Force Academy
F 12 Last day applications are accepted from students to enrol in Session 1 or whole year subjects
Su 14 Term 1 ends - Medicine IV
M 15 Term 2 begins - Medicine IV
Term 2 begins - Medicine VI
Su 21 Term 1 begins - Medicine V
M 29 Term 2 begins - Medicine V
W 31 HECS Census Date for Session 1
Last day for students to discontinue without failure subjects which extend over Session 1 only

April 1993

F 9 Good Friday - Public Holiday
S 10 Easter Saturday - Public Holiday
Mid-session Recess begins
M 12 Easter Monday - Public Holiday
Su 18 Mid-Session Recess ends
Su 25 Term 2 ends - Medicine IV
Term 2 ends - Medicine VI
M 26 Anzac Day - Public Holiday

May 1993

M 3 Term 3 begins - Medicine IV
Term 3 begins - Medicine VI
F 7 Term 1 ends - Australian Graduate School of Management
S 8 May Recess begins - University College, Australian Defence Force Academy
T 11 Publication of Provisional Timetable for June examinations
W 19 Last day for students to advise of examination clashes
Su 23 May Recess ends - University College - Australian Defence Force Academy
Su 30 Term 2 ends - Medicine V
M 31 Term 2 begins - Australian Graduate School of Management

June 1993

T 1 Publication of Timetable for June Examinations
T 8 Term 3 begins - Medicine V
F 11 Session 1 ends
S 12 Study Recess begins
College of Fine Arts assessment week begins
Su 13 Term 3 ends - Medicine IV
Term 3 ends - Medicine VI
M 14 Queen's Birthday - Public Holiday
Term 4 begins - Medicine IV
Term 4 begins - Medicine VI
Th 17 Study Recess ends
F 18 Examinations begin
College of Fine Arts assessment week ends
F 25 Session 1 ends - University College, Australian Defence Force Academy
S 26 Mid-year Recess begins - University College, Australian Defence Force Academy
M 28 Examinations begin - University College, Australian Defence Force Academy

July 1993

T 6 Examinations end
W 7 Midyear Recess begins
S 10 Examinations end - University College, Australian Defence Force Academy
Su 11 Midyear Recess begins - University College, Australian Defence Force Academy
Su 25 Midyear Recess ends
Midyear Recess ends - University College, Australian Defence Force Academy
M 26 Session 2 begins - all courses except Medicine IV, V, and VI
Session 2 begins - University College, Australian Defence Force Academy

August 1993

F 6 Term 2 ends - Australian Graduate School of Management
Last day applications are accepted from students to enrol in Session 2 subjects
Last day for students to discontinue without failure subjects which extend over the whole academic year.
Su 8 Term 4 ends - Medicine IV
Term 3 ends - Medicine V
Term 4 ends - Medicine VI
M 16 Term 5 begins - Medicine IV
Term 4 begins - Medicine V
Term 5 begins - Medicine VI
M 30 Term 3 begins - Australian Graduate School of Management
T 31 HECS Census Date for Session 2
Last day for students to discontinue without failure subjects which extend over Session 2 only

September 1993

S 25 Mid-Session Recess begins
September Recess begins - University College, Australian Defence Force Academy
Su 26 Term 5 ends - Medicine IV
Term 5 ends - Medicine VI
M 27 Term 6 begins - Medicine IV
Term 6 begins - Medicine VI
Th 30 Closing date for applications to the Universities Admission Centre

October 1993

M 4 Labour Day - Public Holiday
Mid-Session Recess ends
September Recess ends - University College, Australian Defence Force Academy
T 5 Publication of provisional timetable for November examinations
W 13 Last day for students to advise of examination clashes
Su 17 Term 4 - Medicine V
T 26 Publication of Timetable for November Examinations
F 29 Session 2 ends - University College, Australian Defence Force Academy

November 1993

M 1 Examinations begin - University College, Australian Defence Force Academy
F 5 Session 2 ends
Term 3 ends - Australian Graduate School of Management
S 6 Study Recess begins
College of Fine Arts assessment week begins
Su 7 Term 6 ends - Medicine IV
Term 6 ends - Medicine VI
Th 11 Study Recess ends
F 12 Examinations begin
College of Fine Arts assessment week ends
F 19 Examinations end - University College, Australian Defence Force Academy
T 30 Examinations end

December 1993

Th 23 Last day for acceptance of applications by Admissions Section for transfer to another undergraduate course within the University
M 27 Christmas Day - Public Holiday
T 28 Boxing Day - Public Holiday

Comprises Schools of Civil Engineering, Computer Science and Engineering, Electrical Engineering, Mechanical and Manufacturing Engineering (incorporating Aerospace Engineering and Naval Architecture), Surveying, the Graduate School of Engineering and Centres for Biomedical Engineering, Photovoltaic Devices and Systems, Advanced Numerical Computation in Engineering and Science, Manufacturing and Automation, Wastewater Treatment, and the Munro Centre for Civil and Environmental Engineering. The Faculty is also associated with the Centres for Groundwater Management and Hydrogeology, Remote Sensing and Geographic Information Systems, Co-operative Research Centres for Waste Management and Pollution Control and Aerospace Structures.

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Gang (Gary) Feng, MEng *Nanjing Aero Inst.*, PhD *Melb.*, MIEEE

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Christopher Xiaolong Lu, MScEng *Beijing*, MIEAust, MIEEE

Centre for Photovoltaic Devices and Systems

Director
Professor M. A. Green

Associate Directors
Dr H.R. Outhred
Dr S.R. Wenham

School of Mechanical and Manufacturing Engineering

Incorporates Aerospace Engineering and Naval Architecture.

Nuffield Professor of Mechanical Engineering and Head of School
Brian Edward Milton, BE PhD *UNSW*, MSc *Birm.*, CPEng, FIEAust, FSAEA, MRAeS

Director of Laboratories
Vacant

Professor of Mechanical Engineering and Director of Programs
Clifford Patterson, MA PhD *Camb.*, FIEAust, CPEng, FIMechE, CPhys, FInstP, FIMA, MIEE

Associate Professor and Director of Undergraduate Studies
John Edward Baker, MSc *Syd.*, BE MEngSc PhD *UNSW*

Director of Graduate Studies
Masud Behnia, BSME, MSME PhD *Purdue*, CEng, MASME, MAIAA, MIEAust

Heads of Departments

Aerospace Engineering
John Randall Page, BSc *Hart.*, MSc *Gran I.T.*, CPEng, FBIS, MRAeS, MAIAA

Applied Mechanics
Associate Professor Eric Joseph Hahn, BE BSc PhD *UNSW*, CPEng, FIEAust, MASME

Design
Associate Professor Alexander Eric Churches, BE PhD *UNSW*, ASTC, FIEAust, CPEng, FRSA

Fluid and Thermal Engineering
Associate Professor Eddie Leonardi, BScEng PhD *UNSW*, CPEng, MASME, MIEAust, MASHRAE

Industrial Technology and Management
Sir James Kirby Professor of Manufacturing Engineering Hartmut Kaebernick, Dipl-Ing Dr-Ing *T.U. Berlin*, CPEng, FIEAust, SMSME, VDI

Mechatronics
Richard Adrian Willgoss, BSc PhD *S'ton.*, CEng, MIEE, MinstP, MIEEE, CPhys, FIEAust

Naval Architecture
Associate Professor Lawrence Julian Doctors, BE MEngSc Syd., PhD Mich., CPEng, FRINA, MSNAME, FIEAust

Executive Assistant to Head of School
Eleonora Maria Kopalinsky, BE PhD *UNSW*

Department of Aerospace Engineering

Associate Professor
Donald Wainwright Kelly, BE *Syd.*, PhD *Lond.*

Senior Lecturers
Noor-e-Alam Ahmed, BSc *Strath.*, PhD *Cran. I.T.*, CPEng, MIMechE
J. R. Page

Department of Applied Mechanics

Professor
C. Patterson

Associate Professors
J. E. Baker
Kerry Patrick Byrne, BE MEngSc *Qld.*, BSc *Melb.*, PhD *S'ton.*
E. J. Hahn

Senior Lecturers
Robin Arthur Julian Ford, BScEng PhD *Lond.*, CPEng, ACGI, MIEAust
Chakravarti Varadachar Madhusudana, BE *Mys.*, ME *I.I.Sc.*, PhD *Monash*, CPEng, MIEAust, MASME
Robert Bond Randall, BTech *Adel.*, BA *Melb.*, CPEng, FIDiage, MIEAust, MAAs

Hugh Lithgow Stark, BSc PhD *Strath.*, CPEng, FIMechE, MIEAust
Khosrow Zarrabi, MSc PhD *UMIST*, MIEAust.

Lecturer
See Seng Leong, BE PhD *UNSW*, CPEng, MIEAust

Associate Lecturers
Mahinda Dharmasiri Kuruppu, BScEng *Sri Lanka*, PhD *H.K.*, CPEng, MIME, MIEAust

Department of Design

Associate Professor
A. E. Churches

Senior Lecturers
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John Michael Challen, BE MEngSc *Syd.*, PhD *UNSW*, FIEAust
Richard Butler Frost, BE *UNSW*, CPEng, FIEAust, FRSA

Lecturer
Robin Arthur Platfoot, BE *UNSW*, PhD *Syd.*

Associate Lecturer
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Department of Fluid and Thermal Engineering

Professor
B. E. Milton

Associate Professors
E. Leonardi
Graham Lindsay Morrison, BE PhD *Melb.*, FIEAust
John Arthur Reizes, ME PhD *UNSW*, CPEng, FIEAust

Senior Lecturers
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Ian Lachlan Maclaine-cross, BE *Melb.*, PhD *Monash*, MIEAust

Department of Industrial Technology and Management

Professor
H. Kaebernick

Associate Professor
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Khoi Hoang, BE *Saigon*, PhD *UNSW*,
Philip Mathew, BE PhD *UNSW*, CPEng, MIEAust
Yi-xin Lawrence Yao, BE *Shanghai Jiaotong*, MS PhD *Wisconsin-Madison*, CPEng, MIEAust, MASME, MSME

Lecturers
Ka Ching Chan, MASc *Tor.*
Atiye Berman Kayis, MS *Middle East T.U.*, PhD *Istanbul T.U.*

Department of Mechatronics

Senior Lecturer
R. A. Willgoss

Lecturers
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Michal John Tordon, DipIng *Bratislavaa*, PhD *Prague*, MIEEE

Associate Lecturer
James Minghui Hu, BE *China Text. U.*, PhD *UNSW*

Department of Naval Architecture

Associate Professors
L. J. Doctors

Senior Lecturers
Mahiuddin Chowdhury, BSc *Bangh.U.T.*, PhD *N'cle (U.K.)*, CPEng, FRINA, FIEAust, MIEAust
Prabhat Kumar Pal, BME *N.C.E., Bengal*, BTech PhD *I.I.T. Kharagpur*, CPEng, FRINA, FIEAust, MIINA, MSTG Hamburg

Heads of Programs

Energy and Power Systems
Associate Professor J.A. Reizes

Machine Systems Design
Mr R.B. Frost

Maintenance Engineering
Mr R.B. Randall

Manufacturing and Automation (Centre for Manufacturing and Automation)
Dr S.S. Leong

Mechanical Building Services
Associate Professor E. Leonardi

Vehicle and Transport Systems
Mr J.R. Page

Administrative Officer
Amos Dimitrius Bauman, AEd BA BEd *Qld.*, MEd *N.E.*

Administrative Assistant
Audrey Muriel Colquhoun

Senior Project Scientist
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Professional Officers
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Anthony Gordon Harris, BSc *Exe.*
Alfred Win Lin Hu, BE *Rangoon I.T.*, MIEEE
Yefim Kotlyar, BMechEng *Moscow Mech. Inst.*
Philip Chi Bong Kwok, BE *BeijingInst.Aer.&Astro.*, CPEng, MIEAust, MIEEE
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Kenneth Norcross, BScEng *UNSW*
Russell Norman Overhall, BE *UNSW*, CPEng, MIEAust
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Computer Systems Officer
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Honorary Research Professor
Peter Louis Brennan Oxley, BSc PhD Leeds, CPEng, CEng, FTS, FIEAAust, FIMechE

Visiting Professors
George Bennett, BA *Syd.*, PhD *UNSW*, ASTC, CEng, FIProdE
Graham de Vahl Davis, AM, BESyd., PhD Camb., CPEng, CEng, FIMechE, FIEAust, MASME
Henry Ehikpehale Enahoro, BSc MScTech *Manc.*, PhD *Sheff.*, CPEng, FIMechE, MIProdE
Zdenek Josef Holy, DiplIng *Prague*, MSc *Birm.*, MEngSc PhD *UNSW*, CPEng, MIEAust

Centre for Advanced Numerical Computation in Engineering and Science

Visiting Professor and Director
Professor G. De Vahl Davis

Centre for Manufacturing and Automation

Director
Dr S.S. Leong

School of Surveying

Professor and Head of School
John Charles Trinder, BSurv PhD *UNSW*, MSc *I.T.C. Delft*, RegSurvNSW, FISAust

Professor of Surveying
Friedrich Karl Brunner, DiplIng Drtech *T.U. Vienna*

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Arthur Harry William Kearsley, MSurvSc PhD *UNSW*, MISAust
Jean Marc Rueger, DiplIng *E.T.H. Zurich*, PhD *UNSW*, ACSM, LSSwitz, MISAust
Artur Stolz, BSurv PhD *UNSW*, RegSurvNSW

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Ewan Gerald Masters, BSurv PhD *UNSW*, MISAust
Christopher Rizos, BSurv PhD *UNSW*
Anthony John Robinson, BSurv MBA PhD *UNSW*, RegSurvNSW, MISAust, MAIC

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Sabapathy Ganeshan, BSc *Ceyl.*
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Karl David Sippel, BSurv *UNSW*

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Bernd Hirsch, BApplSc *Mitchell C.A.E.*

Centre for Biomedical Engineering

Professor and Director
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Associate Professor
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Visiting Professor
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Senior Lecturers
Alberto Pompeo Avolio, BE PhD *UNSW*
Bruce Kenneth Milthorpe, BA *Macq.*, PhD *A.N.U.*

Lecturer
Ross Alexander Odell, BSE *Prin.*, PhD *M.I.T.*

Professional Officer
Laura Anne Poole-Warren, BSc PhD *UNSW*
Peter Roman Slowiaczek, BSc *N'cle(N.S.W.)*

Administrative Assistant
Rhonwen Cuningham, BA DipSocWk *Syd.*

Centre for Groundwater Management and Hydrogeology

In association with the Faculty of Applied Science.

Associate Professor and Director
Colin Raymond Dudgeon, ME PhD *UNSW*, CPEng, MIEAst, MASCE

Senior Lecturer
Richard Ian Acworth, BSc *Leeds*, MSc PhD *Birm.*, FGS

Senior Research Fellow
Jerzy Jankowski, MSc PhD *Wroc.*

Centre for Remote Sensing and Geographic Information Systems

In association with the Faculty of Applied Science.

Director
Andrew Kerr Skidmore, BSc PhD *A.N.U.*

Deputy Director
Professor J. C. Trinder

Handbook Guide

This handbook is divided into separate sections for each School/Unit, identified by a four-letter code (e.g. CIVL, School of Civil Engineering). This code appears on the top right corner of each page relating to the School/Unit. Each School/Unit section is divided into Undergraduate and Graduate Study and includes course outlines and subject descriptions.

Read the opening sections of the handbook first, and then read the information contained under **Course Outlines** (Undergraduate or Graduate as appropriate). These sections cover all degrees and diplomas offered by the Faculty. Detailed information on each subject then appears under **Subject Descriptions,** which includes session/s offered, pre/corequisite details, class hours, credit/unit value, etc.

You will find that almost any course of study you wish to undertake has subjects from other Schools, and even other Faculties. This means that in your engineering course, subjects are listed from other Schools in the Faculty of Engineering, each with their own identifying code, as well as from the School in which you are planning to do a course. If, for example, this is Mechanical and Manufacturing Engineering (MECH), all the subjects for Mechanical and Manufacturing Engineering are described in the section for that School. As Mechanical and Manufacturing Engineering also includes Aerospace Engineering (AERO), Manufacturing Management (MANF) and Naval Architecture (NAVL) these subjects are also included with the School. If they are Electrical Engineeering (ELEC), Computer Science and Engineering (COMP), Civil Engineering (CIVL) or Surveying (SURV) subjects, then descriptions for these subjects will be located in the appropriate School section which has that particular identifying number.

Any subject which is not an Engineering subject (i.e. a subject offered by another Faculty, but included in a course), appears under the **Servicing Subject Descriptions** section.

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.

Undergraduate Study

It is most important that you read the opening sections of the Handbook for general information on the Faculty of Engineering, **Faculty Information**, and **Undergraduate Study, Course Outlines.** Both of these contain specific information relating to undergraduate degrees, including Enrolment Procedures, Conditions for the Award of Degrees, Honours, Professional Practice, Course Transfers and a number of other details that you should be familiar with.

Once you have determined which course you want to do, you must read the course outlines and then the subject descriptions for all subjects to find out what each one entails.

Graduate Study

No matter which graduate degree course you plan to undertake you must read the general summary of graduate courses in the section, **Graduate Study, Course Outlines.** This covers both research degrees and course work programs. Information relating to the various Masters degrees by course work and Graduate Diplomas is detailed in the appropriate School sections. The Centre for Biomedical Engineering is the only Centre in the Faculty of Engineering with its own code number (BIOM) and it located at the end of the section on Centre. The Graduate School of Engineering (GSOE) also has its own identifier and is located at the end of the Graduate Study section.

You will also need to read the **Conditions for the Award of Degrees** at the back of the Handbook for the formal rules governing each degree.

Most importantly, staff in the Faculty of Engineering are only too happy to help you with any queries you might have or problems that need to be sorted out. As a first step, contact the School Office, or there is a list of people who can help you at the beginning of **Faculty Information.** You can then be directed to other staff members who can assist you if there are very specific matters that need to be solved.

Information Key

The following key provides a guide to abbreviations used in this book:

C	credit points
F	full year (Session 1 plus Session 2)
HPW	hours per week
L	lecture
P/T	part-time
S1	Session 1
S2	Session 2
SS	single Session, but which Session taught is not known at time of publication
T	tutorial/laboratory
U	unit value
WKS	weeks of duration
X	external

Prefixes

The identifying alphabetical prefixes for each organizational unit offering subjects to students in the Faculty of Engineering follow.

Prefix	Organizational Unit	Faculty/Board
ACCT	School of Accounting	Commerce & Economics
AERO	School of Mechanical and Manufacturing Engineering	Engineering
ANAT	School of Anatomy	Medicine
BIOM	Centre for Biomedical Engineering	Engineering
BIOS	School of Biological Science	Biological & Behavioural Sciences
BIOT	Department of Biotechnology	Applied Science
CEIC	School of Chemical Engineering & Industrial Chemistry	Applied Science
CHEM	School of Chemistry	Science
CHEN	Department of Chemical Engineering	Applied Science
CIVL	School of Civil Engineering	Engineering
COMP	School of Computer Science & Engineering	Engineering
ECON	School of Economics, Departments of Econometrics and Economics	Commerce & Economics
ELEC	School of Electrical Engineering	Engineering
FUEL	Department of Fuel Technology	Applied Science
GEOG	School of Geography	Applied Science
GEOL	Department of Applied Geology	Applied Science
GSOE	Graduate School of Engineering	Engineering
INDC	Department of Industrial Chemistry	Applied Science
IROB	School of Industrial Relations & Organizational Behaviour	Commerce & Economics
LAWS	School of Law	Law
LIBS	School of Librarianship	Professional Studies
MANF	School of Mechanical & Manufacturing Engineering	Engineering
MATH	School of Mathematics	Science
MATS	School of Materials Science & Engineering	Applied Science
MECH	School of Mechanical & Manufacturing Engineering	Engineering

Prefix	Organizational Unit	Faculty/Board
MINE	Department of Mining Engineering	Applied Science
NAVL	School of Mechanical and Manufacturing Engineering	Engineering
PHPH	School of Physiology & Pharmacology	Medicine
PHYS	School of Physics	Science
PLAN	School of Town Planning	Architecture
POLS	School of Political Science	Arts & Social Sciences
POLY	Department of Polymer Science	Applied Science
REMO	Centre for Remote Sensing	Engineering
SAFE	Department of Safety Science	Applied Science

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/centre representative listed below:

School of Civil Engineering: Mr G. J. Harris, Room 406, Civil Engineering Building.

School of Computer Science and Engineering: Dr G.R. Whale or Ms V. Joubert, School Office, Room 313, Electrical Engineering Building.

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

School of Mechanical and Manufacturing Engineering: Dr E.M. Kopalinsky, Room 105B, or Mr A.D. Bauman, Room 112, Mechanical and Manufacturing Engineering Building.

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

Centre for Biomedical Engineering: Associate Professor K. Schindhelm, 5th Floor, New Research Building.

Centre for Groundwater Management and Hydrogeology: Associate Professor C. Dudgeon, Room 4275, Applied Science Building.

Centre for Remote Sensing: Dr A.K. Skidmore, Room 235, Geography and Surveying 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 Tertiary Entrance Rank obtained in the New South Wales Higher 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 Prerequisites

Mathematics
2u (60-100)
3u (1-50)
4u (1-100)

Additional subject prerequisites

English
2u Contemporary (60-100)
2uG (53-100)
2u (49-100)
3u (1-50)
and

Science
2u Physics (57-100) or
2u Chemistry (60-100)
3u (90-150)
4u (1-50)

and

Mathematics
2u (67-100)

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 Admissions Centre (UAC).

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

Enrolment Procedures

All students re-enrolling in 1993 or enrolling in graduate course should obtain a copy of the free leaflet Re-Enrolling 1993 available from School offices and the Admissions Office. This leaflet provides detailed information on enrolment procedures and fees, enrolment timetables,

enrolment in miscellaneous subjects, locations and hours of Cashiers and late enrolments.

Re-enrolment forms must be lodged with the appropriate School Office by the start of the third week in the preceding December. Enrolment at the University will not be authorised until the re-enrolment form has been checked and the program approved. 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.

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

Faculty of Engineering Library Facilities

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

The library, located on Levels 6 and 7 of the Library tower, caters for the information needs of staff, graduate students and undergraduates in the pure and applied sciences, engineering and architecture.

Physical Sciences Library materials are listed in the Library's online catalogue, microfiche book finding list or microfiche serials catalogue.

This Library provides reference, reader assistance and reader education services including interlibrary loan, online search and CD-ROM facilities. Photocopying facilities are also available.

Trained Library staff are always available on Level 7 to assist readers with their enquiries.

Physical Sciences Librarian: Rhonda Langford

Undergraduate Services

- The **Open Reserve Section** houses books and other materials which are required reading. Level 2.
- The **Audio Visual Section** contains multi media videos and cassette tapes of lectures. The section has wired study carrels and cassette players for student use. The map collection is also located here. Level 3.
- The **Reader Education** program provides orientation tours and introductory library research method lectures to students.

Student Clubs and Societies

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 (CIVSOC); 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.

Students With Disabilities

The University of New South Wales has a policy of equal opportunity in education and seeks wherever possible to ensure maximum participation of students with disabilities.

The University offers a range of assistance: examination support; specialized equipment; educational support; parking provisions; library assistance.

A Resource Guide for students and staff with disabilities and a map showing wheelchair access is available from the Advisor to students with Disabilties, the EEO Unit, the Library and the Students' Union.

It is advisable to make contact with the Adviser to Students with Disabilities prior to, or immediately following enrolment, to discuss your support needs.

The Adviser can be contacted on 697 5418 or at the Student Services Huts, Physics Road (near Barker Street).

International Association for the Exchange of Students for Technical Experience – IAESTE

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.

Further information may be obtained from the Association, c/-The Graduate Careers Council of Australia, PO Box 28, Parkville, Vic 3052. Telephone (03) 347 4644.

Professional Institutions

1. The Institution of Engineers, Australia

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

The IEAust has its national headquarters in Canberra and 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, engineering management and environmental engineering.

Students of an approved school of engineering may join the Institution as a student member (StudIEAust). Student members receive the fortnightly publication Engineers, Australia and for a small fee they also receive The Transactions which contains articles on a particular branch of engineering.

Student members are invited to participate in the Excellence Award for Work Experience, the National Young Engineer of the Year Award and to avail themselves of other IEAust services including the Mentor Scheme and industrial experiences guidance.

For more information and membership application forms, write to The Secretary, The Institution of Engineers, Australia, Sydney Division, 1st Floor, 118 Alfred Street, Milsons Point 2061.

2. The Institution of Surveyors, Australia

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, Australia. 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, 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 2000.

General Information

While this Handbook has been specially designed as a detailed source of reference in all matters related to the Faculty, the University's Student Guide is intended to provide general information on some of the most important rules and procedures and introduces students to many of the services available to them. The Guide, which helps to put the Faculty into perspective within the University as a whole, is issued free of charge to all enrolled students. For fuller details about some aspects of the University and its activities students might need to consult the University Calendar.

Summary of Courses

Undergraduate Study

The Faculty of Engineering offers the following courses:

Bachelor of Engineering
BE

in:
Aerospace Engineering
Civil Engineering
Computer Engineering
Electrical Engineering
Environmental Engineering
Mechanical Engineering
Manufacturing Management
Naval Architecture

These full-time courses are designed to be taken over a period of four years. They may also be taken on a part-time basis which usually involves a combination of mainly day-time study together with some evening attendance over a period of six or seven years. It may not be possible to offer evening classes in the later year subjects.

Courses in sandwich form after the first year are also available in Civil Engineering and Environmental Engineering.

Bachelor of Surveying
BSurv

This course is available on a full-time basis and in sandwich form, the latter providing for alternate periods of full-time study and full-time employment with part-time study.

Combined Degree Courses

Full-time courses are available for the award of the following degrees:

Bachelor of Engineering Bachelor of Science
BE BSc

(5 years' duration) in:
Aerospace Engineering
Civil Engineering
Electrical Engineering
Manufacturing Management
Mechanical Engineering
Naval Architecture

Bachelor of Engineering Bachelor of Arts
BE BA

(5 years' duration) in:
Aerospace Engineering
Electrical Engineering
Manufacturing Management
Mechanical Engineering
Naval Architecture

Bachelor of Engineering Bachelor of Laws
BE LLB

(6 years' duration) in:
Civil Engineering

Bachelor of Engineering (Civil) and Bachelor of Engineering (Mining)
BE BE

(5 years' duration) in:
Civil Engineering

Bachelor of Surveying Bachelor of Science in Computer Science
BSurv BSc

(5 years' duration)

Subject Areas

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.

Co-op Program

The University's Co-op Program in the Faculty of Engineering consists of industry-linked, five-year courses in Aerospace Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering, Manufacturing Management and Naval Architecture.

Co-op scholars are selected largely on the basis of academic attainment, personal skills and motivation as well as on non-academic achievements.

Further information is available from the University's Office of Industry-Linked Education, telephone (02) 697 5116.

Transfer Courses

Students transferring to the University of New South Wales after successful completion of the first year of an engineering degree course at an Australian university would normally be admitted with advanced standing into the degree courses offered by the Faculty of Engineering. Students transferring from related courses at an Australian university are granted exemptions based on parity of all junior courses.

Students 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.

Please note, however, that due to enrolment quotas in undergraduate courses the number of places available for transfer is limited and offeres will be made on a competitive basis.

Formal advanced standing procedures apply for entry into the following Bachelor of Engineering (BE) courses at the University of New South Wales with full credit.

BE in Electrical Engineering

Students studying at the University of Western Sydney, Macarthur, who complete at their first attempt the first year of the Science Program are granted enrolment in the second year of the BE course. Entry is restricted to applicants who are residents of the South-Western Region of Sydney.

BE in Aerospace Engineering
BE in Manufacturing Management
BE in Mechanical Engineering
BE in Naval Architecture

Students studying at the Charles Sturt University, Wagga Wagga, may be admitted to the second year of the above course after satisfactorily completing the one-year Bachelor of Engineering Transfer Program (KSZ) at Wagga Wagga.

BE in Aerospace Engineering

Students who satisfy the requirements of the first two years of the Mechanical Engineering full-time degree course at any other Australian university may be admitted to a two-year program leading to the Bachelor of Engineering degree in Aerospace Engineering. (The first and second years of this course are identical with the first two years of the course in Mechanical Engineering.)

BE in Naval Architecture

Students who satisfy the requirements of the first two years of the Mechanical Engineering full-time degree course at any other Australian university may be admitted to the final two years of the Bachelor of Engineering degree course in Naval Architecture. (The first and second years of this course are identical with the first two years of the course in Mechanical Engineering.)

Further information regarding entry into the above listed courses may be obtained from the Dean's Office, Faculty of Engineering.

Course Revision

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

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. *Students are not permitted to enrol in subjects with clashing timetables.*

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 corequisite 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 student, 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. *Previously failed subjects must be included, except that a failed elective may be replaced by another elective.*

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.

Honours

In the Bachelor of Engineering degrees courses 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.

In the cases of combined degrees, such as the BE BA or the BE BSc, the award of the BA or BSc degree at honours level requires two additional sessions of study.

Students wishing to gain a degree at Honours level in Arts or in Science as part of their combined degree program must meet all the relevant requirements of the Faculty of Arts or the Board of Studies in Science and Mathematics and of the appropriate School concerned. Students may enrol for the Honours year only on the recommendation of the Head of their School in the Faculty of Engineering and with the approval of the Head of the appropriate Arts or Science School, and the Faculty of Engineering. For an Honours in Science, approval must also be sought from the Board of Studies in Science and Mathematics. AUSTUDY support is available for the combined degree program including the Honours level.

Prerequisites and Corequisites

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

Industrial Experience Requirements (Engineering Students)

The Faculty of Engineering endorses the requirement of The Institution of Engineers, Australia, in that all students must complete at least 60 working days of approved industrial experience prior to enrolment in the final year of their course. The staff of the Faculty 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. The award of the degree is dependent on the completion of the requisite periods of industrial employment at a standard approved by the University.

Students enrolled in Bachelor of Engineering courses in the Schools of Civil Engineering, Computer Science and Engineering, Electrical Engineering and Mechanical and Manufacturing Engineering are required to enrol in Industrial Training subjects. Schools' entries under Course Outlines and Subject Descriptions should be consulted for details of subject requirements.

Students will formally enrol in the Industrial Training subject in Year 4, although they are strongly encouraged to complete as much industrial experience as possible in the breaks between the early years of the course.

Practical Experience Requirements (Surveying Students)

All students in 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 SURV8711. Special instructions will be given before commencement of professional practice.

General Education Requirement

The University requires that all 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 individuals, citizens and professionals.

There are differing requirements for general education for students commencing before, in, and after 1988. Students must complete a progam of general education in accordance with the requirements in effect when they commenced their degree program. Students should consult the appropriate course authority or the Centre for Liberal and General Studies in Morven Brown Building, Room G58.

The program requires students to undertake studies in three categories of the program: The key questions addressed by the Program are:

Category A: The External Context: An introduction in non-specialist terms to an understanding of the environments in which humans function.

Course Requirement: 56 hours

1. Australia and the Development of the World Economy. How do we, can we, generate wealth?

2. Human Inequality. How can we, ought we, distribute wealth, status and power?

3. Science and Civilization. What steps should we take, and what policies should we adopt, in science and technology?

4. Ecosystems, Technology and Human Habitation. What effects do our wealth generating and techno-scientific activities have on the environment?

5. Mass Media and Communication. What are the effects of the new mass media of communication?

6. Australian Society and Culture.. What are the key social and cultural influences on Australia today?

Category B: The Internal Context of Assumptions and Values: An introduction to, and a critical reflection upon, the cultural bases of knowledge, belief, language, identity and purpose.

Course Requirement: 56 hours

1. The Self and Society. How do we define ourselves in relation to the larger human community?

2. Changing Conceptions of Human Nature and Well-Being. How do our conceptions of human nature and well being influence both individual and social behaviour?

3. The Pursuit of Human Rationality. What are the prevailing conceptions of and challenges to human rationality?

4. The Use of Language, Images and Symbols. How do language, images and symbols function as means and media of communication?

5. The Computer: Its Impact, Significance and Uses What is the impact of the computer on human society and culture?

6. Beliefs, Values and the Search for Meaning. Which systems of belief and configurations of values are most conducive to the survival and enhancement of the human species and the planet earth?

Category C: An Introduction to the design and responsible management of the human and planetary future: An introduction to the systems over which human beings exercise some influence and control. This category is required only of students in four-year professional and honours programs

The central question to be addressed by students in a systematic and formal way is: For what purpose or purposes will I use my intellectual skills, my expertise, or my technological prowess?

Will these abilities be used, for example:

- in a creative and innovative way?
- to widen the circle of human participation in the benefits they bring?
- to break down the barriers of exclusion and discrimination?
- to enhance the prospects for survival of the human species?
- to enhance the capacity of the planet earth to sustain life?

The way in which the Category C requirement of the Program will be met varies with each of the Schools and courses in the Faculty. The particular details are shown under each School's handbook entry.

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.

Conditions for the Award of the Degree of Bachelor of Surveying

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

(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;

(3) complete an approved program of professional practice 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, 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 approve the variation of any of the preceding conditions.

Graduate Study

The Faculty awards ten higher degrees as follows: Research – Doctor of Philosophy, Master of Engineering and Master of Surveying; Course Work Masters – Master of Biomedical Engineering, Master of Cognitive Science, Master of Computer Science, Master of Engineering Science (available in a number of areas of specialisation), Master of Environmental Engineering Science, Master of Information Science and Master of Surveying Science. 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 Graduate School of Engineering is responsible for the MBT Program which is a joint initiative of the Faculties of Applied Science and Engineering. The two courses offered through this special unit are the Master of Business and Technology, and the Graduate Diploma in Industrial Management (see Graduate School of Engineering section in this Handbook).

Conditions governing the award of higher degrees and graduate diplomas are set out later in this handbook in **Conditions for the Award of 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 acceptable results from one of the following tests or by satisfying the course authority as to their level of proficiency. A pass in the writing component of the tests listed below is strongly recommended.

Minimum Acceptable Score

1. The Test of English as a Foreign Language (TOEFL) 550
2. International English Language Testing Service (IELTS) 6.0
3. Combined Universities Language Test (CULT) 65%
4. Indonesia-Australia Language Foundation (IALF)* Cat 1 or 2

**Cat 3 may be accepted if current English program available.*

Research Degrees

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. Research for this degree may be taken at, or externally to, the University. However the Faculty recommends that periods of residency at the University totalling at least six months be included in the candidate's research program.

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. Applications for admission should be made to the 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.

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 award of 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. Applications for admission should be made to the 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:

PhD
Civil Engineering **1630**
Electrical Engineering **1640**
Computer Science and Engineering **1650**
Mechanical and Manufacturing Engineering **1662**
Surveying **1680**
Biomedical Engineering **1710**

ME
Civil Engineering **2650**
Electrical Engineering **2660**
Computer Science and Engineering **2665**
Mechanical and Manufacturing Engineering **2692**

MSurv
Surveying **2720**

MSc
Civil Engineering **2750**
Electrical Engineering **2760**
Mechanical and Manufacturing Engineering **2781**
Biomedical Engineering **2795**

Course Work Masters Degrees

Course work programs: Detailed information on course work programs is available from the schools offering the courses and can be found in this Handbook under the appropriate School section.

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.

Applicants for admission to a course of study leading to the award of a Masters degree by course work commencing in first session should apply to the Registrar on the prescribed form by the 31st October of the year before the year in which enrolment is to begin. Where application is for registration commencing in the second session, applicants should apply at least two months before the commencement of session. It may be necessary to limit entry to formal courses due to quota restrictions. In such cases, applications may be placed on a reserve list and considered subject to the availability of places. If a firm offer of admission is made, it will be subject to acceptance within three weeks.

Courses of study leading to the award of course work Masters degrees may be undertaken in the Faculty as follows:

MEngSc
Electrical Engineering **8501**
Industrial Engineering **8531**
Mechanical Engineering **8541**
Remote Sensing **8641**
Civil Engineering **8612**
Waste Management **8612** (Internal), **8614** (External)
Surveying **8640**

MCogSc
Cognitive Science **8155**

MCompSc
Computer Science and Engineering **8680**

MEnvEngSc
Civil Engineering **8615**

MInfSc
Computer Science and Engineering **8508**

MSurvSc
Surveying **8651**

MBiomedE
Biomedical Engineering **8660**

The following courses are contributed to by the Faculty of Engineering and further details may be found in the Faculty of Applied Science Handbook: Master of Applied Science in Arid Lands Management (course code **8025**), Master of Safety Science (course **8671**) and Master of Engineering Science in Industrial Safety (course code **8675**).

Master of Engineering Science MEngSc
Master of Environmental Engineering Science MEnvEngSc
Master of Surveying Science MSurvSc

The Master of Environmental Engineering Science allows for a degree to be taken in a specific area of specialisation. The Master of Engineering Science and Master of Surveying Science 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 specialisation in certain areas and further information is available under each School section in this handbook.

Candidates who enrolled from 1990 are required to complete a program totalling 30 credits. Those who first enrolled prior to 1990 including those who are upgrading from a Graduate Diploma must complete 36 credits. A degree may be awarded for formal course work only or for the completion of formal course work and a report on a project depending on the program being offered. The number of credits for a project reports varies amongst schools and centres and between departments within schools and are 9, 12, 15 or 18.

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 or 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.

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 MBioMedE

Information is detailed under Centre for Biomedical Engineering, Graduate Study.

Master of Information Science MInf
Master of Computer Science MCompSc
Master of Cognitive Science MCogSc

Information is detailed under School of Computer Science and Engineering, Graduate Study.

Graduate Diplomas

Courses of study leading to the award of a Graduate Diploma in the Faculty of 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.

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 24 credits except for Biomedical Engineering which requires 30 and the Graduate Diploma specialisation in Computer Science which requires 36. In the latter case, an exemption may be granted from 12 of these credits. In most cases 12 credits may be derived from 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 the prerequisite requirements. If an applicant nominates a course of study taken from the list below, at least half of the credits should come from the subjects taken in that area. The exceptions to this requirement are for the Information Science and Computer Science Graduate Diploma specialisations where all subjects are taken from a prescribed program of study.

It should be noted that some candidates who have partially completed or who have completed the requirements but not taken out the diploma may be considered for upgrading to the relevant Master program with advanced standing. Since the policy on upgrading varies between different schools and centres, further enquiries should be made with the school or centre concerned.

Applicants for admission to a course of study leading to the award of a Graduate Diploma commencing in first session should apply to the Registrar on the prescribed form by 31 October of the year before the year in which enrolment is to begin. Where application is for registration commencing in the second session, applicants should apply at least two months before the commencement of session. It may be necessary to limit entry to formal courses due to quota restrictions. In such cases, applications may be placed on a reserve list and considered subject to the availability of places. If a firm offer of admission is made, it will be subject to acceptance within three weeks.

Courses of study leading to the award of a graduate diploma may be undertaken in the Faculty of Engineering as follows:

School/Course

Graduate Diploma in Engineering:
Biomedical Engineering **5462**
Civil Engineering **5459**
Waste Management **5459**(Internal) **5498**(External)
Electrical Engineering **5458**
Computer Science **5452**
Information Science **5453**
Computer Education **5464**
Industrial Engineering **5455**
Mechanical Engineering **5456**

Graduate Diploma in Remote Sensing **5496**

Graduate Diploma in Surveying **5491**

Further details of the recommended programs of study may be obtained from the course authorities concerned.

Graduate Subjects

The subjects which may be available for a candidate proceeding to the award of the degree of Master of Biomedical Engineering, Master of Computer Science, Master of Engineering Science, Master of Environmental Engineering Science, Master of Information Science, Master of Surveying Science and Graduate Diploma are listed at the end of each School section. 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.

Graduate Diploma Subjects

Graduate Diploma programs in all schools of the Faculty may include subjects from the graduate study lists at the end of each School section in this handbook, subject to the approval of the Head of School responsible for the subject.

School of Civil Engineering

Head of School
Professor R. Fell

First Year Management Committee
Mr V.J. Summersby (Chair)
Professor R.I. Gilbert
Assoc. Professor P.W. Kneen
Dr A. C. Heaney

Senior Administrative Officer
Mr G.J. Harris

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 and operation of transport systems, statistical analysis, land use and transport modelling, economic evaluations and environmental impact studies); **Water Engineering** (hydraulics, hydrology, water resources, waste management and public health engineering).

Within the five departments the School has a broad spectrum of expertise in the disciplines of Environmental Engineering.

The **Centre for Wastewater Treatment** and the **Munro Centre for Civil and Environmental Engineering** are also located within the School. In addition to extensive laboratory facilities on the Kensington campus, the School operates laboratories at King Street, Randwick and 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 is also involved in the **Centre for Groundwater Management and Hydrogeology** which is a joint enterprise with Schools in the Faculty of Applied Science.

The School offers courses (**3620**) and (**3625**) leading to the award of degrees of Bachelor of Engineering (Civil) (BE) and Bachelor of Engineering (Environmental) (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 most subjects are offered only in the daytime. Part-time students will normally take two years for each equivalent full-time year.

Alternatively, the courses 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 one academic year.

A six-year full-time course (**4775**) leading to the award of the degrees of Bachelor of Engineering and Bachelor of Laws (BE LLB) is offered.

A five year full-time combined course (**3146**) leading to the award of the degrees of Bachelor of Engineering (Civil) and Bachelor of Engineering (Mining) is offered..

The degree of Bachelor of Engineering (Civil or Environmental) 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 (Civil or Environmental) 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 the BE course by overseas engineering institutions.

There are formal graduate courses leading to the award of the degree of Master of Engineering Science **8612**, Master of Environmental Engineering Science **8615**, and also the Graduate Diploma in Engineering **5459**. These course are available in specialist areas including engineering construction and management, geotechnical engineering, public health engineering, structural engineering, transport engineering and water engineering. In addition, and within the Master of Engineering Science and Graduate Diploma course structures, courses are offered in the area of waste management. They can be taken internally on a full or part-time basis or externally. These courses are designed to provide engineers and scientists with the background necessary to design treatment, handling and disposal processes for a wide range of waste streams, solve existing waste problems, and understand pertinent waste legislation.

Opportunities are provided for graduate research leading to the award of the degrees of Master of Engineering **2650** and Doctor of Philosophy **1630.**

Undergraduate Study

Course Outlines

3620
Civil Engineering – Full-time Course

Bachelor of Engineering
BE (Civil)

		HPW	
Year 1		S1	S2
CHEM1808	Chemistry 1CE	0	6
CIVL1106	Computing and Graphics	3	3
CIVL1203	Engineering Mechanics 1	4	4
CIVL1301	Civil Engineering Practice	3	2
GEOL5100	Geology for Civil and Environmental Engineers	3	0
MATH1032	Mathematics 1	6	6
PHYS1989	Physics	4	3
Totalling		23	24
Year 2			
CIVL2106	Systems Engineering	2	3
CIVL2203	Engineering Mechanics 2	4	4
CIVL2301	Engineering Construction	2	2
CIVL2402	Materials Engineering 1	4	4
CIVL2505	Hydraulics 1	2	2
MATH2009	Engineering Mathematics 2	4	4
MATH2869	Statistics SC	2	0
SURV0441	Surveying for Engineers	0	4.5
SURV0491	Survey Camp (1 week equivalent to 3 HPW in S2)	0	3
General Education Cat.A		4	0
Totalling		24	26.5
Year 3			
CIVL3106	Engineering Computations	2	2
CIVL3203	Structural Analysis	3	3
CIVL3303	Structural Design	4	4
CIVL3402	Geotechnical Engineering 1	3	3
CIVL3505	Hydraulics 2	3	3
CIVL3601	Engineering Management 1	2	2
CIVL3705	Water Resources	3	3
CIVL3804	Transport Engineering	2	2
General Education Cat.B		2	2
Totalling		24	24
Year 4			
CIVL4006	Industrial Training	0	0
CIVL4101	Engineering Management 2	2	0
CIVL4203	Structural Engineering	4	0
CIVL4306	Engineering and the Environment*	4	0
CIVL4403	Materials Engineering 2	3	0
CIVL4502	Geotechnical Engineering 2	3	0
CIVL4605	Water Supply and Wastewater Disposal	3	0
CIVL4704	Highway and Pavement Engineering	3	0
CIVL4906	Project/Thesis	1	6
Plus two of the following five elective majors:			
CIVL4811	Construction Major	0	9
CIVL4822	Geotechnical Major	0	9
CIVL4833	Structures Major	0	9
CIVL4844	Transport Major	0	9
CIVL4855	Water Major	0	9
Totalling		23	24

**General Education Cat.C.*

3625
Environmental Engineering – Full-time Course

Bachelor of Engineering
BE (Environmental)

Note: The General Education requirements Category C. for this course are still to be determined.

Year 1		HPW S1	S2
CHEM1002	Chemistry 1	6	6
CIVL1007	Engineering Practice	2	2
CIVL1203	Engineering Mechanics	4	4
GEOG1031	Environmental Processes	0	4
GEOL5100	Geology for Civil and Environmental Engineers	3	0
MATH1032	Mathematics I	6	6
PHYS1989	Physics 1	4	3
Totalling		25	25
Year 2			
BIOS1021	Biology B	0	6
CIVL1106	Computing and Graphics	3	3
CIVL2007	Engineering Mechanics and Materials	4	4
CIVL2017	Data Survey and Analysis	0	2
CIVL2106	Systems Engineering	2	3
CIVL2505	Hydraulics 1	2	2
INDC4120	Chemistry of the Industrial Environment	3	0
MATH2009	Engineering Mathematics 2	4	4
MATH2869	Statistics SC	2	0
General Education Cat.A		4	0
Totalling		24	24
Year 3			
BIOS3111	Population and Community Ecology	3	3
CEIC0010	Mass Transfer and Material Balance	2	2
CIVL3007	Environmental Fluid Mechanics	3	3
CIVL3106	Engineering Computations	2	2
CIVL3402	Geotechnical Engineering	3	3
CIVL3601	Engineering Management I	2	2
CIVL3705	Water Resources	3	3
CIVL3804	Transport Engineering	2	2
GEOL9110	Hydro and Environmental Geology	0	4
General Education Cat.B		4	0
Totalling		24	24
Year 4			
CEIC0020	Fluid/Solid Separation	2	0
CHEN3070	Process Control	2	0
CIVL4006	Industrial Training	0	0
CIVL4007	Waste Management	3	0
CIVL4037	Communications and Ethics	0	2
CIVL4101	Engineering Management 2	2	0
CIVL4605	Water Supply and Wastewater Engineering	3	0
CIVL4907	Project/Thesis	1	6
GEOG3042	Environmental Impact Assessment	4	0
GEOL9120	Groundwater Contaminant Transport	4	0
LAWS3410	Environmental Law	0	4
SURV0752	Remote Sensing Techniques and Applications	4	0
Plus two of the following three elective majors:			
CEIC0030	Environmental Protection in the Process Industries	0	6
CIVL4017	Water Engineering	0	6
CIVL4027	Geotechnical and Transport Engineering	0	6
Totalling		25	24

Combined Courses

Programs for combined degree courses offered in the Faculty of Engineering are listed below. In all cases material not in italic typeface refers to the BE degree component of the combined course.

3730
BE BSc in Civil Engineering - Full-time Course

Students may seek permission to undertake a five-year full-time combined course leading to the award of the degrees of Bachelor of Engineering (Civil) 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 PHYS1002 Physics 1 in the second program.

The prerequisite CHEM1002 for Year 2 Chemistry subjects will be waived for students in Course 3730.

Approved Programs

Geography and Environmental Chemistry

Year 1
CHEM1808
CIVL1106, CIVL1203, CIVL1301
GEOL5100
MATH1032
PHYS1989

Year 2
CHEM2011, CHEM2031, CHEM2041
CIVL2203, CIVL2301, CIVL2402
GEOG1031 and any other Year 1 Geography subject
MATH2009
One 56-hr or two 28-hr General Education subject/s Cat. A

Year 3
CHEM3311
CIVL2106, CIVL2505, CIVL3106, CIVL3203, CIVL3303
GEOG3021, GEOG2032
SURV0441, SURV0491
One 56-hr or two 28-hr General Education subject/s Cat. B

Year 4
CIVL3402, CIVL3505, CIVL3601, CIVL3705, CIVL3804
GEOG3011, GEOG3042, GEOG3211
At least 2 units chosen from:
GEOG2021, GEOG3032, GEOG3051, GEOG3062

Year 5
Choose 2 units from Table 1 in the Sciences Handbook at Level II or higher
CIVL4006, CIVL4101, CIVL4203, CIVL4306*
CIVL4403, CIVL4502, CIVL4605, CIVL4704, CIVL4906
Two of the following subjects:
CIVL4811, CIVL4822, CIVL4833, CIVL4844, CIVL4855
**General Education Cat. C,*

Physics with Mathematics

Year 1
CHEM1808
CIVL1106, CIVL1203, CIVL1301
GEOL5100
MATH1032
PHYS1002

Year 2
CIVL2203, CIVL2301, CIVL2402
MATH2510, MATH2520, MATH2100, MATH2120
MATH2869
PHYS2011, PHYS2021, PHYS2031
One 56-hr or two 28-hr General Education subject/s (Cat A)

Year 3
CIVL2106, CIVL2505, CIVL3203, CIVL3303
MATH2501
PHYS2001, PHYS3021, PHYS3041
SURV0441, SURV0491
One 56-hr or two 28-hr General Education subject/s (Cat B)

Year 4
CIVL3402, CIVL3505, CIVL3601, CIVL3705, CIVL3804
PHYS3030
Choose 1 unit from: PHYS3631, PHYS3110, PHYS3010, PHYS3050
Choose 2 Level II or Level III Mathematics units from Table 1 in the Sciences Handbook.

Year 5
CIVL4006, CIVL4101, CIVL4203, CIVL4306*, CIVL4403, CIVL4502, CIVL4605, CIVL4704, CIVL4906
Two of the following subjects:
CIVL4811, CIVL4822, CIVL4833, CIVL4844, CIVL4855
Choose 1 unit from Table 1 in the Sciences Handbook at Level 11 or higher.
**General Education Cat. C.*

Computing with some Mathematics

Year 1
CHEM1808
CIVL1106, CIVL1203, CIVL1301
GEOL5100
MATH1032
PHYS1989

Year 2
CIVL2106, CIVL2203, CIVL2301, CIVL2402
COMP1011, COMP1021
MATH2501†, MATH2510†, MATH2520†, MATH2869
One 56-hr or two 28-hr General Education subject/s Cat.A

Year 3
CIVL2505, CIVL3203, CIVL3303
COMP2011, COMP2021, COMP2031
MATH2100†, MATH2120†,
SURV0441, SURV0491
One 56-hr or two 28-hr General Education subject/s Cat.B
Choose .5 Level II or Level III Mathematics unit from the Sciences Handbook.

Year 4
CIVL3402, CIVL3505, CIVL3601, CIVL3705, CIVL3804
COMP3121,
Choose three units, at least one of which is a Computer Science Unit, from COMP3211, COMP3231, COMP3311 or Level II or Level III Mathematics units from the Sciences Handbook.

Year 5
CIVL4006, CIVL4101, CIVL4203, CIVL4306*, CIVL4403, CIVL4502, CIVL4605, CIVL4704, CIVL4906
Two of the following subjects:
CIVL4811, CIVL4822, CIVL4833, CIVL4844, CIVL4855
Choose 1 unit from the Sciences Handbook at Level II or higher.
**General Education Cat. C.*

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

3146
BE(Civil) BE(Mining) in Civil Engineering and Mining Engineering - Full-time Course

The Civil Engineering component of this course is administered by the School of Civil Engineering, the Mining Engineering component is administered by the School of Mines in the Faculty of Applied Science.

Year 1
CHEM1808
CIVL1106, CIVL1203, CIVL1301
GEOL5100
MATH1032
PHYS1989

Year 2
CIVL2106, CIVL2203, CIVL2301, CIVL2402, CIVL2505
MATH2009, MATH2869
SURV0441, SURV0491

Year 3
CIVL3106, CIVL3203, CIVL3303, CIVL3402, CIVL3505, CIVL3601, CIVL3705, CIVL3804

Year 4
CIVL4006, CIVL4203, CIVL4306, CIVL4502, CIVL4605, CIVL4704, CIVL4822, CIVL4906
GEOL5311
MINE1320, MINE1231, MINE1420, MINE1630, MINE2230,
SURV0580

Year 5
ELEC0802
MINE1130, MINE1140, MINE1330, MINE1830, MINE4330,
MINE1530, MINE1740, MINE2140, MINE3040, MINE7342,
PHYS2920
*Plus three advanced subjects from the following, including at least one subject marked *.*
MINE1040, MINE1440, MINE1840*, MINE1940, MINE7440*

4775
BE (Civil Engineering) LLB in Civil Engineering and Law - Full-time Course

This course is administered by the School of Law.

Year 1
CHEM1808
CIVL1106, CIVL1203, CIVL1301
GEOL5100
MATH1032
PHYS1989

Year 2
CIVL2106, CIVL2203, CIVL2402, CIVL2505
LAWS1120, LAWS7410
MATH2009, MATH2869
SURV0441, SURV0491

Year 3
CIVL3106, CIVL3203, CIVL3303, CIVL3402, CIVL3505, CIVL3601, CIVL3705, CIVL3804
LAWS1410

Year 4
CIVL4006, CIVL4203, CIVL4502, CIVL4605, CIVL4704, CIVL4306 taken concurrently with *LAWS3410*
LAWS1610, LAWS2160, LAWS3010
Plus one of the following elective majors:
CIVL4811, CIVL4822, CIVL4833, CIVL4844, CIVL4855

Year 5
LAWS1010, LAWS8320, LAWS8820, LAWS2150, LAWS6210, LAWS7420, LAWS7430 (The research component is taken in conjunction with or after)
Law electives to value 9 credit points.

Year 6
Law electives to value 24 credit points.

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

CIVL0616
Structures
Staff Contact: Dr A. C. Heaney
S1 L1 T2
Notes: This is a servicing subject for courses offered by other schools and faculties.

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.

CIVL0626
Civil Engineering for Electrical Engineers
Staff Contact: A/Prof P.W. Kneen
S1 L2 T2
Notes: This is a servicing subject for courses offered by other schools and faculties.

Includes an introduction to the various branches of civil engineering, the nature and organisation 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 plair., reinforced and

prestressed, aluminium and timber. Brittle fracture. Introduction to buckling. Engineering failures. Introduction to design of transmission lines and towers.

CIVL0636
Properties of Materials
Staff Contact: Prof R.I. Gilbert
F L1 T1
Notes: This is a servicing subject for courses offered by other schools and faculties.

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.

CIVL0646
Engineering for Surveyors 1
Staff Contact: Dr B.S. Jenkins
S1 L1.5 T1.5
Notes: This is a servicing subject for courses offered by other schools and faculties.

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.

CIVL0656
Engineering for Surveyors 2
Staff Contact: A/Prof W.O. Yandell
S2 L3
Notes: This is a servicing subject for courses offered by other schools and faculties.

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.

CIVL1007
Engineering Practice
Staff Contact: Prof D.L. Wilkinson
F L1 T1
Prerequisites: HSC Exam Score Range Required - 2 unit English (General) 53-100, 2 unit English 49-100, 3 unit English 1- 50, or 2 unit contemporary English 60-100
Notes: Excluded GENS4529

Introduction to the structure, nature and scope of environmental engineering work and the problems resolved by practitioners. History of engineering. Branches of engineering; organisation of the profession. Methodologies employed by engineers in their work. Communication methods and skills. Report preparation.

Introduction to Construction Practice. Construction of concrete and steel structures. Construction of earthworks. Earthworks plant. Construction of rockworks. Management of Engineering Projects. The nature of civil engineering projects. Management overview. Legal, political and environmental aspects. Technical and economic investigations. Design. Contractual aspects. Construction practice. Hand-over. Operation and management; Demolition.

CIVL1106
Computing and Graphics
Staff Contact: Dr A.C. Heaney
F L1 T2

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.

CIVL1203
Engineering Mechanics
Staff Contact: Prof R.I. Gilbert
F L2 T2
Corequisite: MATH1032

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. Planar motion of rigid bodies. Derivation and solution of equations of motion for simple spring-mass systems responding to forces of simple form. Applications to civil engineering problems.

CIVL1301
Civil Engineering Practice
Staff Contact: Mr V.J. Summersby
S1 L2 T1 S2 L1.5 T.5
Prerequisites: HSC Exam Score Range Required - 2 unit English (General) 53-100, 2 unit English 49-100, 3 unit English 1-50 or 2 unit contemporary English 60-100

Introduction to the structure, nature and scope of civil engineering work and the problems resolved by practitioners. History of civil engineering. Branches of engineering; organisation 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.

CIVL2007
Engineering Mechanics and Materials
Staff Contact: Dr F.S.K. Tin Loi
F L3 T1
Prerequisite: CIVL1203

Mechanics of Solids: Review of properties of cross-sectional shapes. Bars subjected to axial force; stress, strain and deformation. Homogeneous and non-homogeneous bars. Linear and non-linear material behaviour (elastic and plastic deformation). Strain energy. Bars in bending; stresses and deformations. Deflection calculations; step functions; moment area methods. Concepts of stiffness and flexibility. Stability and buckling of compression members. Shear and torsional stresses and deformations. Stresses and strain at a point; Mohr's circle. Combined stresses. Effects of temperature, strain rate, static and dynamic loading, and creep on material behaviour.

Use of Concrete in Civil Engineering Practice: Behaviour of concrete; composition, function and properties of constituents; cements, aggregates, admixtures. Properties of fresh and hardened concrete. Specification, quality control and code requirements. Time dependent behaviour. Durability, permeability, corrosion protection of reinforcing steel in concrete. Destructive and non-destructive testing. Special concrete making materials and techniques.

Metals Technology: Relationship of properties to microstructure, dislocation mechanisms of plastic deformation; micro-mechanism of creep and fracture. Property control by strain hardening, alloying and heat treatment of steel and aluminium.

Polymer and Ceramic Materials: The structure and properties of polymers and ceramics. Ceramic-metal composites.

CIVL2017
Data Survey and Analysis
Staff Contact: Prof D.L. Wilkinson
S2 L1.5 T.5
Prerequisite: MATH2869

Planning and design of experiments. Optimal utilization of instrumentation. Analysis of experimental data: analysis of variance and co-variance. Simple and multiple regression. Confidence limits and reliability. Analysis of time series. Sample survey design and analysis.

CIVL2106
Systems Engineering
Staff Contact: Mr R.R. Wakefield
S1 L1 T1 S2 L2 T1
Prerequisites: CIVL1106, MATH1032
Corequisite: MATH2869

Systems concepts: general systems theory, classification and representation of systems, dynamic behaviour. Modelling concepts. 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.

Techniques for numerical analysis and decision making: simulation, optimisation, network models, decision theory. Economic models. Benefit-cost techniques.

The solution of Civil Engineering problems involving probabilistic and statistical aspects. Problems examined include hydrological data fitting, traffic data analysis, structural reliability, limit state design, quality control, geomechanics site investigations and field data gathering and reduction. Regression. Decision processes associated with indefinite information; the modelling of the associated Civil Engineering systems.

CIVL2203
Engineering Mechanics 2
Staff Contact: Dr A.C. Heaney
F L2.5 T1.5
Prerequisite: CIVL1203

Review of properties of cross-sectional shapes. The approach to design. Design objectives and criteria. The concept of limit states. Types of structural members. Load paths. Three dimensional statics: concurrent and non-concurrent force systems.

Bars subject to axial force; stress, strain and deformation. Homogeneous and non-homogeneous bars. Linear and non-linear material behaviour. Strain energy. Design of tension and stocky compression members in steel. Connections. Ultimate strength concepts. Bars in bending; stresses and deformations. Deflection calculations; step functions; moment area methods. Concepts of stiffness and flexibility. Design of flexural members. Shear and torsional stresses and deformations. Design for shear. Stresses and strain at a point; Mohr's circle. Combined stresses. Bolted and welded connections. Structural stability and dynamic loading.

CIVL2301
Engineering Construction
Staff Contact: Mr G. Nawar
F L1.5 T.5
Prerequisite: CIVL1301

The handling of heavy materials: elementary machines, motion resistance and analysis. Special purpose cranes. Crane analysis. Work physiology. Earthmoving production. Vehicle terrain mobility. Compressed air. Construction of foundations: caissons, coffer dams and piling. Sand and aggregate production. Tunnelling: hard rock and soft ground. Specialist construction: pipelines, bridges, dams and buildings. Masonry construction. Design of formwork. Blasting practice.

CIVL2402
Materials Engineering 1
Staff Contact: Dr N. Gowriplan
F L2.5 T1.5
Prerequisites: CIVL1203, GEOL5002, CHEM1808
Corequisite: CIVL2203

Use of concrete and metals in Civil Engineering Practice: Behaviour of concrete, composition, function and

properties of constituents, cements, aggregates, admixtures. Properties of fresh and hardened concrete. Specification, quality control and code requirements. Mix design and proportioning methods. Time dependent behaviour. Durability, permeability, corrosion protection of reinforcing steel in concrete. Destructive and non-destructive testing. Special concrete making materials and techniques.

Behaviour of metals and other engineering materials. Response of materials to forces in tension, compression, bending, shear and torsion; elastic and plastic deformation strength brittleness, hardness etc. Effects of temperature and strain rates, static and dynamic loading, fatigue, brittle fracture and creep failures.

Metals Technology Relationship of properties to microstructure, dislocation mechanisms of plastic deformation; micro-mechanism of creep and fracture. Property control by strain hardening, alloying and heat treatment of steel and aluminium.

CIVL2505
Hydraulics 1
Staff Contact: Dr B.S. Jenkins
F L1 T1
Prerequisites: CIVL1203, MATH1032

Fluid properties: definition of a fluid, density, unit weight, specific volume, relative density, bulk modulus, vapour pressure, surface tension, viscosity, properties of gases. Fluid statics: pressure at a point, absolute and gauge pressure, manometers, forces on plane and curved surfaces, buoyancy, stability of floating bodies, accelerated bodies of fluid.

Kinematics of Fluid Flow: streamlines, pathlines, continuity.

Fluid dynamics: the energy equation, the momentum equation, application of the concepts of flow resistance , energy loss and fluid momentum to steady flows in closed conduits and to steady uniform free-surface flows. Hydrodynamics: the stream function and velocity potentials, rotation, basic flow patterns, flow nets.

CIVL3007
Environmental Fluid Mechanics
Staff Contact: Prof D.L. Wilkinson
F L2 T1
Prerequisite: CIVL2505

Shear stress in fluids: laminar and turbulent flow: boundary layers: friction and pressure drag. Flow in pipes: pipe friction. Pumps. Free surface flow, specific energy, controls, hydraulic jumps, gradually varied flow.

Turbulent diffusion and dispersion in rivers, oceans and the atmosphere. Buoyancy effects - jet and plume models. Influence of cross flows. Effects of density stratification. Gravity and turbidity currents.

CIVL3106
Engineering Computations
Staff Contact: Dr I.J. Somervaille
F L1 T1
Prerequisites: CIVL1106, MATH2009

Solution of linear and non-linear equations. Numerical differentiation. Curve fitting and interpolation. Numerical integration. Solution of ordinary and partial differential equations. Eigen value problems. Introduction to finite elements.

CIVL3203
Structural Analysis
Staff Contact: Dr R.E. Lawther
F L2 T1
Prerequisite: CIVL2203

The requirements of structural analysis. The work theorem and its applications. Flexibility and stiffness analysis of trusses. Flexibility and stiffness analysis of frames. Reciprocal theorems. Introduction of finite element analysis.

CIVL3303
Structural Design
Staff Contact: Mr S.J. Foster
F L3 T1
Prerequisite: CIVL2203

Loads on structures; dead, live, wind, earthquake, etc. Reinforced concrete beams and one-way slabs; service load and ultimate behaviour; moment-curvature relationships. Ultimate strength design and ductility. Design for serviceability. Durability. Shear strength. Bond and anchorage.

Reinforced concrete beam-columns; uniaxial and biaxial bending. Slenderness effects. Composite concrete – steel beams. Prestressed concrete determinate beams. Strength and serviceability design.

Design of steel girders; lateral and local buckling, web buckling. Steel beam-columns, slenderness effects. Plastic design of continuous steel beams.

CIVL3402
Geotechnical Engineering 1
Staff Contact: Dr V. Murti
F L2 T1
Prerequisites: CIVL2203, GEOL5100

Description of soil, clay mineralogy, plasticity and particle size distribution. Basic relationships of phases. Soil classification and material specification. Hydraulic properties of soils and flow of water through soil. The principle of effective stress. Consolidation theory, stress distributions and settlement. Compaction and basic stabilisation. Mohr's circle, failure criteria, stress paths and strength of soils. Soil testing. Site investigation and selection of design parameters. Slope stability including simple models and methods of slices. Laboratory work to compliment the lectures.

CIVL3505
Hydraulics 2
Staff Contact: Prof D.L. Wilkinson
F L2 T1
Prerequisite: CIVL2505

Shear stress in fluids: laminar and turbulent flow, shear stresses, boundary layers, flow separation, wakes, friction drag and pressure drag. Flow in closed conduits; friction factors, head losses, flow in systems in series, pipes in parallel and pipe networks. Pumps: types, their characteristics and selection. Unsteady flow in pipes: surges, pressure waves, and water hammer. Free surface flow: specific energy, controls, hydraulic jumps, gradually varied flow, flow in channels of non-cohesive alluvial material. Flow in porous media: Darcy equation, seepage flow nets, uplift forces on structures. Hydraulic models:

dimensional analysis, similarity criteria and scale selection, scale effects.

CIVL3601
Engineering Management 1
Staff Contact: Mr R.R. Wakefield
F L1.5 T.5
Prerequisites: CIVL1301, CIVL2106

Basic techniques used in the management of engineering works; purpose and principles of management; management of people, plant, materials, money and sites; management of safety. Planning techniques used in management: networks, critical path method, and PERT. Operations research in management: methodologies for problem solving including simulation and queuing theory. Theory of the management of humans. Theory of the management of organisations. Use and management of information systems. Law and the law of contract.

CIVL3705
Water Resources
Staff Contact: Dr J.E. Ball
F L2 T1
Prerequisite: MATH2869
Corequisite: CIVL3505

Hydrological processes – hydrological cycle, climatology, atmospheric water. Precipitation – processes and analysis. Runoff – process, measurement, analysis. Flood estimation. Urban hydrology – drainage design, retarding basins, flood routing. Groundwater hydrology – aquifers, aquifer modelling, water extraction, groundwater recharge and discharge processes, unsaturated flow. Water resource systems – systems approach, objectives and constraints, modelling, stochastic behaviour, optimisation.

CIVL3804
Transport Engineering
Staff Contact: Dr M.C. Dunne
F L1 T1
Prerequisites: CIVL2106, MATH2869

Traffic Flow Theory: Traffic measurements. Traffic stream parameters: flow, concentrations, speed, spacing, headway. Fundamental diagram of traffic. Overtaking models, moving observer. Car following theory. Traffic flow and speed sampling. Capacity of highways, uncontrolled and signal controlled intersections.

Transport Systems: Description and analysis of interactions. Feedback, steady state performance, sensitivity analyses. Travel demand: traffic generation, distribution and assignment to modes and routes. Transport supply: capacity and operational measures of public transport modes. Land-use and transport planning. Economic evaluation.

CIVL4006
Industrial Training
Staff Contact: Mr G. Nawar
Students are required to complete a minimum of 60 working days of approved industrial training, submit a report on this training before the fourth week of Session 1 of fourth year, and to present a seminar during the first session of fourth year outlining their industrial training experiences.

CIVL4007
Waste Management
Staff Contact: Head, Department of Water Engineering
S1 L2 T1
Prerequisite: INDC4120
Note: Subject not offered in 1993

Chemical fixation, acid waste treatment, metals removal, landfill site selection, leachate testing, toxicity testing, hydrogeological sampling. Transportation of hazardous materials. Legal aspects of hazardous waste.

CIVL4017
Water Engineering
Staff Contact: Head, Department of Water Engineering
S2 L4 T2
Prerequisites: CIVL3402, CIVL3007
Notes: Subject not offered in 1993

Selection of 4 topics from:

Water Resources
The evaluation of water resources planning and management alternatives (the "rational" approach). Water and politics. Water and law.

Hydrology
Introduction to flood estimation. Runoff routing methods of estimating flood hydrographs - principles of methods, description of models, calibration, application of computer models on PC's and mainframe. Extreme flood estimation. Evapotranspiration.

Numerical Modelling of Free Surface Flow
An introduction to one-dimensional and two-dimensional numerical models of unsteady gradually varied canal, river and flood plain flows.

Public Health Engineering
Sewerage systems. Wastewater treatment plant design. Effluent disposal as related to the control of receiving water quality and effluent reuse. Water supply systems. Water treatment.

Advanced Hydraulics
Hyrdraulic modelling. Introduction to unsteady flow in open channels.

Coastal Engineering
Design of ocean outfalls. Ocean wave statistics. Shoaling of waves at a coastline. Introduction to coastal processes.

CIVL4027
Geotechnical and Transport Engineering
Staff Contact: Head, Department of Geotechnical Engineering
S2 L3 T3
Prerequisites: CIVL3402, CIVL3804
Notes: Subject not offered in 1993

Four topics selected from:

Soil engineering. Rock engineering. Foundation engineering. Geotechnical engineering. Advanced pavement design. Theoretical soil mechanics. Concrete technology.

Theory of land use/transport interaction - travel demand and transport supply. Economic, social and environmental assessment. Analysis of impacts of transport activity: accidents, noise, air pollution, intrusion and energy consumption.

CIVL4037
Communications and Ethics
Staff Contact: School Office
S2 L.5 T1.5
Notes: Subject not offered in 1993

Written and verbal communication skills in engineering practice. Preparation of proposals and reports. Relations to the media. Engineering ethics.

CIVL4101
Engineering Management 2
Staff Contact: Mr J.B. O'Brien
S1 L1.5 T.5
Prerequisite: CIVL3601

Contract management and administration. Business and financial management: corporate entities; basic accounting to trial balance; income statements; balance sheets; accounting for fixed assets; taxation aspects; financial report. Management of large projects; management of international projects.

CIVL4203
Structural Engineering
Staff Contact: Prof R.I. Gilbert
S1 L3 T1
Prerequisites: CIVL3203, CIVL3303

Slab design: two-way edge-supported slabs and flat slab design; idealised frame and simplified design methods, punching shear, moment transfer at column connections, serviceability approach, detailing. Design of reinforced concrete footings and retaining walls. Plastic analysis and design of steel frames. Approximate analysis and structural form. Variational theorems. Brief discussions of cable structures, arches, plates and shells.

CIVL4306
Engineering and the Environment
Staff Contact: Prof D.L. Wilkinson
S1 L2 T2
Prerequisite: CIVL3601

Engineering impact on the environment, the conservation movement and the response of engineers. Principles of ecological systems and the environment: short-term and long-term impact of engineering on land, water, air and noise. The Australian national conservation strategy. Public attitudes: community involvement as an integral part of the planning process, risk perceptions. Environmental methodologies: environmental and social impact statements, methods for measuring and predicting impact. Assessment of engineering on the biophysical and social environment. Impact of current engineering activity on the future distribution of resources. Decision making methodologies for engineering and non-engineering groups. Planning for non-optimal engineering solutions. Professional ethics.

CIVL4403
Materials Engineering 2
Staff Contact: Dr A.C. Heaney
S1 L3
Prerequisites: CIVL2402, CIVL3303

Metals used in structures: types, applications and developments in steels, aluminium 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.

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.

CIVL4502
Geotechnical Engineering 2
Staff Contact: A/Prof B. Shackel
S1 L2 T1
Prerequisite: CIVL3402

Theoretical and presumptive bearing capacity of shallow foundations. Allowable settlement and foundations on sand and rock. Lateral earth pressures and retaining wall design. Single axially and laterally loaded piles, pile groups. Reactive soils, residential slabs and footings.

CIVL4605
Water Supply and Wastewater Disposal
Staff Contact: Ms P.A. Fitzgerald
S1 L2 T1
Prerequisite: CIVL2505

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. Waste water treatment: preliminary and primary treatment, biological treatment, sludge digestion, tertiary treatment.

CIVL4704
Highway and Pavement Engineering
Staff Contact: A/Prof B. Shackel
S1 L2 T1
Prerequisites: CIVL3402, CIVL3804

Introduction to road design: elements, terminology, standard plans. Road form: drivers perception, speed environment and interactions. Policies for road and intersections design. Horizontal and vertical alignment, visibility, drainage. Design evaluations: perspective, visibility and speed. Urban roads and intersections - different design philosophy. Vehicle turning paths and channelisations design. Introductory discussion on freeways and interchanges.

Pavement terminology, elements, classifications. Subgrades (earth) – variability and water problems. Traffic loads: frequency, weight, distribution, estimation and environmental factors. Bitumen pavements: properties, design and construction. Design and construction of flexible and rigid pavements. Selections of pavement type: serviceability and economic considerations.

CIVL4811
Construction Major
Staff Contact: Mr J.B. O'Brien
S2 HPW9
Prerequisites: CIVL2301, CIVL4101, CIVL4306

Professional level constsruction and project management skills and techniques: advanced construction technology topics and topics in the planning, design, organization, coordination, staffing, administration, control and management of construction and allied projects. State-of-the-art work associated with selected advanced topics in construction and project management.

CIVL4822
Geotechnical Major

Staff Contact: Mr G.R. Mostyn
S2 HPW9
Prerequisites: CIVL4306, CIVL4502, CIVL4704

Advanced pavement engineering including concrete technology. Rock engineering, slopes and tunnels. Foundation engineering. Soil engineering including site characterization, critical state theory and liquefaction. A two and a half day field trip is included as part of the subject.

CIVL4833
Structures Major

Staff Contact: Professor R. I. Gilbert
S2 HPW9
Prerequisites: CIVL4203, CIVL4403

Specialisation in each of the following strands of structural engineering: Bridge engineering. Concrete structures. Structural analysis and stability. Structural dynamics.

CIVL4844
Transport Major

Staff Contact: Prof J.A. Black
S2 HPW9
Prerequisite: CIVL4306

Application of computer aided methods for geometric design of roads. Design for traffic management and control: efficiency, safety, environmental factors, information systems, lighting. Environmental and social impact of transport design. Transport system design and operations.

CIVL4855
Water Major

Staff Contact: Dr J.E. Ball
S2 HPW9
Prerequisites: CIVL3505, CIVL3705, CIVL4605

Specialisation in six of the following strands (only six topics are offered each year): Water resources. Hydrology. Advanced hydraulics. Coastal engineering. Public health engineering. Environmental and social issues. Special topic.

CIVL4906
Project/Thesis

Staff Contact: A/Prof W.O. Yandell
S1 1 S2 6
Prerequisites: All third year subjects
Corequisite: The appropriate major

Directed laboratory, investigatory, design, field or research work on an approved subject under the guidance of members of the academic staff. Each student is required to present a seminar and a written project/thesis on the work undertaken. Time devoted to the project/thesis is one hour per week in Session 1 for library methodology instruction and preliminary work, and six hours per week in Session 2 to carry out the major part of the work.

CIVL4907
Project/Thesis
S1 1 S2 6
Prerequisites: All third year subjects
Corequisite: The appropriate major
Notes: Subject not offered in 1993

Directed laboratory, investigatory, field or research work on an approved subject under the guidance of members of the academic staff. Each student is required to present a seminar and a written project/thesis on the work undertaken. Time devoted to the project/thesis is one hour per week in Session 1 for library methodology instruction and preliminary work, and six hours per week in Session 2 to carry out the major part of the work.

Graduate Study

There are formal graduate courses leading to the award of the degree of Master of Engineering Science 8612, Master of Environmental Engineering Science 8615, and also the Graduate Diploma in Engineering 5459. These course are available in specialist areas including engineering construction and management, geotechnical engineering, public health engineering, structural engineering, transport engineering and water engineering. In addition, and within the Master of Engineering Science and Graduate Diploma course structures, courses are offered in the area of waste management. They can be taken internally on a full or part-time basis or externally. These courses are designed to provide engineers and scientists with the background necessary to design treatment, handling and disposal processes for a wide range of waste streams, solve existing waste problems, and understand pertinent waste legislation.

Opportunities are provided for graduate research leading to the award of the degrees of Master of Engineering 2650 and Doctor of Philosophy 1630.

Course Work Programs

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 specialist areas are available from the School. All subjects for the the Masters degrees are also offered in the Graduate Diploma programs.

8612
Civil Engineering

Master of Engineering Science
MEngSc

Waste Management
8612 Internal
8614 External

8085
Waste Management

Master of Applied Science
MAppSc

Candidates are required to complete a course totalling at least 30 credits, made up of compulsory subjects, elective subjects and a project. The degree may be obtained internally on a full time (normally 2 sessions) or part time (normally 4 sessions) basis. An external course program is also offered (normally over 4 sessions) to students outside Sydney with resource material posted to students and evaluation made on written assignments and examinations.

Candidates are enrolled as MEngSc or MAppSc degree students depending on their previous qualifications, experience and course content.

Internal Program

Compulsory Subjects		**C**
CIVL9872	Solid Waste Management	3
CIVL9881	Hazardous Waste Management	3
CIVL9884	Environmental Engineering Science 1	3
CIVL9886	Environmental Engineering Science 3	3
FUEL5880	Unit Operations in Wastewater Sludge and Solids Management	3
Project (MEngSc)		
CIVL9909		9
Project (MAppSc)		
GEOL9504		9
Elective Subjects		
(2 of the following for MEngSc, 3 for GradDip)		
CEIC5630	Industrial Water and Wastewater Engineering	3
CIVL9857	Sewage Treatment and Disposal	3
CIVL9870	Hydraulics and Design of Water and Wastewater Treatment Plants	3
CIVL9887	Advanced Topics in Waste Management	3
FUEL5920	Atmospheric Pollution Control	3
GEOG3042	Environmental Impact Assessment	3
GEOL9011	Hydrology G	3
GEOL9020	Geopollution Management	3
GEOL9060	Environmental Geology	3
MINE1524	Mining Conservation	3
MINE5355	Mine Fill Technology	3

		C
SAFE9242	Human Behaviour and Safety Science	3
SAFE9543	Management of Dangerous Materials*	3

External Program

CIVL8855	Water and Wastewater Analysis and Quality Requirements	3
CIVL8857	Sewage Treatment and Disposal	3
CIVL8872	Solid Waste Management	3
CIVL8881	Hazardous Waste Management	3
CIVL8884	Environmental Engineering Science 1	3
FUEL5881	Unit Operations in Wastewater, Sludge and Solids Management	3
GEOL9320	Geopollution Management	3

Project

CIVL8909		9

Project

CIVL8803		9

Notes: MEngSc students undertake a 9 credit project to make 30 credits and GradDip students complete a 3 credit project to make 24 credits.

Civil subjects starting with 8 are the external equivalents of the internal subjects starting with a 9.

** Subject to approval of course coordinator.*

8615
Master of Environmental Engineering Science

MEnvEngSc

Candidates are required to complete a program totalling 30 credits. The program is made up of compulsory subjects, selective subjects and a 9 credit project.

Compulsory Subjects		C
CIVL9884	Environmental Engineering Science 1	3
CIVL9885	Environmental Engineering Science 2	3
CIVL9888	Environmental Management	3
CIVL9889	Environmental Law and Economics	3
CIVL9909	Project	9

Elective Subject Groupings

Waste Management (Liquids)

CEIC5630	Industrial Water and Wastewater Engineering	3
CIVL9851	Unit Operations in Public Health Engineering	3
CIVL9857	Sewage Treatment	3
CIVL9858	Water Quality Management	3

Waste Management (Solids)

CIVL9872	Solid Waste Management	3
CIVL9881	Hazardous Waste Treatment	3
CIVL9887	Advanced Topics in Waste Management	3
SAFE9543	Management of Dangerous Materials	3

Elective Subject Groupings		C
Water Engineering		
CIVL9835	Coastal Engineering 1	3
CIVL9836	Coastal Engineering 2	3
CIVL9858	Water Quality Management	3
CIVL9875	Hydrological Processes	3
CIVL9876	Applied Hydrological Modelling	3
CIVL9880	Groundwater Modelling	3
Geotechnical Engineering		
CIVL9788	Site Investigation	3
GEOL9030	Geological Engineering	3
GEOL9060	Environmental Geology	3
GEOL9080	Groundwater Geophysics	3
GEOL9320	Geopollution Management	3
Transport Engineering		
CIVL9407	Transport Systems Design (Non-Urban)	3
CIVL9408	Transport Systems Design (Urban) Management	3
CIVL9420	Transport and the Environment	3
Management		
CIVL9702	Project Planning and Control	3
CIVL9704	Quantitative Engineering Management	3
CIVL9705	Engineering Management Practice	3
CIVL9706	Management of People	3
CIVL9710	Engineering Risk Management	3
CIVL9731	Project Management	3
Land and River Management		
GEOG9310	River Management	
GEOG9320	Soil Degradation and Conservation	
GEOG9300	Vegetation Management	

Subjects offered within the MEngSc degree program are also available to students enrolled for a MEnvEngSc degree, subject to the approval of the course coordinator.

5459
Graduate Diploma in Civil Engineering

Details of the recommended programs of study may be obtained from the Head of School. All subjects offered in the Masters programs can also be taken in the Graduate Diploma programs subject to the approval of the course coordinator.

5459
Waste Management
5459 Internal
5498 External

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

External subjects

CIVL8803
Project (GradDip)
C3

A critical review of literature on a selected topic or a minor design project.

CIVL8855
Water and Wastewater Analysis and Quality Requirements
Staff Contact: Ms P.A. Fitzgerald
C3 S1

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.

CIVL8857
Sewage Treatment and Disposal
Staff Contact: Mr P.J. Bliss
C3 S2

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.

CIVL8872
Solid Waste Management
Staff Contact: Mr S.J. Moore
C3 S2

Characterisation of municipal solid waste; collection; transfer stations; waste minimisation and recycling; waste treatment, including size reduction, composing, incineration, emerging technologies; landfill disposal, including preparation of landfill management plans and operational aspects; introduction to planning of waste management systems.

CIVL8881
Hazardous Waste Management
Staff Contact: Mr S.J. Moore
C3 S2

Waste audits and characterisation of hazardous wastes in regions and industries; control of generation and transport of hazardous waste, manifest systems; waste minimisation; on-site treatment methods; integrated off-site treatment facilities; management of residues from treatment facilities; introduction to planning of regional hazardous waste management systems. Characteristics of individual waste types (dioxins, PCBs, pesticides, heavy metal, etc.) and waste management in individual industries (steel, pulp and paper, petro-chemical, food processing, etc.) covered by assignments.

CIVL8884
Environmental Engineering Science 1
Staff Contact: Ms P.A. Fitzgerald
C3 S1

Water chemistry: Basic concepts in aqueous chemistry: pH buffering, alkalinity, chemical equilibrium, kinetics of chemical reactions, neutralisation and precipitation, Henry's Law.

Introduction to Microbiology: Structure and metabolism of cells and micro-organisms; monitoring methods for pathogens and indicator organisms; impact of water and wastewater treatment on disease transmission.

CIVL8909
Project (external)
C9

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.

Department of Transport Engineering

CIVL9402
Transport, Environment, Community
Staff Contact: Prof J.A. Black
C3 F
Notes: Not offered in 1993.

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.

CIVL9403
Theory of Land Use Transport Interaction
Staff Contact: Prof J.A. Black
C3 SS

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).

CIVL9405
Urban Transport Planning Practice
Staff Contact: Prof J.A. Black
SS C3
Notes: Not offered in 1993.

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.

CIVL9407
Transport Systems Design (Non-Urban)
Staff Contact: Mr T. ten Brummelaar
C3 S1

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.

CIVL9408
Transport Systems Design (Urban)
Staff Contact: Mr T. ten Brummelaar
C3 S2

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.

CIVL9410
Highway Engineering Practice
Staff Contact: Assoc. Prof B. Shackel
C3 S1
Notes: Not offered in 1993.

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.

CIVL9412
Economics for Transportation Studies
Staff Contact: Prof J.A. Black
C3 SS
Notes: Not offered in 1993.

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.

CIVL9414
Transport Systems Part 1
Staff Contact: Dr U. Vandebona
C3 S1

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.

CIVL9415
Transport Systems Part 2
Staff Contact: Dr U. Vandebona
C3 S2

Historical introduction to transport systems and development of various transport modes, road (vehicles, pedestrians, cycles), conveyor, 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.

CIVL9416
Traffic Engineering
Staff Contact: Dr M.C. Dunne
C6 F

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.

CIVL9417
Transport and Traffic Flow Theory
Staff Contact: Prof J.A. Black
C6 F
Notes: Not offered in 1993.

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.

CIVL9418
Statistics for Transport Studies Part 1
Staff Contact: Prof J.A. Black
C3 SS
Notes: Not offered in 1993.

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.

CIVL9419
Statistics for Transport Studies Part 2
Staff Contact: Prof J.A. Black
C3 SS
Notes: Not offered in 1993.

Prerequiste: Assumed knowledge CIVL9418

Linear models. Analysis of variance and co-variance. Simple and multiple regression. Design of experiments,

interpretation of results. Sample survey design and analysis.

CIVL9420
Special Topic in Transport Engineering
Staff Contact: Prof J.A. Black
C3 S2

This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

Department of Engineering Construction and Management

CIVL9701
Economic Decision Making in Engineering
Staff Contact: Prof D.G. Carmichael
C3 SS

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 multiple objective planning.

CIVL9702
Project Planning and Control
Staff Contact: Prof D.G. Carmichael
C3 S1

The critical path method, PERT, arrow diagrams, precedence diagrams, resource levelling, resource constrained scheduling, network compression, overlapping relationships, applied cpm, cost control, cash flow, project control, legal considerations, simulation in networks, stochastic networks, project management, applications.

CIVL9704
Quantitative Engineering Management
Staff Contact: Mr R.R. Wakefield
C3 S2
Notes: Not offered in 1993.

Models and techniques to assist the manager in making decisions; modelling and regression, forecasting; job planning, layout planning, capacity planning; work measurement; optimization (linear programming, non-linear programming, dynamic programming), inventory models, transportation, assignment and allocation, heuristic techniques, multiple and single objectives, applications.

Techniques dealing with uncertainty and variability in management situations, including a review of probability theory, reliability, availability, quality control, decision analysis, queuing, simulation, applications.

CIVL9705
Engineering Management Practice
Staff Contact: Prof D.G. Carmichael
C3 SS
Notes: Not offered in 1993.

Management theory and processes, the structure and function of organizations; decision making, gaming behaviours in management, interpersonal skills, conflict management, management of group action, management information, marketing, negotiating, quality.

CIVL9706
Management of People
Staff Contact: Prof D.G. Carmichael
C3 SS

The development of skills for the management of people and their workplaces; industrial relations, health and safety issues; the recognition of people as the basic unit of engineering productivity and engineering organizations.

CIVL9710
Engineering Risk Management
Staff Contact: Mr G. Nawar
C3 S2

Introduction to the concept of risk and decision making under conditions of uncertainty; project objectives and planning, risk identification in engineering processes; human error, natural hazards and unforeseen risks; risk evaluation and quantification methods; relevant statistical techniques; risk avoidance and minimization; financial risk, portfolio theory, risk sharing and financing; ambient and acceptable risk levels; insurances.

CIVL9714
Special Topic in Engineering Management
Staff Contact: Prof D.G. Carmichael
C3 SS
Notes: Not offered in 1993.

A series of lectures from industry experts or visiting specialists in current and advanced engineering management.

CIVL9723
Construction Design
Staff Contact: Prof D.G. Carmichael
C3 SS
Notes: Not offered in 1993.

Design theory as applied to construction processes; application to selected areas of the construction industry such as temporary works design, formwork and falsework, dewatering systems, ground support systems and mixed construction activities such as tunnelling and high rise building construction.

CIVL9724
Construction Engineering and Technology
Staff Contact: Mr J.B. O'Brien
C3 S2
Notes: Not offered in 1993.

Construction engineering theory, construction processes: methods engineering, automation and mechanization concepts; modelling, design and analysis; problem solving; task analysis; adaptive systems and control concepts; experimental studies of construction processes. Construction technologies; construction robotics, applications of expert and knowledge based systems. Studies to be selected 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.

CIVL9725
Engineering Financial Management
Staff Contact: Mr V.J. Summersby
C3 S1

Engineering financial planning, control of labour, plant and materials. Insurances. Financial accounting. Project finance and taxation. Management accounting techniques and cost controls.

CIVL9726
Legal Studies and Professional Practice
Staff Contact: Prof D.G. Carmichael
C3 S1

Nature and sources of law, court procedures, interpretation of documents, evidence, technical opinions, expert witness; contract law, contract administration; company law; arbitration; duties of an engineer; professional liability.

CIVL9727
Construction Planning and Estimating
Staff Contact: Prof D.G. Carmichael
C3 S2

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.

CIVL9728
Special Topic in Construction
Staff Contact: Prof D.G. Carmichael
C3 SS

A construction topic presented in depth by industry experts or visiting specialists.

CIVL9731
Project Management
Staff Contact: Mr J.B. O'Brien
C3 SS

A problem-oriented approach to project management; the nature of engineering and construction projects; the project team, organizational and behavioural aspects, team motivation; behavioural aspects of project management; the organization and management of project resources; short term field planning and management strategies; project success evaluation techniques; project management decision processes; fast track projects; work delegation across organizational boundaries, contract design, development and administration; management information and decision support systems; management control systems and large project cost and schedule control; case studies in project management.

CIVL9732
Masonry Construction, Design and Materials
Staff Contact: Mr G. Nawar
C3 SS

Properties of masonry units, mortar, grout and accessories; advantages and limitations of masonry in construction; construction planning, methods and productivity; general design principles, details and performance limit states; structural design of masonry subject to axial, in-plane and out-of-plane lateral loads; reinforced and prestressed masonry; design for fire resistance; workmanship and site control; cleaning, maintenance and repair.

Department of Geotechnical Engineering

CIVL9753
Soil Engineering
Staff Contact: Mr G.R. Mostyn
C3 SS
Notes: Not offered in 1993.

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.

CIVL9776
Rock Mechanics
Staff Contact: A/Prof S. Valliappan
C3 SS
Notes: Not offered in 1993.

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.

CIVL9777
Numerical Methods in Geomechanics
Staff Contact: A/Prof S. Valliappan
C3 S1
Notes: Not offered in 1993.

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.

CIVL9781
Advanced Concrete Technology
Staff Contact: Dr N. Gowriplan
C3 SS
Notes: Not offered in 1993.

Basic structure of concrete. Morphology of the products of different cementitious materials. Fresh concrete properties. Code and special criteria for acceptance and rejection of concrete. Quality control of concrete. Deterioration mechanisms and durability of concrete. Non-destructive testing. High strength concrete and special concretes. Special cements and mixtures. Long-term effects in concrete. Mix design theories and practical applications. Placing of concrete.

CIVL9783
Pavement Materials
Staff Contact: A/Prof W.O. Yandell
C3 S1

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.

CIVL9784
Pavement Design
Staff Contact: A/Prof B. Shackel
C3 S2

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.

CIVL9785
Pavement Evaluation and Maintenance
Staff Contact: A/Prof W.O. Yandell
C3 S2

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.

CIVL9786
Industrial and Heavy Duty Pavements
Staff Contact: A/Prof B. Shackel
C3 S2
Notes: Not offered in 1993.

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.

CIVL9788
Site Investigations
Staff Contact: Mr G.R. Mostyn
C3 S1

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.

CIVL9790
Stability of Slopes
Staff Contact: Prof R. Fell
C3 S1

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.

CIVL9791
Foundation Engineering 1
Staff Contact: Mr G.R. Mostyn
C3 S1

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.

CIVL9792
Foundation Engineering 2
Staff Contact: A/Prof S. Valliappan
C3 S2

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.

CIVL9793
Geomechanics
Staff Contact: Dr V. Murti
C3 SS

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.

Department of Structural Engineeering

CIVL9802
Elastic Stability 1
Staff Contact: Dr R.E. Lawther
C3 SS
Notes: Not offered in 1993.

Euler strut; uniform and non-uniform cross sections. Eccentric loading; stressing beyond the elastic limit. Struts continuous over several supports. Stability of frames.

CIVL9803
Elastic Stability 2
Staff Contact: Dr R.E. Lawther
C3 S2
Notes: Not offered in 1993.

Energy methods of formation of stability problems. Approximate methods. Thin-walled open section struts; lateral buckling of beams; bending and buckling of thin plates.

CIVL9804
Vibration of Structures 1
Staff Contact: Prof R.I. Gilbert
C3 SS

Review of basic aspects. Analysis of lumped mass systems with various degrees of freedom. Vibration in beams and other continuous structures.

CIVL9805
Vibration of Structures 2
Staff Contact: Prof R.I. Gilbert
C3 SS
Notes: Not offered in 1993.

Vibration of buildings. Earthquake and blast loading. Bridges under moving loads. Vibration effects in foundations. Generalized dynamics and Lagrange's equations.

CIVL9806
Prestressed Concrete 1
Staff Contact: Prof R.I. Gilbert
C3 S1
Notes: Not offered in 1993.

Historical development. Methods of prestressing. Elastic analysis and design. Flexural capacity and shear capacity of prestressed elements.

CIVL9807
Prestressed Concrete 2
Staff Contact: Prof R.I. Gilbert
C3 S2
Notes: Not offered in 1993.

Analysis and design of statically indeterminate structures. Methods of securing continuity. Composite structures. Creep and shrinkage effects in concrete structures.

CIVL9809
Reinforced Concrete 1
Staff Contact: Mr S.J. Foster
C3 S1
Notes: Not offered in 1993.

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.

CIVL9810
Reinforced Concrete 2
Staff Contact: Prof R.I. Gilbert
C3 S2
Notes: Not offered in 1993.

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.

CIVL9814
Analysis of Plates and Shells
Staff Contact: A/Prof V.A. Pulmano
C3 SS
Notes: Not offered in 1993.

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.

CIVL9817
Experimental Structural Analysis
Staff Contact: Prof R.I. Gilbert
C3 SS
Notes: Not offered in 1993.

Dimensional analysis and principles of similitude, model analysis and design of models. Instrumentation and special methods of measurement. Evaluation of data.

CIVL9818
Bridge Design 1
Staff Contact: Dr F.S.K. Tin Loi
C3 S1
Notes: Not offered in 1993.

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.

CIVL9819
Bridge Design 2
Staff Contact: Dr F.S.K. Tin Loi
C3 SS
Notes: Not offered in 1993.

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.

CIVL9820
Structural Analysis and Finite Elements 1
Staff Contact: Dr I.J. Somervaille
C3 S1
Notes: Not offered in 1993.

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.

CIVL9821
Structural Analysis and Finite Elements 2
Staff Contact: A/Prof P.W. Kneen
C3 S2
Notes: Not offered in 1993.

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. Isoparametric elements, numerical integration. Finite elements methods in numerical analysis.

CIVL9822
Steel Structures 1
Staff Contact: A/Prof M.A. Bradford
C3 S1
Notes: Not offered in 1993.

Introduction to limit states design, methods of analysis of steel structures, columns, tension members, bending of beams, lateral buckling of beams, design by buckling analysis, beam-columns, elastic design of frames.

CIVL9823
Steel Structures 2
Staff Contact: A/Prof M.A. Bradford
C3 S1
Notes: Not offered in 1993.

Effective lengths of columns in braced and sway frames, uniform torsion of steel structures, warping torsion of steel structures, design rules for torsion, design of bolted plates and connections, design of welded plates and connections, design process for industrial frames.

Department of Water Engineering

CIVL9830
Hydromechanics
Staff Contact: Head of Department
C3 SS
Notes: Not offered in 1993.

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.

CIVL9831
Closed Conduit Flow
Staff Contact: A/Prof C.R. Dudgeon
C3 SS
Notes: Not offered in 1993.

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.

CIVL9832
Pipe Network and Transients
Staff Contact: Dr B.S. Jenkins
C3 SS
Notes: Not offered in 1993.

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.

CIVL9833
Free Surface Flow
Staff Contact: A/Prof C.R.Dudgeon
C3 S1
Notes: Not offered in 1993.

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.

CIVL9835
Coastal Engineering 1
Staff Contact: Prof D.L. Wilkinson
C3 SS
Notes: Not offered in 1993.

Theory of periodic waves as applied to tides and wind generated waves in water of varying depths. Wave and tide prediction.

CIVL9836
Coastal Engineering 2
Staff Contact: Prof D.L. Wilkinson
C3 SS
Notes: Not offered in 1993.

Wave forces on structures, shore processes and beach erosion. Estuarine hydraulics, wave and tide models.

CIVL9847
Water Resources Policy
Staff Contact: Dr J.E. Ball
C3 SS
Notes: Not offered in 1993.

Resource economics, water supply, water demand, multiple objective planning, multiple purpose projects, water law, water administration, case studies.

CIVL9848
Water Resource System Design
Staff Contact: Head of Department
C3 SS
Notes: Not offered in 1993.

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.

CIVL9849
Irrigation
Staff Contact: Head of Department
C3 S1
Notes: Not offered in 1993.

Soils, soil-water relationships, plants, climate, crop requirements; water budgets, sources, quality,

measurement; irrigation efficiency. Design of irrigation systems, appurtenant works, distribution.

CIVL9851
Unit Operations in Public Health Engineering
Staff Contact: Mr P.J. Bliss
C3 S1
Notes: Not offered in 1993.

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.

CIVL9852
Water Distribution and Sewage Collection
Staff Contact: Mr P.J. Bliss
C3 SS
Notes: Not offered in 1993.

Water collection, transmission and distribution systems – layout design and analysis, reservoirs, pumping. Sewage collection design and analysis – capacities, corrosion, pumping.

CIVL9855
Water and Wastewater Analysis and Quality Requirements
Staff Contact: Ms P.A. Fitzgerald
C3 S1
Notes: Not offered in 1993.

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.

CIVL9856
Water Treatment
Staff Contact: Ms P.A. Fitzgerald
C3 S2
Notes: Students specialising in Public Health Engineering normally study BIOT7100 Biological Principles and BIOT7030 Biotechnology in the School of Biotechnology. Not offered in 1993.

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.

CIVL9857
Sewage Treatment and Disposal
Staff Contact: Mr P.J. Bliss
C3 S2
Notes: Students specialising in Public Health Engineering normally study BIOT7100 Biological Principles and BIOT7030 Biotechnology in the School of Biotechnology. Not offered in 1993.

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.

CIVL9858
Water Quality Management
Staff Contact: Mr S.J. Moore
C3 SS
Notes: Not offered in 1993.

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.

CIVL9860
Investigation of Groundwater Resources 1
Staff Contact: Dr R.I. Acworth
C3 SS
Notes: Not offered in 1993.

Occurrence and extraction of groundwater, investigation and drilling methods, systems approach, optimization techniques, conjunctive use studies, quality of groundwater.

CIVL9861
Investigation of Groundwater Resources 2
Staff Contact: Dr R.I. Acworth
C3 SS
Notes: Not offered in 1993.

Geophysical methods, remote sensing, photo-interpretation, arid- environment studies, analogue models, case studies.

CIVL9862
Fluvial Hydraulics
Staff Contact: Dr B.S. Jenkins
C3 S2
Notes: Not offered in 1993.

Unsteady and varied flow in non-uniform channels, secondary currents, sediment transport, channel morphology, scour and shoaling, river control works, modelling of fluvial processes.

CIVL9863
Estuarine Hydraulics
Staff Contact: Prof D.L. Wilkinson
C3 S2
Notes: Not offered in 1993.

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.

CIVL9868
Public Health Science
Staff Contact: Ms P.A. Fitzgerald
C3 S1
Notes: Not offered in 1993.

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.

CIVL9870
Hydraulics and Design of Water and Wastewater Treatment Plants
Staff Contact: Mr P.J. Bliss
C3 S2
Corequisites: CIVL9856, CIVL9857 or equivalent
Notes: Not offered in 1993.

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.

CIVL9871
Water Supply and Sanitation in Developing Countries
Staff Contact: Head of Department
C3 SS
Prerequiste: CIVL9851, CIVL9855, CIVL9868 or equivalent
Notes: Not offered in 1993.

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.

CIVL9872
Solid Waste Management
Staff Contact: Mr S.J. Moore
C3 S2
Notes: Not offered in 1993.

Characterisation of municipal solid waste; collection; transfer stations; waste minimisation and recycling; waste treatment, including size reduction, composing, incineration, emerging technologies; landfill disposal, including preparation of landfill management plans and operational aspects; introduction to planning of waste management systems.

CIVL9875
Hydrological Processes
Staff Contact: A/Prof I. Cordery
C3 S1
Notes: Not offered in 1993.

Hydrological cycle, water and energy balances and circulation, precipitation process, interception, infiltration, storm runoff process, evaporation and transpiration, surface groundwater interactions, land use effects.

CIVL9876
Applied Hydrological Modelling
Staff Contact: A/Prof I. Cordery
C3 S1
Notes: Not offered in 1993.

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.

CIVL9877
Flood Design 1
Staff Contact: Head of Department
C3 S1
Notes: Not offered in 1993.

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.

CIVL9878
Flood Design 2
Staff Contact: Head of Department
C3 S2
Notes: Not offered in 1993.

Introductory flood routing, loss rates, linear and nonlinear response, unit hydrographs, runoff routing, choice of method of flood estimation, urban drainage design.

CIVL9880
Groundwater Modelling
Staff Contact: Dr R.I. Acworth
C3 S1
Notes: Not offered in 1993.

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.

CIVL9881
Hazardous Waste Management
Staff Contact: Mr S.J. Moore
C3 S2
Notes: Not offered in 1993.

Waste audits and characterisation of hazardous wastes in regions and industries; control of generation and transport of hazardous waste, manifest systems; waste minimisation; on-site treatment methods; integrated off-site treatment facilities; management of residues from treatment facilities; introduction to planning of regional hazardous waste management systems. Characteristics of individual waste types (dioxins, PCBs, pesticides, heavy metal, etc.) and waste management in individual industries (steel, pulp and paper, petro-chemical, food processing, etc.).

CIVL9884
Environmental Engineering Science 1
Staff Contact: Ms P.A. Fitzgerald
C3 S1

Water chemistry: Basic concepts in aqueous chemistry: pH buffering, alkalinity, chemical equilibrium, kinetics of chemical reactions, neutralisation and precipitation, Henry's Law.

Introduction to Microbiology: Structure and metabolism of cells and micro-organisms; monitoring methods for pathogens and indicator organisms; impact of water and wastewater treatment on disease transmission.

CIVL9885
Environmental Engineering Science 2
Staff Contact: Prof D.L. Wilkinson
C3 S1

Classification of soils and improvement of the engineering properties of soils. Aspects of soil chemistry relevant to contaminant behaviour of soild.

Fundamentals of dispersion common to all environmental media (air,water,soil).

Air chemistry: interaction and degradation of gaseous pollutants in the atmosphere.

Dispersion processes: nature of dispersion processes,advection and diffusion. Modelling of dispersion in the atmosphere, water bodies and soils.

CIVL9886
Environmental Engineering Science 3
Staff Contact: Mr S.J. Moore
C3 S1

Fundamentals of dispersion common to all environmental media (air, water, soil). Aspects of soil chemistry relevant to contaminant Cl behaviour in soils. assification of soils and improvement of the engineering properties of soils related to waste management. Introduction to hydrogeology. Management of waste projects: basic management concepts; management of environmental studies, investigations and design projects; management of operating waste facilities.

CIVL9887
Advanced Topics in Waste Management
Staff Contact: Mr S.J. Moore
C3 S2
Prerequisites or corequisites: CIVL9872, CIVL9881
Notes: Not offered in 1993.

A selection of at least 7 topics from the following to suit the class needs, expertise of visiting academics and researchers in the Cooperative Research Centre for Waste Management and Pollution Control, and issues of current interest. Background and basis of solid and hazardous waste classification and control systems; legislative and economic (market) regional pollution control mechanisms; developing techniques for waste minimisation; site selection and EIS preparation for waste facilities; dispersion of contaminants in the atmosphere; community consultation; detailed legislative requirements; application of systems concepts in waste management; environmental management plans; risk assessment at waste facilities; contaminated site characterisation and remediation; topics of interest to visiting academics; case studies by way of assignments.

CIVL9888
Environmental Management and Economics
Staff Contact: Prof D.L. Wilkinson
C3 S2

Spectrum of modern environmentalism, sustainable development and urban growth. The structure of the environmental regulatory process. Decision making and management systems; case studies; introduction to micro-economics with reference to environmental issues, sustainable economic growth and zero growth. Environmental costing.

CIVL9889
Legislative Aspects of the Environment
Staff Contact: Prof D.L. Wilkinson
C3 S2

Statutory and common law regulation of access to, use and management of natural resources and waste disposal in the natural environment. Case studies from waste treatment and disposal, water resources management, disposal of mine wastes and other areas as appropriate.

CIVL9901
Special Topic in Civil Engineering
C3 SS
Notes: Not offered in 1993.

This syllabus changes to allow presentation of a special topic of currrent interest particularly by visitors with recognized expertise in the topic.

CIVL9902
Special Topic in Civil Engineering
C3 S2

This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

CIVL9909
Project
C9
Notes: Not offered in 1993.

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.

CIVL9915
Project Report
C15
Notes: Not offered in 1993.

School of Computer Science and Engineering

Head of School
Professor J. Hiller

Executive Assistant to Head of School
Dr G. R. Whale

Executive Officer
Mr P. Ivanov

Administrative Assistant
Ms V. Joubert

The School, which was formerly the Department of Computer Science in the School of Electrical Engineering and Computer Science, was established on 1 January 1991. The School of Computer Science and Engineering and the restructured School of Electrical Engineering have joint responsibility for the curriculum of the Computer Engineering course.

The staff of the School are grouped around the activity areas of Artificial Intelligence, Formal Methods and Software Engineering, Computer Architecture and VLSI Design, Information Science, Algorithms and Programming Techniques, Networks and Operating Systems and Human-computer interaction. Subjects in these areas are offered to students taking major studies in computer science or computer engineering, while introductory-level computing subjects are available more generally to students studying Science, Arts or Engineering. Computer science has links with discrete mathematics, which furnishes the theory behind the algorithms that computer software implements, and electrical engineering, which supplies the present technology underlying physical computing devices.

The School, together with the School of Electrical Engineering, jointly administers the BE Computer Engineering **3645.** It also offers a major in Computer Science in the BSc (Science and Mathematics) **3970**, combined BE BSc degree courses **3681, 3725, 3726,** combined BA BE course **3722** and combined BSc LLB course **4770.**

The formal graduate courses offered are the Master of Cognitive Science **8155,** Master of Computer Science **8680,** Master of Information Science **8508.** Graduate Diploma in Computer Science **5452,** Graduate Diploma in Information Science **5453** and Graduate Diploma in Computer Education **5464.** Opportunities are provided for graduate research leading to the award of the degree of Master of Engineering **2665** and Doctor of Philosophy **1650.**

Summary of Undergraduate Courses

Normal full-time

Course and Degree(s)	Duration
3645 BE in Computer Engineering	4 years
3722 BE BA in Computer Engineering	5 years
3725 BE BSc in Electrical Engineering	5 years
3726 BE BSc in Computer Engineering	5 years
3730 BE BSc in Civil Engineering	5 years
3611 BE BSc in Aerospace Engineering	5 years
3661 BE BSc in Manufacturing Management	5 years
3681 BE BSc in Mechanical Engineering	5 years
3701 BE BSc in Naval Architecture	5 years
3745 BSurv BSc in Surveying	5 years

Majors

Course and Degree	Duration
3970 BSc	3 years (Pass) 4 years (Hons)
3400 BA	3 years (Pass) 4 years (Hons)
3420 BSoc Sc	3 years (Pass) 4 years (Hons)
4770 BSc LLB	5 years

For a description of the combined BE BSc and BSurv BSc courses, see the entries in this Handbook for the schools conducting the engineering/surveying major. The BSc degree course is described in the Science Handbook. Majors are offered in Computer Science and Psychology, and Computer Science and Philosophy; for the BA and BSocSc degree courses, see the Arts and Social Sciences Handbook and for the BSc LLB course, see the Law Handbook.

Undergraduate Study

Course Outlines

3645
Computer Engineering - Full-time Course

Bachelor of Engineering
BE

Whilst jointly administered by the Schools of Computer Science and Enginering and Electrical Engineering, for convenience, day-to-day administration of the course is conducted through the Computer Science and Engineering School Office, Room 313, to which enquiries should be directed.

		HPW S1	HPW S2
Year 1			
ACCT9001	Introduction to Accounting A	1.5	0
ACCT9002	Introduction to Accounting B	0	1.5
COMP1011	Computing 1A	6	0
COMP1021	Computing 1B	0	6
ELEC1011	Electrical Engineering 1	0	6
MATH1032	Mathematics 1 or	6	6
MATH1042	Higher Mathematics 1	0	0
MATH1081	Discrete Mathematics	6	0
PHYS1969	Physics 1 (Electrical Engineering)	6	6
Totalling		25.5	25.5
Year 2			
COMP2011	Data Organization	5	0
COMP2021	Digital System Structures	5	0
COMP2031	Concurrent Computing	0	5
ECON1103	Microeconomic Principles	3.5	0
ELEC2011	Systems Theory	0	2.5
ELEC2030	Circuit Theory + Laboratory	3.5	0
ELEC2033	Analog Electronics + Laboratory	0	4.5
ELEC4532	Integrated Digital Systems	0	4
Year 2			
MATH2400	Finite Mathematics	2	0
MATH2510	Real Analysis or		
MATH2610	Real Analysis	2.5	0
MATH2520	Complex Analysis or		
MATH2620	Complex Analysis	2.5	0
MATH2849	Statistics SE1	0	2
MATH3150	Transform Methods	0	2
PHYS2959	Introductory Semiconductor Physics	1.5	0
General Education Cat. A		0	4
Totalling		25.5	24

Students must attain a mark of 70CR or better in MATH1032 or MATH1042 in order to do Higher Level MATH subjects.

Year 3			
COMP3111	Software Engineering	5	0
COMP3121	Algorithms and Programming Techniques	0	5
COMP3211	Computer Organization and Design	4	0
COMP3221	Microprocessors and Interfacing	0	5
ELEC3032	Signals, Spectra and Filter + Lab.	3.5	0
MATH2601	Linear Algebra or		
MATH2501	Linear Algebra	4.5	0
MATH2859	Statistics SE2	2.5	0
MATH3141	Numerical and Mathematical Methods	0	3.5
	Total Quality Management	1.5	1.5
Option A		5	0
Option B		0	5
General Education Cat. B		0	4
Totalling		25.5	24

Recommended Options for the four streams are listed below:

Communications Stream
Option A: ELEC3031 Integrated Electronics + Laboratory
Option B: ELEC3013 Communications Systems 1

Electronics Stream
Option A: ELEC3031 Integrated Electronics + Laboratory
Option B: ELEC3016 Electronic Signal Processing

Systems and Control Stream
Option A: ELEC3031 Integrated Electronics + Laboratory
Option B: ELEC3014 Systems and Control 1
Students who elect the Communications, Electronics or Systems and Control Stream must also take the following subjects in year 3 or year 4:

COMP3131 Parsing and Translation and/or
COMP3231 Operating Systems

COMP3331 Computer Networks and Applications or
ELEC4351 Digital Communication and Computer Networks

Computing Stream
Option A: Any level 3/4 Computer Science subjects or
ELEC3031 Integrated Electronics + Laboratory
Option B: Any level 3/4 Computer Science subject
Note: COMP3131 Parsing and Translation, COMP3231 Operating Systems and COMP3331 Computer Networks and Applications must be taken either in year 3 or year 4

Students undertaking computing electives only must complete at least two Level 4 Computer Science subjects in year 3 and/or year 4.

A complete list of the level 3 and level 4 Computer Science subjects is given later in this section.

	HPW	
Year 4	S1	S2
5 Professional Electives	15	10
COMP4903 Industrial Training	0	0
COMP4910 Thesis Part A	7	0
COMP4911 Thesis Part B	0	14
IROB2721 Managing People (General Education Cat.C)	4	0
Totalling	26	24

Professional Electives may be chosen from level 3/4 Computer Science Subjects and the Electrical Engineering Professional Elective Subjects listed below. Students should also note the compulsory subjects which must be taken in Year 3 or Year 4, listed in the previous section.

Computer Engineering Professional Electives

Communications Stream
ELEC3016 Electronic Signal Processing
ELEC4042 Signal Processing
ELEC4313 Optical Communications
ELEC4323 Digital and Analogue Communications
ELEC4351 Digital Communication and Computer Networks
ELEC4503 Advanced Electronic Circuits
ELEC4512 Semiconductor Devices

Electronics Stream
ELEC4042 Signal Processing
ELEC4503 Advanced Electronic Circuits
ELEC4512 Semiconductor Devices
ELEC4522 Microelectronics Design and Technology
ELEC4540 Applied Photovoltaics
COMP4215 VLSI Systems Architecture and Design

Systems and Control Stream
ELEC4042 Signal Processing
ELEC4412 Systems and Control 2
ELEC4413 Digital Control
ELEC4432 Instrumentation and Control
ELEC4503 Advanced Electronic Circuits
ELEC4512 Semiconductor Devices

Computing Stream
Level 3 Computer Science Subjects
COMP3131 Parsing and Translation
COMP3231 Operating Systems
COMP3311 Database Systems
COMP3331 Computer Networks and Applications
COMP3411 Artificial Intelligence
COMP3421 Computer Graphics
COMP3511 Human-Computer Interaction

Level 4 Computer Science Subjects

COMP4011 Occasional Elective (Computer Engineering)
COMP4012 Occasional Elective (Computer Engineering)
COMP4121 Parallel Algorithms and Architectures
COMP4131 Programming Language Semantics
COMP4141 Theory of Computation
COMP4211 Advanced Architectures and Algorithms
COMP4215 VLSI Systems Architecture and Design
COMP4216 Distributed Operating Systems
COMP4411 Artificial Intelligence: Knowledge-Based Systems
COMP4412 Artificial Intelligence: Interacting with the World
COMP4444 Neural Networks

Combined Courses

Students in Computer 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 Computer Science and Engineering 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 average (a creditable performance, ie 65%) 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 **3726** should contact the School of Computer Science and Engineering before completing the Year 2 enrolment. Students may opt to join the BE BA course (**3722**) in year 1, whereas transfer to **3726** normally occurs after year 2.

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 Computer Science and Engineering 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 **3722** and **3726** each year is arranged by the School of Computer Science and Engineering.

3722
BE BA in Computer Engineering

With this combined degree course students can add their choice of Arts program to the standard, professionally accredited engineering course offered by the School of Computer Science & Engineering. The full range of Arts programs is available.

Because the engineering and arts programs have common content, such as mathematics and physics, only one more year of study is normally required to gain the additional qualification of Bachelor of Arts.

Eligibility

Anyone who meets the entry requirements for both Engineering and Arts is eligible for the combined course. Students may enter directly in first year or may apply to transfer from the normal engineering course later, although with late transfer it might not be possible to complete the course in minimum time.

Organization

The BE BA course is administered by the School of Computer Science & Engineering.

Students should start discussing their program with representatives of the School and the Faculty of Arts and Social Sciences as soon as possible - preferably well before enrolment. Enquiries should be directed to the Executive Assistant to the Head of School of Computer Science & Engineering and the Executive Assistant to the Dean of the Faculty of Arts and Social Sciences.

Students should work out for themselves the Arts program they would like to add to their chosen engineering course. The Arts & Social Sciences Faculty Handbook describes the options, and the School of Computer Science & Engineering can supply sample programs showing what previous students have arranged.

There are no special rules on what to include in each year. Students should schedule the arts and engineering components to suit their preferences while meeting the constraints of timetables and pre-requisites. The sample programs can help here too.

The Arts component must be approved by the Faculty of Arts and Social Sciences.

The final program and schedule must be approved by the School of Computer Science & Engineering.

Rules

1. In addition to the BE course, students must complete a major sequence offered within the BA course and meet the additional requirements listed below:

Faculty which provides the chosen major
Faculty of Arts and Social Sciences:
Arts Credit Points required (minimum) 48 total, including major sequence

Other Faculties:
Major sequence plus at least 12 Credit Points from Schools of the Faculty of Arts and Social Sciences

Mathematics majors are not usually permitted. BE BSc combined degrees are more appropriate for this.

2. The requirements of the General Education Program must be met. In some cases subjects within the combined course may satisfy the Category A and/or Category B guidelines. Students should consult the Centre for Liberal and General Studies for advice.

Note that exemption from the General Education Category A and Category B requirements for the BE BA program will not be available to students who withdraw from the combined program and revert to the BE or BA course.

The Category C General Education requirement is satisfied as part of the final year BE Computer Engineering program.

3. There will be a testamur for each part of the combined degree course.

4. Students who complete the BE program first may proceed to graduation with the degree of Bachelor of Engineering in the usual way, subject to the satisfaction of the General Education requirement.

5. Students who complete the requirements for their Arts program and the first two years of the BE program may proceed to graduation with the degree of Bachelor of Arts.

3726
BE BSc in Computer Engineering

Students who achieve a creditable performance in the first two years of their Computer Engineering course many apply to transfer to the combined Bachelor of Engineering/Bachelor of Science BE BSc course. The combined degree course normally requires an additional year of study and enables students to complete a major sequence in Mathematics or Physics in the Faculty of Science while completing their studies in Computer Engineering.

Students wishing to enrol in the combined course may do so only on the recommendation of the Head of School and with the approval of the Board of Studies in Science and Mathematics. Because of the need to include appropriate pre-requisites, students considering course 3726 should

contact the School of Computer Science & Engineering before completing their Year 2 enrolment. Application to transfer to the combined degree course must be made in writing to the Head of School at the end of Year 2.

After completing Years 1, 2 and 3 (modified where necessary as indicated below) of the Computer Engineering course, students in their fourth year complete a specific program consisting of four Level III Science units from related disciplines, the appropriate General Education electives and no less than four other Level II or Level III units. The subjects chosen should be in accord with the rules of the BSc course 3970 leading to a major in Mathematics or Physics. In their fifth year students complete Year 4 of the Computer Engineering course 3645. The program below outlines the course of study:

Year 1 (Standard Program for course 3645)
ACCT9001, ACCT9002.
COMP1011, COMP1021,
ELEC1011,
MATH1042 or MATH1032, MATH1081,
PHYS1969.

Year 2
COMP2011, COMP2021, COMP2031,
ECON1103,
ELEC2011, ELEC2030, ELEC2033, ELEC4532,
MATH2400, MATH2610, MATH2620, MATH2849,
MATH3150,
PHYS2959,
General Education (Category A).

For Physics majors the 1.5 hour subject PHYS2959 must be replaced by the 4.5 hour subject PHYS2989 Solid State Physics. Mathematics subjects may be taken at the ordinary level.

Year 3
COMP3111, COMP3121, COMP3211, COMP3221,
ELEC3032,
MATH2601, MATH2859, MATH3141, Elective subjects in Computer Science and/or Electrical Engineering, General Education (Category B).

Mathematics majors should take the higher level subject MATH2601 and are required to add MATH2110 Vector Analysis to their program, as a Mathematics pre-requisite, in place of General Education which will be taken in Year 4.

Physics majors are required to add the following subjects to their program in place of General Education and a five hour Computer Science subject in Session 1 (these will be taken in Year 4):

PHYS2979 Electromagnetic Theory
PHYS2999 Mechanics and Thermal Physics
MATH2100 Vector Calculus

Year 4
Mathematics
56-hour General Education subject (Category B).

Choose at least 5 Mathematics units, 4 of which are Level III.

Choose 3 Level II or Level III units from those available in Program 1000 of course 3970 (see Sciences handbook for details).
or
Physics
56-hour General Education subject (Category B).

Choose 7 Level II or Level III units from those available in program 0100 of course 3970 of which four must be Level III Physics units chosen to include PHYS3010, PHYS3021, PHYS3030 and PHYS3060.

Computer Science subject deferred from Year 3 of the Computer Engineering course.

Year 5
Year 4 of the Computer Engineering course.

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

COMP1011
Computing 1A
Staff Contact: Mr N. Cerpa
S1 or S2 L3 T3
Prerequisites: as for MATH1032
Corequisites: MATH1032 or MATH1042
Notes: Excluded COMP1811, 6.611, 6.600

Defining problems. Reasoning about and solving problems using Logic, Abstraction, Specification, Algorithms and Data Structures. Exposure to a functional programming language (Miranda) for practical experience with these concepts. Computing Systems: Hardware (CPU, Memory, Peripherals), Software (Operating Systems, Networks, Languages) and Users. Computing Applications: Document Processing, Spreadsheets, Data Bases, Graphics and Communications.

COMP1021
Computing 1B
Staff Contact: Dr G. Whale
S1 or S2 L3 T3
Prerequisites: COMP1011
Notes: Excluded COMP1821, 6.621, 6.021D

Introduction to procedural programming style and comparison with functional programming. Control structures: selection, recursion and iteration. Abstract Data Types: lists, stacks, queues, trees. Implementation in a procedural language (Modula-2) using linked structures. Searching and sorting. The layered model of a computer, instruction set, execution cycle, data storage, assembly language programming.

COMP1811
Computing 1 (Procedural)
Staff Contact: Mr P. Compton
S1 or S2 L3 T3
Prerequisites: as for MATH1032
Notes: Excluded COMP1011, 6.611, 6.600

Defining problems. Reasoning about and solving problems using Logic, Abstraction, Specification, Algorithms and Data Structures. Exposure to a procedural programming language (Modula-2) for practical experience with these concepts. Computing Systems: Hardware (CPU, Memory, Peripherals), Software (Operating Systems, Networks, Languages) and Users. Computing Applications: Document Processing, Spreadsheets, Data Bases, Graphics and Communications.

COMP1821
Computing 2
Staff Contact: Dr T. Gedeon
S1 or S2 L3 T3
Prerequisites: COMP1811
Notes: Excluded COMP1021, 6.621, 6.021D

Abstract data types. Lists, stacks, queues, trees. Implementation in a procedural language (Modula-2) using linked structures. Searching and sorting. Introduction to functional programming. The layered model of a computer, instruction set, execution cycle, data storage, assembly language programming.

COMP2011
Data Organization
Staff Contact: Dr A. Sowmya
S1 or S2 L3 T2
Prerequisites: COMP1021 or COMP1821
Notes: Excluded 6.641

Data types and data structures: abstractions and implementations. Data Representation: logical and physical. Files: access methods, implementation, external data structures. Primary and secondary memory: performance, management policies. Data encapsulation and information hiding; introduction to object orientation.

COMP2021
Digital System Structures
Staff Contact: Dr G. Heiser
S1 or S2 L3 T2
Prerequisites: COMP1021 or COMP1821
Notes: Excluded ELEC2012

Digital Systems: switches and gates, boolean algebra, minimisation techniques, combinational and sequential design, timing analysis, finite state machines; analysis, design and realisation of modest digital subsystems, understanding major subsystems in a model computer. Assembly language programming: translation of higher level programming abstractions and data structures to a real computer using an assembler as a target; study of the relationships between the programming model and the hardware model of a computer; understanding of instruction execution.

COMP2031
Concurrent Computing
Staff Contact: Dr J. Olszewski
S1 or S2 L3 T2
Prerequisites: COMP1021 or COMP1821

The process model: sequential versus parallel computation. Interprocess communication and synchronisation mechanisms: coroutines, message passing, buffers, pipes, remote procedure calls, semaphores, monitors. Resource sharing, exclusion, deadlock, livelock, scheduling. Distributed algorithms: detection of deadlock, detection of termination. Protocols for data transfer.

COMP3111
Software Engineering
Staff Contact: Mr K. Robinson
S1 L3 T2
Prerequisites: COMP2011
Notes: Excluded 6.642, 6.660G

Informal specification: Data flow diagram methodology, analysis, design, testing, management and documentation of software. Formal specification: set theory, logic, schema calculus, case studies. The Z specification notation. Managing the project lifecycle. CASE tools. A major group project is undertaken.

COMP3121
Algorithms and Programming Techniques
Staff Contact: School Office
S2 L3 T2
Prerequisites: COMP2011
Notes: Excluded 6.642, 6.660G, COMP9101

Computability theory. Deterministic and non-deterministic algorithms. Stochastic algorithms. Computational complexity: time and space bounds. Algorithms for parallel computation and their hardware implementation. Game playing. Branch and bound. Discrete event simulation. Linear programming. Dynamic programming.

COMP3131
Parsing and Translation
Staff Contact: Mr K. Robinson
S2 L3 T2
Prerequisites: COMP2011
Notes: Excluded 6.643, 6.664G, COMP9102

Syntax-directed parsing and translation of well-structured objects encountered in computing. Grammars: terminal symbols, non-terminal symbols, productions, phrase structure grammars, Chomsky classification, context-free grammars, finite state grammars, logic grammars. Parsing: LL(k) grammars, top-down parsing; LR(k) grammars, bottom-up parsing; parser generators. Translation: action symbols, translation grammars, attributed-grammars, abstract syntax, unparsing. Lexical analysis: finite-state grammars, finite-state machines, regular expressions, lexical analyzer generators.

COMP3211
Computer Organisation and Design
Staff Contact: Prof G. Hellestrand
S1 L3 T2
Prerequisites: COMP2021 or ELEC2021
Notes: Excluded 6.654G, COMP9211

Combinational and sequential circuit design; synchronisation, communication and arbitration; register transfer specification (Modal). Arithmetic Design Strategies. Memory Organisation: physical and virtual address space; operating system and compiler support; memory mapping and caching. Communications Organisation: shared memory, memory mapping; network systems. Processor Design: the instruction pipeline; hardwired and micro-programmed control; instruction sets; RISC and object-based processor organisation. Error Detection/Correction and Fault Tolerance; coding theory.

COMP3221
Microprocessors and Interfacing
Staff Contact: Dr S. Matheson
S2 L3 T2
Prerequisites: COMP2021
Notes: Excluded 6.0318, 6.060G, 6.613, 6.732E, ELEC3020, COMP9221

The concept of a microprocessor system, busses, address spaces, memory devices, bus timing, bus standards, the VME bus, I/O device interfacing, polling, interrupts, DMA interfaces, the 68000 processor family, the C programming language, device drivers, the device driver software environment, other microprocessors, advanced topics. Laboratory work involves interfacing to and programming MC68000-series microprocessor-based systems.

COMP3231
Operating Systems
Staff Contact: Mr S. Russell
S1 L3 T2
Prerequisites: COMP2011, COMP2031 or ELEC3020
Notes: Excluded 6.632, 6.672, COMP9201

Operating system organisation and services. Process management: scheduling, synchronisation and communication. Memory management: segmentation, paging and virtual memory. Storage management. File systems. Protection and security. Distributed operating systems and file systems. Case studies: UNIX and Mach.

COMP3311
Database Systems
Staff Contact: Dr A. Ngu
S1 L3 T2
Prerequisites: COMP2011
Notes: Excluded 6.005G, 6.633, 6.659G, 19.608, COMP9311

The relational database model, object data bases, 4GL query languages, database design and implementation, deductive databases. Concurrency, optimisation, distribution. A major project involving both design and realisation is included.

COMP3321
Business Systems Organization
Staff Contact: School Office
S2 L3 T2
Prerequisites: COMP2011
Notes: Excluded 6.647, 6.661G. Not offered 1993.

Review of the organization of accounting systems: journals, accruals, merchandising. The structure, design, development, and integration of various business systems selected from the following: general ledger; financial reporting; debtors; creditors; stock control; invoicing; purchasing and receiving; fixed assets; payroll. Systems for generating application systems and packages. User interfaces. File specifications and B-tree index files. Distributed commercial systems. The partial implementation of a business system is undertaken as a group project.

COMP3331
Computer Networks and Applications
Staff Contact: Dr K. Burston
S2 L3 T2
Prerequisites: COMP2011
Notes: Excluded 6.633, 6.659G, COMP9331

History of digital communication and early computer networks. Circuit and packet switching. Digital data transmission: Protocols. Error detection and recovery. The seven layer OSI model: local area networks. Internetworking: repeaters, bridges, gateways; TCP/ICP. Data encoding, compression, encryption. Applications: file transfer, electronic mail, remote procedure calls, distributed file systems, distributed graphics, multi-media communications.

COMP3411
Artificial Intelligence
Staff Contact: Dr W. Wilson
S1 L2 T3
Prerequisites: COMP2011
Notes: Excluded 6.666G, COMP9414

Machine intelligence. Principles: knowledge representation, automated reasoning, machine learning. Tools: AI programming languages, control methods, search strategies, pattern matching. Applications: computer vision, speech recognition, natural language processing, expert systems, game playing, computer-aided learning. Philosophical and psychological issues.

COMP3421
Computer Graphics
Staff Contact: Dr T. Lambert
S1 L3 T2
Prerequisites: COMP2011
Notes: Excluded 6.668G, COMP9415

Graphics hardware: scan conversion of lines and polygons. 2D transformations: windowing, clipping, viewports. User interfaces. 3D transformations: perspective transformation, 3D clipping, hidden surface removal, lighting and texture maps. Hierarchical modelling of objects, modelling curves and surfaces with splines and fractals. Graphics standards.

COMP3511
Human-Computer Interaction
Staff Contact: Dr C. Quinn
S1 L3 T2
Prerequisites: COMP2011
Notes: Excluded 6.006G, COMP9511

Introduces analysis and design of user-system interactions. A cognitive approach focuses on user goals and enabling technologies, progressing from principles to process. Topics: human information processing system, interaction devices and components, communication models, the design cycle, and evaluation.

COMP4011
Occasional Elective S1 (Computer Engineering)
Staff Contact: School Office
S1 L3 T2
Prerequisites: Any 4 level 3 Computer Science subjects

A program of advanced coursework offered by a new or visiting staff member in an area of computer science/engineering. Syllabus details will be available from the school office before the start of session.

COMP4012
Occasional Elective S2 (Computer Engineering)
Staff Contact: School Office
S2 L3 T2
Prerequisites: Any 4 level 3 Computer Science subjects

A program of advanced coursework offered by a new or visiting staff member in an area of computer science/engineering. Syllabus details will be available from the school office before the start of session.

COMP4121
Parallel Algorithms and Architectures
Staff Contact: School Office
SS HPW4
Prerequisites: COMP3121 or COMP9101

Analysis of algorithms: the classes P, NP, and NC. Sorting networks. Computational geometry. Graph algorithms. Parallel computational models: PRAM, linear processor array, Mesh Connected, Cube Connected, Perfect Shuffle. Complexity; programming paradigms for parallel computation. Parallel algorithms for merging, sorting, selection, searching and combinational problems. Vector architectures and algorithms: pipelining and chaining, multiple functional units, sparse operations, gather/scatter, data dependencies.

COMP4131
Programming Language Semantics
Staff Contact: Mr K. Robinson
S2 HPW4
Prerequisites: Any 4 level 3 Computer Science subjects

Formal methods for specifying the semantics of programming languages and that of programs expressed in those languages. Denotational Semantics: application to language design and the implementation of translators and compilers. Axiomatic semantics, weakest-precondition, refinement. Concrete and abstract syntax, the lambda calculus, semantic functions, denotations, recursion.

COMP4141
Theory of Computation
Staff Contact: Dr A. Sharma
S1 HPW4
Prerequisites: Two level 3 Computer Science subjects or equivalent

Computability: primitive recursive functions, computable functions, universal programs, undecidability, Church-Turing thesis, Turing machines, recursively enumerable sets and elementary recursive function theory; Complexity: the sets P and NP, NP-completeness and Cook's theorem. Logic: predicate logic and its unsatisfiability problem.

COMP4211
Advanced Architectures and Algorithms
Staff Contact: Dr S. Matheson
SS HPW4
Prerequisites: COMP3211
Notes: Excluded COMP9214

Deterministic parallel systems: classification schemes, performance evaluation and interconnection schemes. Dataflow and other paradigms. Non-deterministic systems: stochastic computing, neural networks. Case studies: database machines, image processors, functional programming machines and paradigms, AI machines, fault tolerance, vector architectures and supercomputing.

COMP4215
VLSI Systems Architecture and Design
Staff Contact: Prof G. Hellestrand
S1 HPW4
Prerequisites: ELEC4532, COMP3221 or ELEC3020
Notes: Excluded COMP9215

Review of electronics and technology. Integrated digital subsystems. Analog functions in VLSI. Testing and testability. Integrated digital systems. VLSI design tools. Project work involves specification and simulation of a significant subsystem in the MODAL hardware description language, followed by fabrication and testing.

COMP4216
Distributed Operating Systems and Architectures
Staff Contact: Dr G. Heiser
S2 HPW4
Prerequisites: COMP3211, COMP3231, COMP3331
Notes: Excluded COMP9216

Architectural Support: virtual addressing, caching, exception handling, communications; multiprocessor systems; capability-based architectures. Communication Models: IPC, RPC and Session models; broadcast, multicast; distributed virtual memory; Naming and Security; Cryptographic authentication and capability-based protection schemes Distributed File Systems: File services; Sharing and cache consistency; transaction services; availability, scaling, replication, recoverability. Object-Orientation: weak, supportive and strong models; remote invocation versus server-based interaction; naming of operations; persistence and inheritance models. Fault Tolerance.

COMP4411
Artificial Intelligence: Knowledge-Based Systems
Staff Contact: Dr C. Sammut
SS HPW4
Prerequisites: COMP3411
Notes: Excluded COMP9414, COMP9416.

Topics will be selected from Expert Systems: applications of expert systems; the expert system life cycle; knowledge representation; reasoning for expert systems; knowledge acquisition; knowledge maintenance; expert system project and Machine Learning: learning as search; concept description languages; reinforcement learning; induction; learning theories; theory revision; learning project.

COMP4412
Artificial Intelligence: Interacting with the World
Staff Contact: Dr A. Sowmya
SS HPW4
Prerequisites: COMP3411
Notes: Excluded COMP9414, COMP9416

Topics selected from Intelligent Robotics : image processing and computer vision; simulation; programming languages for robots; path and motion planning under constraints; design and control models; planning and learning; Robotics Project and Natural Language Processing: overview of linguistics; grammars and languages; basic parsing techniques; semantic analysis and representation structures; cognitive modelling; natural language generation; natural language systems; natural language project.

COMP4444
Neural Networks
Staff Contact: Dr T. Gedeon
S1 HPW4
Prerequisites: Any 4 level 3 Computer Science subjects or equivalent

Network architectures: perceptrons, Hopfield nets, Kohonen nets, ART models, back-propagation trained feed-forward nets, weightless nets; hardware based neural networks; practical applications of neural networks; input and output coding; selecting the right model; designing successful applications of neural networks.

COMP4903
Industrial Training
Staff Contact: School Office
Students enrolled in courses **3645, 3722** and **3726** 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 2000 words long, summarising the work done and training received. Experience claimed as an industrial elective covers requirements for this subject.Industrial Experience

Students will formally enrol in the subject in year 4, although they are strongly encouraged to complete as much industrial experience as possible in the breaks between the early years of the course.

COMP4910
Thesis Part A

COMP4911
Thesis Part B
This is done in the last two sessions of the BE degree course. For full-time students, seven hours per week in the first session and fourteen 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. Generally, the thesis involves the design and construction of experimental apparatus or software, or both, together with appropriate 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.

Graduate Study

The formal graduate courses offered are the Master of Cognitive Science **8155,** Master of Computer Science **8680,** Master of Information Science **8508.** Graduate Diploma in Information Science **5453,** Graduate Diploma in Computer Science **5452,** and Graduate Diploma in Computer Education **5464.** Opportunities are provided for graduate research leading to the award of the degree of Master of Engineering **2665** and Doctor of Philosophy **1650.**

Course Work Programs

8155
Master of Cognitive Science

MCogSc

For course details see School Office, School of Computer Science and Engineering.

Master of Information Science/Master of Computer Science

MInfSc/MCompSc

These degrees allow for flexibility of choice between formal coursework and research.

Candidates are required to complete a program totalling 36 and 48 credits for formal coursework for the MInfSc, MCompSc degrees respectively. Alternatively, a degree may be awarded for the completion of formal coursework and a report on a project. The number of credits for a project report is 18.

Candidates may undertake interdisciplinary studies after having met the requirements of the specialisation 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 candidate may be selected.

Period of candidature: The normal period for the degrees are three sessions full time for the degree of MInfSc and 4 sessions full time for the degree of MCompSc for the degree of MCompSc if the full 48 credits are required. The maximum period of candidature is six academic sessions for both degrees. 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 subjects failed totals more than six.

8508
Master of Information Science

MInfSc

Candidates are required to complete a program totalling at least 36 credits and this may be taken in one of two ways:
i. Major Project Option –
18 credits of coursework and an
18 credit Project, or

ii. Coursework Option –
36 credits all of which will be associated with subjects although 6 credits will relate to a minor project or design.

The typical duration of the course is three sessions full-time or five sessions part-time.

I. Major Project Option

Compulsory Subjects		**C**
At least one of:		
COMP9314	Advanced Data Base Management A	3
COMP9315	Advanced Data Base Management B	3
and		
COMP9511	Human Interface Computing	3
COMP9514	Advanced Decision Theory for Information Science	3
Students will take at least one of:		
GEOG9240	Geographic Information Systems	3
LIBS0817	Information Storage and Retrieval	3
REMO9580	Design Analysis in Remote Sensing	3
SURV9604	Land Information Systems	3

It is necessary that subjects of at least three credits be taken in one of the areas of expert systems, knowledge-based systems, artificial intelligence, or decision support systems.

II. Coursework Option

Compulsory subjects:
At least one subject from each of the above subject groupings plus:
COMP9311 Introduction to Data Base Systems
(For students with limited knowledge of Data Bases)
COMP9596 Advanced Topics in Information Science
ELEC9336 Digital Communication Networks 1

The remaining three subjects may be chosen from subjects offered in the specialisations:

Computer Science/Computer Engineering
Digital Communications and Systems
Signal Processing
Cybernetic Engineering and Advanced Robotics

It could also be appropriate to select subjects dealing with behavioural aspects of judgement and choose from the programs offered by other schools.

Students should note that the decision to take Coursework or Project options will not be made until the first 12 credits of coursework has been completed. The Project option will not be available to all students and high grades in the first four subjects will be needed to obtain approval to select that option.

8680
Master of Computer Science*

MCompSc

Candidates are required to complete a course totalling at least 48 credits but those who consider that they have extensive knowledge of computing may request exemption from 12 credits of Level 1 subjects.

The program of study may be taken in one of two ways:

Project Option

18 credit project COMP9918
12 credits from Level 1 subjects
at least 9 credits from Level 2 subjects
remaining subjects to be chosen from Computer Science Level 3 electives or

Coursework Option

12 credit Level 1 subjects
12 credits from Level 2 subjects
12 credits from Computer Science Level 3 subjects
remaining subjects to be chosen from Computer Science or other specialisations subject to approval

Level 1 Subjects
COMP9021 Introduction to Computer Science
COMP9022 Digital System Structures
COMP9023 Concurrent and Functional Programming
COMP9024 Data Structures, File Systems and Data Bases

Level 2 Subjects
COMP9008 Software Engineering
COMP9101 Design and Analysis of Algorithms
COMP9102 Compiling Techniques and Programming Languages
COMP9201 Operating Systems
COMP9211 Computer Organisation and Design
COMP9221 Microprocessor Systems
COMP9231 Integrated Digital Systems
COMP9331 Computer Networks and Applications
COMP9414 Artificial Intelligence
COMP9415 Computer Graphics
COMP9416 Expert Systems and Deductive Data Bases

Level 3 Subjects
COMP9114 Formal Specification
COMP9115 Programming Languages: Fundamental Concepts
COMP9214 Computer Architecture
COMP9215 VLSI Systems Architecture and Design

** Note that the Course Structure is currently under review.*

5452
Graduate Diploma in Computer Science

GradDip

5433
Graduate Diploma in Information Science

GradDip

5464
Graduate Diploma in Computer Education

GradDip

For Graduate Diploma course details of recommended programs of study may be obtained from the School Office. Subjects offered in the Masters programs may be taken in the Graduate Diploma programs subject to the approval of the course coordinator. The following extra subjects are offered for the Graduate Diploma in Computer Education:

	C
COMP9011 Literacy and Programming	3
COMP9012 Software Engineering and Tools	3
COMP9013 Data Bases and Expert Systems	3
COMP9014 Computer Organisation and Interfacing	3
COMP9015 Issues in Computing	3
COMP9018 Computer Graphics and Applications	3

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

COMP9008
Software Engineering
Staff Contact: Mr K.Robinson
C3 S1 HPW4
Prerequisite: Assumed knowledge COMP9024
Notes: Excluded CIMP3111

Informal specification: Data flow diagram methodology, analysis, design, testing, management and documentation of software.

Formal specification: set theory, logic, schema calculus, case studies. The Z specification notation. Managing the project lifecycle. CASE tools. A major project is undertaken.

COMP9011
Literacy and Programming
Staff Contact: Ms L. Quinn
C3 S1 HPW3

Introduction to a number of the packages such as: spreadsheets, word processing, data base systems,

hypertext, graphics, networking. It will be necessary that skills be acquired with these systems. There will also be an introduction to both procedural and functional programming.

COMP9012
Software Engineering and Tools
Staff Contact: Ms L. Quinn
C3 S1 HPW3

Introduction to the Data Flow/Process Interaction model of software specification and architecture. The techniques of Software Engineering involved in specification, analysis, design, implementation, testing, debugging, maintenance, and modification are discussed. Modern CASE tools are discussed and used.

Software Tools: reusability, packages, libraries, processes, concurrency, intercommunication channels, windows, graphics, data bases, translators, pattern matchers, sorters, and user interfaces are discussed and used in the context of a programmers' shell.

COMP9013
Data Bases and Expert Systems
Staff Contact: Ms L. Quinn
C3 S1 HPW3

Introduction to some basic material on data structures. Experience with commercial relational data base systems and an application generator. Some of the notions of data base design and the redundancy: efficiency tradeoff will be discussed.There will be an overview given of expert systems, artificial intelligence, knowledge based systems and decision support systems.

COMP9014
Computer Organisation and Interfacing
Staff Contact: Ms L. Quinn
C3 HPW3

Logic and Boolean algebra. Digital logic circuits. Components and architecture of a digital computer. Machine code and assembly language programming. Design and operation of interfaces between the computer and the outside world. Applications: interfacing scientific intruments to a microcomputer.

COMP9015
Issues in Computing
Staff Contact: Ms L. Quinn
C3 HPW3

A review of issues that affect the use of Computer Systems. Topics that may be covered include: the human implications of computing systems, the affect of computing operations on organisational structure, software copyright, privacy, the role of computing systems and information systems in decision making, the significance of the timeliness of information and its implication on the value of decision making and the requirements for a computing system.

COMP9018
Computer Graphics and Applications
Staff Contact: Ms L. Quinn
C3 HPW3

This subject will provide both a series of lectures on topics such as the basics of graphic systems and graphic devices. Application areas to be considered may include business, entertainment, computer-based training, mapping. The laboratory work will involve use of sophisticated hardware for drawing, animation, simulation and CAD operations.

COMP9021
Introduction to Computer Science
Staff Contact: Prof G. Hellestrand
C3 HPW3

Defining and recognising problem classes. Reasoning about problems: specification, analysis, design, and refinement of computing solutions. Procedural programming. Data types and abstractions. Control structures, functions, procedures, and modules.

Data structures; lists, queues, trees. Implementation in Modula-2 programs. Introduction to problem solving using the functional Programming language Miranda.

COMP9022
Digital System Structures
Staff Contact: Dr G. Heiser
C3 S1 HPW3
Prerequisite: Assumed knowledge COMP9021 or COMP1021
Notes: Excluded COMP2021.

Digital Systems: switches and gates, boolean algebra, minimization techniques, combinational and sequential design, timing analysis, finite state machines; analysis, design and realization of modest digital subsystems, understanding major subsystems in a model computer.

Assembly language programming: translation of higher level programming abstractions and data structures to a real computer using an assembler as a target; study of the relationships between the programming model and the hardware model of a computer; understanding of instruction execution.

COMP9023
Concurrent and Functional Programming
Staff Contact: Dr J. Olszewski
C3 S2 HPW3
Prerequisite: Assumed knowledge COMP9021 or COMP1021
Notes: Excluded COMP2031.

The process model – sequential versus parallel computation, interprocess communication and synchronisation mechanisms; coroutines, message passing, buffers, pipes, remote procedure calls, semaphores, monitors. Resource sharing, exclusion, deadlock, livelock, scheduling. Distributed algorithms; detection of a deadlock, detection of termination. Protocols for data transfer. Development of functional programming techniques introduced in COMP9021.

COMP9024
Data Structures, File Systems and Data Bases
Staff Contact: Dr A. Amin
C3 S2 HPW3
Prerequisites: Assumed knowledge COMP9021 or COMP1021
Notes: Excluded COMP2011.

The abstraction and representation of information; fundamental types, sets and sequences, recursive sets (arrays and structures (lists, trees)), classes (structure and

manipulation). Practical work will use Modula-2 and Miranda. Internal (memory) and external (file system) representation of information. Structured policies for packaging information (data bases (sets, hierarchy, network, relations), knowledge bases and frames). Efficiency and complexity of representation. Introduction to data bases and query languages. The manipulation of knowledge. Prolog as a query language.

COMP9101
Design and Analysis of Algorithms
Staff Contact: School Office
C3 S1 HPW3
Prerequisite: Assumed knowledge COMP9024 or COMP2011
Notes: Excluded COMP3121

Techniques for 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 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.

COMP9102
Compiling Techniques and Programming Languages
Staff Contact: Mr P. Ho
C3 S2 HPW3
Prerequisite: Assumed knowledge COMP9024 or COMP2011
Notes: Excluded COMP3131.

Language description; phrase structure grammars. Chomsky classifications, context-free grammars, finite state grammars, Backus Naur Form, sysntax graphs, LL(k), LR(K), LSL(k).

Lexical analysis: finite state recognisers. Syntax analysis: top-down compilation for LL(1) grammars using syntax graph driven analysers or recursive descent. Bottom-up compilation LR(k) grammars. Semantic analysis; program translation and code generation, attributed grammars. Compiler generators: Code optimization. Run-time organization; activation record stacks heap management.

COMP9114
Formal Specification
Staff Contact: Mr K. Robinson
C3 SS HPW3
Prerequisite: Assumed knowledge; background to final year Computer Science level, equivalent to subjects COMP9008, COMP9101 and COMP9102

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.

COMP9115
Programming Languages: Fundamental Concepts
Staff Contact: Mr K. Robinson
C3 SS HPW3
Prerequisite: Assumed knowledge; background to final year Computer Science level, equivalent to subjects COMP9008, COMP9101, COMP9102

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.

COMP9201
Operating Systems
Staff Contact: Mr S. Russell
C3 S2 HPW3
Prerequisite: Assumed knowledge, COMP9023 and COMP9024
Notes: Excluded COMP3231.

Services provided by operating systems. System calls and user commands (command languages, menus, etc). Virtual machines. Efficient techniques and methods of process management, memory management, input/output and communication handling. Performance evaluation and tuning. Protection and security.

COMP9211
Computer Organization and Design
Staff Contact: Prof G. Hellestrand
C3 S1 HPW4
Prerequisites: Assumed knowledge ELEC2012 or COMP9022
Notes: Excluded COMP3211.

Topics will be chosen from:
Advanced Design Strategies: combinational and sequential circuit design and realisation; synchronisation, communication and arbitration; register transfer specification (Modal). Arithmetic Design Strategies. Memory Organization; physical and virtual address space; memory hierarchy; operating system and compiler support; memory mapping and caching.

Communications Organization: shared memory, memory mapping; network systems. Processor Design: the instruction pipeline; hardwired and micro-programmed control; instruction sets; RISC and object-based processor organization. Error Detection/Correction and Fault Tolerance; testing and testability; faults, errors and failures; coding theory; diagnosing and correcting errors.

COMP9214
Computer Architectures
Staff Contact: Dr S. Matheson
C3 S1 HPW3
Prerequisite: Assumed knowledge, ELEC2021 or COMP9022

Review of conventional computer architectures, description methods and performance evaluation. Alternative approaches to CPU, memory, communication, busses and I/O organization. Influences on computer architecture, including technologicial innovation and new application areas. Case studies of specialized machines, including array, associative and functional processors and

general-purpose machines that aim for high performance, ultra-reliability or minimal cost.

COMP9215
VLSI System Design
Staff Contact: Prof G. Hellestrand
C3 S1 HPW4
Prerequisite: Assumed knowledge, background in electronic design equivalent to ELEC4532 or COMP9231
Notes: Excluded COMP4215

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 LSI design project. Selected project designs will be submitted for fabrication and returned to students for testing.

COMP9216
Parallel and Distributed Computing Systems
Staff Contact: School Office
C3 SS HPW3
Prerequisite: Assumed knowledge, background to final year Computer Science level, equivalent to subjects COMP3111, COMP3121 and COMP3131
Notes: Not offered in 1993

Parallelism concurrency in functionally coupled and distributed communicationally coupled, computing systems. Topics selected from: Synchronisation, communication and arbitration; Computational paradigms -s; concurrent synchronous processing, lists, trees; Computational paradigms - p: vectors, arrays, APL tables, associative look-up 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. Object based systems; Languages with communication and processes; CSP, ADA C; Locally and geographically distributed systems: Failure tolerant computer systems.

COMP9231
Integrated Digital Systems
Staff Contact: Prof G. Hellestrand
C3 S2 HPW4
Prerequisite: Assumed knowledge ELEC2012 or COMP9022.
Notes: Excluded ELEC4532.

Integrated circuit logic families with emphasis on MOS technologies, 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.

COMP9221
Microprocessor Systems
Staff Contact: Dr I. Gorton
C3 S1 HPW4
Prerequisite: Assumed knowledge COMP9021, COMP9022
Notes: Excluded 6.0318, 6.613, 5.087G, 5.088G, COMP3221, ELEC3020.

Concepts of a microprocessor system: address spaces, memory devices, bus timing and standards, the VME bus. Input/output interfacing: polling and interrupts. DMA interfaces. The MC68000 family and assembly programming language. Other microprocessors. The subject includes two hours per week of laboratory work involving interfacing to and programming MC68000-series micrprocessor-based systems.

COMP9311
Data Base Systems
Staff Contact: Prof J. Hiller
C3 S1 or S2 HPW3
Prerequisites: Assumed knowledge, familiarity with storage structures
Notes: Excluded 6.659G, 55.823G

A first subject on data base management systems to be presented at a level appropriate for a graduate subject.

The material to be covered will include a selection from: the relational, hierarchic/network, and inverted file data models; normalisation and the problems of redundancies; views and their updates; high level query languages; distributed systems; deductive data bases; data definitions; application generators.

COMP9314
Advanced Data Base Management A
Staff Contact: Ms L. Quinn
C3 S1 HPW3
Prerequisite: Assumed knowledge COMP9311

Examination in detail of some of the commercially oriented issues associated with recent developments in data base management systems. Topics to be treated may include: functional analysis and data base design, object data bases, application generators, and office data systems. The subject will involve the students in performance of a significant data base design task.

COMP9315
Advanced Data Base Management B
Staff Contact: Ms L. Quinn
C3 S2 HPW3
Prerequisite: Assumed knowledge corresponds to the treatment in COMP9311

Examination in detail of some of the technical issues associated with recent developments in data base management systems. Topics to be treated may include: query optimisation, concurrent processing and its control, recovery and restart, and distributed dbms.

COMP9331
Computer Networks and Applications
Staff Contact: Dr K. Burston
C3 S2 HPW3
Prerequisite: Assumed knowlege COMP9024
Notes: Excluded COMP3331.

Introduction: applications, LANs, MANs, and WANs, topologies. Protocol Layers: ISO Model. Physical Layer: transmission media and line codes. Data Link Layer: Functions, frames, error control, flow control, performance. Network Layer: routing. Transport Layer: connection control. Application Layer: Functions. Distributed file

systems, NFS. Distributed processing, NCS, Electronic Mail, Virtual Terminals and File Transfer, Telnet/FTP. Graphical interfaces, X. WAN: Interconnecting computers and LANS. Modems, X25, N-ISDN. Future Networking: B-ISDN, Multi-Media.

COMP9414
Artificial Intelligence
Staff Contact: Mr P. Staines, School of Philosophy
C3 S1 HPW3
Prerequisite: Assumed knowledge COMP9024
Notes: Excluded COMP3411

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 Artifical 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.

COMP9415
Computer Graphics
Staff Contact: Dr T. Lambert
C3 S1 HPW3
Prerequisite: Assumed knowledge,background to final year Computer Science levels, equivalent to subjects COMP9101, COMP9102

Graphics hardware: scan conversion of lines and polygons. 2D transformations, windowing, clipping, viewports, user interfaces. 3D transformations: perspective transformation, 3D clipping, hidden line surface removal, lighting and texture maps. Hierarchical modelling of objects, modelling curves and surfaces with splines and fractals. Graphics standards will be examined.

COMP9416
Expert Systems and Deductive Data Bases
Staff Contact:
C3 S2 HPW3
Prerequisites: COMP9311, and some familiarity with rule based systems and reasoning procedures.

Introduction to Expert Systems including knowledge representation, inference, reasoning under uncertainty, qualitative modelling and knowledge acquisition. Students will build an expert system using a shell. Introduction to deductive database including logic programming, clause indexising and query optimisation, integration of deductive databases and expert systems.

COMP9511
Human-Computer Interaction
Staff Contact: Dr C. Quinn
C3 S2 HPW3
Corequisites: Knowledge of data base query languages
Notes: Excluded 55.821G.

Introduces theories and models of user-system interaction. A scientific approach emphasizes the literature and methodological issues in HCI design, using a cognitive engineering framework. Topics: models of mind, interaction formalisms and tools, and theories of design.

COMP9514
Advanced Decision Theory for Information Science
Staff Contact: Prof J. Hiller
C3 SS HPW3
Prerequisites: Assumed knowledge, a graduate level in expert systems or 55.821G or equivalent.

This subject will link results from fields such as information theory, the economics of information, the theory of judgement and choice, certainty theory and the theory of evidence. There will be a review of maximum utility theory decision making and the associated axioms. Developments of maximum expected utility theory including prospect theory, regret theory and duality theory will be introduced. The results will be linked to system design.

COMP9596
Advanced Topics in Information Science
Staff Contact: Prof J. Hillier
C6 S1 or S2 HPW6
Prerequisite: Assumed knowledge 55.821G or equivalent.

This subject will integrate information science skills in an experimental situation involving software development and assessment. The subject will be project oriented. There may be a lecture portion that relates to statistical aspects of experimental design and hypothesis testing.

COMP9918
Project Report
C18

School of Electrical Engineering

Head of School
Professor G. A. Rigby

Executive Assistant to Head of School
Dr C. J. E. Phillips

Executive Officer
Mr K. J. Flynn

Administrative Assistant
Miss A. G. M. Johnson

The School comprises four departments and a Special Research Centre: **Communications** (all aspects of theory, applied electronics and engineering relating to communication systems and networks such as telephones, broadcasting and television); **Electric Power** (electrical machines and generation, distribution and utilisation of electric energy); **Electronics** (electronic circuits, devices, micro-electronics and application of electronics to such areas as solar power generation); **Systems and Control** (development of theories for the control of complex systems and the application of these theories including computer simulation). The **Centre for Photovoltaic Devices and Systems** conducts research into energy efficient silicon solar cells for electricity generation.

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 specialised groups (such as Digital Systems, Biomedical Engineering, Measurement, Microelectronics, etc.) are also active.

Summary of Courses	Usual Duration (years)
3640 BE	4 full-time
3645 BE	4 full-time
3720 BE and BA	5 full-time
3725 BE and BSc	5 full-time

Course 3645 is jointly administered by the Schools of Computer Science and Engineering, and Electrical Engineering.

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.

The formal graduate courses offered are: Master of Engineering Science in Electrical Engineering **8501**; Graduate Diploma in Electrical Engineering **5458**. Opportunities are provided for graduate research leading to the award of the degrees of Master of Engineering **2660**, Master of Science **2760** and Doctor of Philosophy **1640**.

Recognition

The degree of Bachelor of Engineering (BE) is recognised 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 the BE courses by overseas engineering institutions.

Substitution of Subjects

General Education
Students must apply to the Director, Centre for Liberal and General Studies, for permission to substitute a subject for part, or all, of their General Studies (old rules) or General Education (new rules) requirement.

Other 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) The normal Year 4 of the BE degree program includes 5 Professional Electives. Students may substitute for one of these electives, a subject of suitable level and difficulty from an area outside the School relevant to the profession of Electrical Engineering. A graduate subject of the School may also be substituted in this way, provided that the student has passed the Year 3 Electrical Engineering subjects at an adequate level.

(ii) Part-time BE students in full-time employment may request substitution of Industrial Electives (ELEC0931, ELEC0932, ELEC0933) for up to three subjects in the BE degree course. See Industrial Elective subject descriptions for details.

Undergraduate Study

Course Outlines

3640
Electrical Engineering - Full-time Course

Bachelor of Engineering
BE

Course 3640 has been revised and is shown below.

		HPW	
Year 1		S1	S2
CHEM1806	Chemistry 1EE	3	0
COMP1011	Computing 1A	0	6
ELEC1010	Introduction to Electrical Engineering	1.5	0
ELEC1011	Electrical Engineering 1	0	6
MATH1032	Mathematics 1	6	6
MATH1090	Discrete Mathematics	3	0
MECH0160	Introductory Engineering Design and Drawing Practice	3	0
MECH0360	Introductory Engineering Mechanics	3	0
PHYS1969	Physics 1	6	6
Totalling		25.5	24

		HPW	
Year 2		S1	S2
COMP1021	Computing 1B	6	0
ELEC2010	Circuit Theory	2.5	0
ELEC2011	System Theory	0	2.5
ELEC2012	Digital Circuits	0	2.5
ELEC2015	Electromagnetic Applications	0	2.5
ELEC2016	Electrical Design and Practice	2	5
ELEC2020	Analog Electronics	0	2.5
MATH2110	Higher Vector Calculus	2.5	0
MATH3150	Transform Methods	0	2
MATH2610	Higher Real Analysis	2.5	0
MATH2620	Higher Complex Analysis	0	2.5
MATH2849	Statistics SE 1	0	2
PHYS2979	Electromagnetic Theory	3.5	0
PHYS2989	Solid State Physics	4.5	0
One 56-hr or two 28-hr General Education subject/s (Cat A)		0	4
Totalling		23.5	25.5

Note: Students who plan to specialize in Computer Science, Mathematics or Physics in a BE/BSc degree course should consult the School before enrolling in year 2.

Year 3			
ELEC3010	Introduction to Electrical Energy	2.5	0
ELEC3011	Integrated Electronics	2.5	0
ELEC3012	Signals, Spectra and Filters	2.5	0
ELEC3013	Communication Systems 1	0	4
ELEC3014	Systems and Control 1	0	4
ELEC3020	Microprocessors and Interfacing	2.5	0
ELEC3110	Electrical Engineering Laboratory 3	6	0

		HPW S1	HPW S2
Year 3			
MATH2501	Linear Algebra	5	0
MATH2859	Statistics SE 2	2	0
MATH3141	Numerical and Mathematical Methods	0	3.5
and two from††:			
ELEC3015	Electrical Energy	0	4
ELEC3016	Electronic Signal Processing	0	4
Technical Elective†		0	4
and:			
One 56-hr or two 28-hr General Education subject/s (Cat B)		0	4
Totalling		23	23.5

Note: Students who intend to major in particular disciplines should note that certain subjects are prerequisites for the Professional Electives they choose in Year 4.

†See list of Technical Electives later this section.

†† Students who wish to take all three of the year 3 elective subjects may do so by substitution for one Professional Elective in year 4

Year 4			
5 Professional Electives		15	10
ELEC4010	Introduction to Management for Electrical Engineers (Gen. Ed. Cat.C)	4	0
ELEC4011	Ethics and Electrical Engineering Practice (Gen.Ed. Cat.C)	0	2
ELEC4903	Industrial Training	0	0
ELEC4910	Thesis Part A	6	0
ELEC4911	Thesis Part B	0	12
Totalling		25	24

Normally 3 electives are taken in Session 1 and 2 in Session 2. See list of Professional Electives later in this section.

3640
Electrical Engineering – Part-time Course

Bachelor of Engineering
BE

Note: As from 1989 no formal part-time course is being offered. However, after completing Year 1 full-time it is possible for students to progress on a semi-part-time basis with a reduced program. It should also be noted that very few undergraduate subjects are offered in the evenings.

3640
Electrical Engineering – Sandwich Course

Bachelor of Engineering
BE

Note: No new enrolments will be accepted into the Sandwich course from 1990.

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

3645
Computer Engineering – Full-time course

Bachelor of Engineering
BE

This course commenced in 1989, and is jointly administered by the Schools of Electrical Engineering, and Computer Science and Engineering. For course details refer to the entry under the School of Computer Science and Engineering.

Technical Electives – all courses

		HPW S1	HPW S2
ACCT9062	Accounting for Engineers	1.5	1.5
CIVL0626	Civil Engineering	4	0
COMP2011	Data Organization	5	
		or	5
COMP2031	Concurrent Computing	0	5
ELEC3401	Reliability Engineering in Design and Development	0	4
ELEC3402	Introductory Physiology for Engineers	4	0
FUEL0020	Fuels and Energy	0	4
MATS9640	Materials Science and Engineering for Electrical Engineers	0	4
MECH0760	Mechanical Engineering	4	0
PHYS2999	Mechanics and Thermal Physics	2	2
SAFE9533	Electrical Safety	0	4

Electrical Engineering Professional Electives – all courses

Professional Elective subjects in the Computer Science area require either COMP2011 or COMP2031 as a prerequisite. A free choice may not be possible. Each elective is 5 hours per week for one session.

ELEC4042 Signal Processing
ELEC4202 Power Systems
ELEC4215 Industrial Electrical Systems
ELEC4216 Electric Drive Systems
ELEC4240 Power Electronics
ELEC4303 Electromagnetic Wave Propagation
ELEC4313 Optical Communications
ELEC4323 Digital and Analog Communications
ELEC4333 Communication Systems 2
ELEC4351 Data Communications and Computer Networks
ELEC4352 Data Networks 2
ELEC4412 Systems and Control 2
ELEC4413 Digital Control
ELEC4432 Computer Control and Instrumentation
ELEC4483 Biomedical Engineering
ELEC4503 Advanced Electronic Circuits
ELEC4512 Semiconductor Devices
ELEC4522 Microelectronics Design and Technology
ELEC4532 Integrated Digital Systems
ELEC4540 Applied Photovoltaics
COMP3211 Computer Organization and Design

COMP3231 Operating Systems
COMP3311 Database Systems
COMP3411 Artificial Intelligence

Because of timetable clashes not all combinations of subjects are 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 or computer science.

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 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 transfer to a combined course must be made in writing to the Head of School by the start of the third week of December in the year that they complete Year 2 of the BE degree 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 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.

3720
BE BA in Electrical Engineering

With this combined degree course students can add their choice of arts program to the standard, professionally accredited engineering course offered by the School of Electrical Engineering. The full range of Arts programs is available.

Because the engineering and arts programs have common content, such as mathematics and physics, only one more year of study is normally required to gain the additional qualification of Bachelor or Arts.

Eligibility

Anyone who meets the entry requirements for both Engineering and Arts is eligible for the combined course. Students may enter directly in first year or may apply to transfer from the normal engineering course later, although with late transfer it might not be possible to complete the course in minimum time.

Organization

The BE BA course is administered by the School of Electrical Engineering.

Students should start discussing their program with representatives of the School and the Faculty of Arts and Social Sciences as soon as possible - preferably well before enrolment. Enquiries should be directed to the Executive Assistant to the School and the Executive Assistant to the Dean of the Faculty of Arts and Social Sciences.

Students should work out for themselves the arts program they would like to add to their chosen engineering course. The Arts and Social Sciences Faculty Handbook describes the options, and the School of Electrical Engineering can supply sample programs showing what previous students have arranged.

There are no special rules on what to include in each year. Students should schedule the arts and engineering components to suit their preferences while meeting the constraints of timetables and prerequisites. The sample programs can help here too.

The Arts component must be approved by the Faculty of Arts and Social Sciences.

The final program and schedule must be approved by the School of Electrical Engineering.

Rules

1. In addition to the BE course, students must complete a major sequence offered within the BA course and meet the additional requirements listed below:

Faculty which provides the chosen major
Faculty of Arts and Social Sciences:
(minimum) 48 credit points total, including major sequence

Other Faculties:
Major sequence plus at least 12 Credit Points from Schools of the Faculty of Arts and Social Sciences.

Mathematics majors are not usually permitted. BE BSc combined degrees are more appropriate for this.

2. The requirements of the General Education Program must be met. In some cases subjects within the combined course may satisfy Category A and/or Category B guidelines. Students should consult the Centre for Liberal and General Studies for advice.

3. There will be a testamur for each part of the combined degree course.

4. Students who complete the BE program first may proceed to graduation with the degree of Bachelor of Engineering in the usual way.

5. Students who complete the requirements for their Arts program and the first two years of the BE program may proceed to graduation with the degree of Bachelor of Arts.

3725
BE BSc in Electrical Engineering

As noted above students wishing to transfer to the combined degree should contact the Electrical Engineering School Office before completing their Year 2 enrolment. After completing Years 1,2 and 3 (modified where necessary as indicated below) of the Electrical Engineering course, students in their fourth year complete a specific program consisting of four Level III Science units chosen from related disciplines, the appropriate General Education electives and three or four other Level II or Level III units. The subjects chosen should be in accord with the rules of the BSc course 3970 leading to a major in Computer Science, Mathematics or Physics. In their fifth year students complete year 4 of the Electrical Engineering course.

Students may open up a wider choice of subjects in their Science year by including additional Computer Science (viz COMP2011 and COMP2031), in Years 2 and 3 or Physics (viz PHYS2999) in years 2 or 3 of their Electrical Engineering program. Any Electrical Engineering subject omitted will have to be taken later in the course. The extra subject in year 2 may be credited towards either the BE or the BSc requirements but not both.

Students who plan to specialise in Computer Science, Mathematics or Physics in a BE/BSc degree course should consult the School before enrolling in year 2.

Year 1 (Standard program for course 3640)
CHEM1806, COMP1011,
ELEC1010, ELEC1011,
MATH1032/MATH1042, MATH1090,
MECH0160, MECH0360,
PHYS1969

Year 2
COMP1021,
ELEC2010, ELEC2011, ELEC2012, ELEC2015,
ELEC2016, ELEC2020,
MATH2110, MATH2610, MATH2620, MATH2849,
MATH3150,
PHYS2979, PHYS2989,
General Education (Category A).

Computer Science majors add COMP2011 in Session 2 by moving 2 hours of General Education to Session 1. Higher Mathematics subjects may be taken at the ordinary level.

Physics majors may take the Higher Mathematics subjects at the ordinary level.

Year 3
ELEC3010, ELEC3011, ELEC3012, ELEC3013,
ELEC3014, ELEC3020, ELEC3110,
MATH2601, MATH2859, MATH3141,
Two from ELEC3015, ELEC3016 and Technical Elective,
General Education (Category B).

Computer Science majors must take COMP2031 as their Technical Elective. The Higher Mathematics subject MATH2061 may be taken at the ordinary level.

Physics majors must take PHYS2999 as their Technical Elective. The Higher Mathematics subject MATH2601 may be taken at the ordinary level.

Year 4
Refer to course 3970 in the Science Handbook for subject details. Any General Education deferred from Year 2 or 3 should be taken during this year.

Computer Science
Choose at least 7 Level II or Level III units including at least 4 Computer Science units at Level III with the balance being chosen from Level III Computer Science units and other Level II or Level III units from the Science Program 0600.

Mathematics
Choose at least 5 Mathematics units, 4 of which are Level III.

Choose at least 3 Level II or Level III units from the Science Program 1000.

Physics
Choose 7 Level II or Level III units of which at least 4 must be Level III Physics units chosen to include PHYS3010, PHYS3031, PHYS3030 and PHYS3060.

Year 5
Year 4 of the Electrical Engineering course.

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

ELEC0802
Electrical Power Engineering
Staff Contact: Dr B. Farah
S2 HPW3
Prerequisite: PHYS1002 or equivalent (PHYS2920 or 6.851 for students in Course **3140**)

The course deals with the principles and practice of electrical power apparatus, particularly the transformer, the dc motor and the ac motor. It also covers some of the electronic power converters for power supplies and for control of electrical machinery. The course commences with the basic circuit theory and phasor algebra relevant to the analysis of the above systems and then proceeds to the consideration of distribution of electrical power. It then covers the operation, analyses and characteristics of transformers, dc motors, ac motors and a few semiconductor power converter circuits. Rating and thermal consideration electrical apparatus are also treated.

ELEC0805
Electronics for Measurement and Control
Staff Contact: Dr B. Farah
S2 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.

ELEC0931
Industrial Elective

ELEC0932
Industrial Elective

ELEC0933
Industrial Elective
Prerequisites: for ELEC0931, ELEC0932, ELEC0933 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.
Note: New enrolments in the part-time BE or sandwich course are not accepted, as those courses are no longer offered.

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 ELEC4911. An Industrial Elective cannot be claimed for work submitted for credit as ELEC4911 Thesis. Details of the procedure for registering and the requirements to be met can be obtained from the School of Electrical Engineering.

ELEC1010
Introduction to Electrical Engineering
Staff Contact: A/Prof H.R. Outhred
S1 L1 T.5
Prerequisite: HSC Exam Score Range Required - 2 unit English (General) 53-100,or 2 unit English 49-100, or 3 unit English 1-50, 2 unit Contemporary English 60-100

Introduction to the nature and scope of electrical engineering, including communications, computing, electrical energy, electronics and systems. Careers for electrical engineers in public and private enterprise. Organisation, verbal and written communication and research skills in engineering.

ELEC1011
Electrical Engineering 1
Staff Contact: Dr E.H. Fooks
S2 L3 T3
Corequisite: PHYS1969 or equivalent

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. Power in DC and AC circuits. Circuit models of diodes and transistors. Transistor switching. Combinational logic principles and circuits. Diode and transistor logic implementations.

ELEC2010
Circuit Theory
Staff Contact: Prof I.F. Morrison
S1 L2 T.5
Prerequisites: ELEC1011, MATH1032
Corequisite: MATH2620 or MATH2520

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; linearity, network theorems; resonance, bandwidth, and quality factor. Two-port network: 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. Operational amplifiers and ideal transformers.

ELEC2011
Systems Theory
Staff Contact: Dr D.J. Clements
S2 L2 T.5
Prerequisites: ELEC2010, MATH2610 or MATH2510
Corequisites: MATH3150, MATH2620, MATH2520

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. Impulse responses, step responses, convolution. Frequency responses, poles, zeros. Introduction to feedback, stability. Examples of systems will be taken from areas of circuits, analog and digital electronics, power and mechanical engineering, communications and control.

ELEC2012
Digital Circuits
Staff Contact: Dr T. Hesketh
S2 L2 T.5
Prerequisite: ELEC1011

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.

ELEC2015
Electromagnetic Applications
Staff Contact: Dr T.R. Blackburn
S2 L2 T.5
Prerequisites: PHYS2979
Notes: Excluded 6.825.

General field properties. Dielectric and magnetic materials and their applications. Electrodynamic forces. Transformer and motor action: rotating magnetic fields. Applications of Maxwell's equation. Transmission lines from circuit and electromagnetic viewpoints. Electromagnetic radiation and electromagnetic interference.

ELEC2016
Electrical Design and Practice
Staff Contact: Dr K.C. Daly
S1 L1 T1 S2 L1 T4
Prerequisites: ELEC1011, ELEC1010, PHYS1969
Corequisites: ELEC2010, ELEC2020, ELEC2012
Notes: Excluded ELEC2110, ELEC2111, ELEC2014.

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: wirewrapping, PCB layouts (using computer aids), interconnection technologies, earthing. Laboratory practice: Experimental work on digital and analog devices and circuits. Group Project including design, production and test.

ELEC2020
Analog Electronics
Staff Contact: Dr S.R. Wenham
S2 L2 T.5
Prerequisites: ELEC2010, PHYS2989 or PHYS2859

Operating principles and terminal characteristics of PN diodes, solar cells, bipolar and field effect transistors. Small signal models of devices, including h-parameter model. Analysis and design of low-frequency Class-A amplifiers, including choice of biasing method.

ELEC2030
Circuit Theory and Laboratory
Staff Contact: Prof I.F. Morrison
S1 L2 T1.5
Prerequisites: ELEC1011, MATH1032
Corequisite: MATH2620 or MATH2520
Notes: Excluded ELEC2010. Only available to course 3645.

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: linearity, network theorems; resonance, bandwidth, and quality factor. Two-port network: 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. Operational amplifiers and ideal transformers. The use of the computer aided circuit analysis package Micro-Cap III. Laboratory Technique.

ELEC2033
Analog Electronics and Laboratory
Staff Contact: Dr S.C. Wenham
S2 L2 T2.5
Prerequisites: ELEC2010, PHYS2989 or PHYS2859
Notes: Excluded ELEC2020. Only available to course 3645.

Operating principles and terminal characteristics of PN diodes, bipolar and field effect transitors, 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. Laboratory work on circuits, devices and systems. Computer aided experimental work.

ELEC3010
Introduction to Electrical Energy
Staff Contact: A/Prof C. Grantham
S1 L2 T.5
Prerequisites: ELEC2015
Corequisite: ELEC3110

Introduction to energy systems: overview of electricity generation, transmission, distribution, storage and utilisation. Transformers: equivalent circuit, elimination of harmonics. Per-unit system. Thermal rating of equipment. Electrical machines: fundamentals and applications. Small electrical machines. Introduction to power electronics: single- and three-phase switching of electrical power.

ELEC3011
Integrated Electronics
Staff Contact: Dr C.Y. Kwok
S1 L2 T.5
Prerequisite: ELEC2020
Corequisite: ELEC3110

Analysis and design of bipolar and field effect transistor amplifiers. Applications of negative feedback. Differential amplifiers. Properties and applications of operational amplifiers. Analysis and design of sinusoidal oscillators.

ELEC3012
Signals, Spectra and Filters
Staff Contact: Dr D.H. Irving
S1 L2 T.5
Prerequisites: ELEC2011, MATH3150
Corequisite: MATH2849, MATH2859, ELEC3110

Analysis and processing of continuous and discrete signals: frequency response, transfer functions, and convolution. Generalised Fourier analysis: autocorrelation, cross-correlation and power density spectra. Linear system relations, ideal filters and distortionless transmission. Random signal theory: modelling random signals, nonlinear devices, linear system identification using cross-correlation. Analogue filters: poles and zeros, stability, implementations with operational amplifiers and lumped elements. Sampled systems: sampling theorem, interpolation and reconstruction, aliasing and quantisation. Elementary digital filters: data smoothing by moving average and first order filters. Differentiators and integrators. The z-transform: transfer functions, poles and zeros, stability.

ELEC3013
Communication Systems 1
Staff Contact: A/Prof I. Korn
S2 L2 T2
Prerequisite: ELEC3012 or ELEC3032

Overview of information acquisition, transmission and processing. Aims to enable students not specialising 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 specialise in communications. Topics include analogue to digital conversion (sampling, quantising, aliasing, pulse code modulation, delta modulation, time and frequency division multiplexing). 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, equalisers, line coding).

ELEC3014
Systems and Control 1
Staff Contact: A/Prof P.D. Neilson
S2 L2 T2
Prerequisite: ELEC3012 or ELEC3032

Consolidation and extension of basic material on continuous-time and discrete-time systems, and the relationships between them. 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.

ELEC3015
Electrical Energy
Staff Contact: A/Prof C. Grantham
S2 L2 T2
Prerequisite: ELEC3010

Electrical energy supply systems: Principles of operation and planning. DC machines, induction machines and synchronous machines. Variable speed drives. Applications of power electronics. Lighting, heating, air-conditioning and refrigeration. Electrical equipment for hazardous atmospheres.

ELEC3016
Electronic Signal Processing
Staff Contact: Dr C.Y.Kwok
S2 L2 T2
Prerequisites: ELEC3011 or ELEC3031, ELEC3012 or ELEC3032

Electronic techniques for generation and shaping of wave-forms. Comparators and Schmitt triggers. Pulse and delay generators - monostables. Astable and relaxation oscillators. Active RC filters and switched capacitor filters. Signal sampling and multiplexing. A/D and D/A converters.

ELEC3020
Microprocessors and Interfacing
Staff Contact: I. Gorton
S1 L2 T.5
Prerequisite: ELEC2012
Notes: Excluded COMP3221.

Concepts of a microprocessor system: address spaces, memory devices, bus timing and standards, the VME bus. Input/output interfacing: polling and interrupts. DMA interfaces. The 68000 family and assembly programming language. Other microprocessors.

ELEC3031
Integrated Electronics + Laboratory
Staff Contact: Dr C.Y. Kwok
S2 L2 T2.5
Prerequisite: ELEC2020
Notes: Only available to course 3645.

Analysis and design of bipolar and field effect transistor amplifiers. Applications of negative feedback. Differential amplifiers. Properties and applications of operational amplifiers. Analysis and design of sinusoidal oscillators. Includes the appropriate laboratory component from ELEC3110 Electrical Engineering Laboratory 3.

ELEC3032
Signals, Spectra and Filters + Laboratory
Staff Contact: Dr D.H. Irving
S1 L2 T1.5
Prerequisites: ELEC2011, MATH3150
Corequisites: MATH2849, MATH2859
Notes: Only available to course 3645.

Analysis and processing of continuous and discrete signals: frequency response, transfer functions, and convolution. Generalised Fourier analysis: autocorrelation, cross-correlation and power density spectra. Linear system relations, ideal filters and distortionless transmission. Random signal theory: modelling random signals, nonlinear devices, linear system identification using cross-correlation. Analogue filters: poles and zeros,

stability, implementations with operational amplifiers and lumped elements. Sampled systems: sampling theorem, interpolation and reconstruction, aliasing and quantisation. Elementary digital filters: data smoothing by moving average and first order filters. Differentiators and integrators. The z-transform: transfer functions, poles and zeros, stability. Includes the appropriate laboratory component from ELEC3110 Electrical Engineering laboratory 3.

ELEC3110
Electrical Engineering Laboratory 3
Staff Contact: Dr R. Radzyner
S1 T6
Prerequisite: ELEC2016
Corequisites: ELEC3020, ELEC3010, ELEC3011, ELEC3012

A programme of experiments and laboratory-based design exercises in electrical energy, electronic devices and circuits, signal processing and microprocessors.

ELEC3120
Electrical Energy Strand of ELEC3110
Staff Contact: Dr R. Radzyner
S1 T1
Notes: Excluded ELEC3110

A program of experiments and laboratory-based design exercises in electrical energy.

ELEC3121
Electronics Strand of ELEC3110
Staff Contact: Dr. R. Radzyner
S1 T2
Notes: Excluded ELEC3110

A program of experiments and laboratory-based design exercises in electronic devices and circuits.

ELEC3122
Signals, Spectra and Filters Strand of ELEC3110
Staff Contact: Dr R. Radzyner
S1 T1
Notes: Excluded ELEC3110

A program of experiments and laboratory-based design exercises in signal processing

ELEC3123
Microprocessor and Interfacing Strand of ELEC3110
Staff Contact: Dr R. Radzyner
S1 T2
Notes: Excluded ELEC3110.

A program of experiments and laboratory-based design exercises in microprocessors and their applications.

ELEC3401
Reliability Engineering for Design and Development
Staff Contact: H.S. Blanks
S2 L2 T2
Prerequisite: MATH2849 attempted
Corequisite: MATH2859
Notes: 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. RM 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.

ELEC3402
Introductory Physiology for Engineers
Staff Contact: A/Prof B.G. Celler
S1 L2 T2

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.

ELEC4010
Introduction to Management for Electrical Engineers
Staff Contact: Prof G.A. Rigby
S1 L3 T1
Prerequisite: ELEC2016

The purpose of this subject is to introduce students to key management concepts and techniques in the content of electrical engineering. Topics to be discussed will be taken from accounting, economics, finance, marketing, decision-making techniques, operations research, project and strategic management, human resources, industrial relations and law.

ELEC4011
Ethics and Electrical Engineering Practice
Staff Contact: A/Prof H.R. Outhred
S2 L1 T1
Prerequisite: ELEC4010

An introduction to the ethical issues associated with electrical engineering practice. The role of the professional expert in society will be discussed and the nature of the decision making process will be examined. Social, political, environmental and economic considerations in decision making will be explored using case studies.

ELEC4042
Signal Processing
Staff Contact: Dr C.J.E. Phillips
S1 L2 T3
Prerequisite: ELEC3012

Analysis and processing of continuous-time (analog) and discrete-time (digital) signals and systems with emphasis on digital signal processing. Design and implementation of finite and infinite duration impulse response (FIR and IIR) digital filters. Aspects of nonlinear filtering techniques. Applications of the discrete Fourier transform (DFT), faster Fourier transform (FFT) algorithms and applications. Processing and analysis of random signals and noise; correlation functions, mean square estimation, Wiener filters and linear prediction. Adaptive signal processing; adaptive FIR filters, least mean-square (LMS) algorithm and applications. Spectrum estimation.

ELEC4202
Power Systems
Staff Contact: Dr R.J. Kaye
SS L2 T3
Prerequisite: ELEC3015

Review of basic concepts used in power systems analysis: phasers, complex power, systematic network analysis, three phase systems, the per-unit methodology. Some aspects of power systems analysis, including load flow and fault analysis. Distribution systems. An introduction to power system protection. Power systems planning: electricity pricing, demand side options, co-ordinated pricing and planning, practical tariffs.

ELEC4215
Industrial Electrical Systems
Staff Contact: Dr T.R. Blackburn
SS L2 T3
Prerequisite: ELEC3015

The design, operation, and maintenance 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 safety and general wiring procedures). Insulation systems, their design and practical limitations. High voltage testing techniques and their use in insulation assessment of high, medium and low voltage industrial systems.

ELEC4216
Electrical Drive Systems
Staff Contact: A/Prof C. Grantham
SS L2 T3
Prerequisite: ELEC3010

Electrical Drive Systems. Elements of Drive Systems and their requirements for servo and industrial drive applications. Drive representation, quadrant operation, dynamic and regenerative braking. Transfer function representations of dc motor and converter and drive performance analysis. Performance analysis of induction motor drives with variable voltage, voltage source, current source and variable frequency supply. Performance analysis of synchronous and reluctance motors with variable frequency supply. Transducers in electric drive systems. Computer aided design.

ELEC4240
Power Electronics
Staff Contact: Dr K.C. Daly
SS L2 T3
Prerequisites: ELEC2020, ELEC3010, MATH3150
Notes: Excluded 6.212.

The course will be of interest to intending electronic specialists who want to know about techniques of designing high current electronic circuits using devices in the switching mode rather than in the linear mode as well as to power specialists who want to know of techniques of power conversion by other than electromechanical means. The course starts with coverage of the full spectrum of modern power semiconductor devices, their characteristics - both static and switching, their drive circuit design and protection techniques including the snubber. Topologies of power electronic circuits for applications in controlled rectification, inversion, dc-dc conversion and ac-ac conversion, their control techniques and characteristics will then be treated. Effects of power electronic circuits on supply systems will also be covered.

ELEC4303
Electromagnetic Wave Propagation
Staff Contact: Dr I. Skinner
SS L2 T3
Prerequisite: ELEC2015

Fundamental concepts and analytical techniques of guided wave propagation. Transmission line theory, impedance matching, waveguide theory, coaxial lines, rectangular and circular waveguides. Poynting theorem. Troposheric and ionospheric propagation. Basic antenna theory. Aperture antennas. Phase arrays.

ELEC4313
Optical Communications
Staff Contact: Prof P.L. Chu
SS L2 T3
Prerequisite: ELEC3013

Theory of multimode and single mode optical fibres. Measurements of fibre characterisation calculation of fibre bandwidth optical sources and transmitters. Optical detectors and receiver design. Power Budget calculation.

ELEC4323
Digital and Analog Communications
Staff Contact: A/Prof I. Korn
SS L2 T3
Prerequisites: ELEC3013, MATH3150, MATH2859

Theory and practice of modern digital and analog communications systems. Sampling, digital multiplexing, pulse shaping. Nyquist's criteria, error probability. Analog to digital convertion, quantisation and companding, pulse code modulation, delta modulation. Transmission media, line coding, digital carrier systems, signal space, optimun detection. Information theory, (channel capacity, source coding, compact codes, error control coding). Analog modulation: amplitude modulation, angle modulation. Multilevel transmission, minimum shift keying, matched filters, correlation receivers.

ELEC4333
Communications Systems 2
Staff Contact: Prof T.B. Vu
SS L2 T3
Prerequisites: ELEC3013, ELEC3016

Modern communications systems from a systems point of view. Topics selected from: radar: Fundamentals of radio systems, CW radar, MTI and Pulse Doppler radar, tracking radar, synthetic aperture radar, electronic navigation aids, radio direction finding, VOR and dopper VOR, DME, hyperbolic systems of navigation aids, television systems: Monochrome and colour television systems, teletext, terrestrial and satellite TV transmission, the MAC transmission format and HDTV systems; satellite communications systems: satellite channel, antenna systems, effect of rainfall and atmospheric losses, receiver noise, link analysis, satellite transponders, FDMA, TDMA, CDMA, mobile satellite communications systems.

ELEC4351
Data Communication and Computer Networks
Staff Contact: Dr W.J. Dewar
SS L3 T2
Prerequisites: ELEC3013, ELEC3020

Data communications. Error detection coding and synchronisation. Physical layer standards and modems. IEEE-488 instrument bus. Principles of data networks and queuing theory. HDLC data link layer. ISDN and X.25 packet switching. Local area networks. Contention and token passing systems. Laboratory work covers experiments on physical, data link and network layer protocols in a practical network.

ELEC4352
Data Networks 2
Staff Contact: H. Mehrpour
SS L3 T2
Prerequisite: ELEC4351

Data transmission on telephone networks. High speed Local Area Networks (HSLANs) and Metropolitan Area Networks (MANs). Local area network interconnection. Protocol modelling and verification techniques. Analysis of protocols for data link, network and transport layers. TCP/IP protocols. Operating system views of communications; network protocol drivers, network servers.

ELEC4412
Systems and Control 2
Staff Contact: Prof N.W. Rees
SS L2 T3
Prerequisites: ELEC3012, ELEC3014
Notes: ELEC4432 recommended prerequisite.

This subject discusses the analysis and design of control systems using both classical and state-space design methods. The course covers: Process modelling by physical analysis. Experimental methods and system identification. Classical PID control and discrete PID implementation. Classical frequency response and root locus design for continuous systems. Discrete and continuous state space theory, controllability, observability, solution of state equations. State variable feedback pole placement. Observers. Optimal control. Multivariable transfer function models. Decoupling control. Relative gain array.

ELEC4413
Digital Control
Staff Contact: Dr D.J. Clements
SS L2 T3
Prerequisites: ELEC3014, MATH2849, MATH2859
Notes: ELEC4412 recommended prerequisite.

Covers the design and implementation of digital control systems. The topics covered include: identification of discrete-time model parameters; pole placement and lineal-quadratic controller design; observers; noise models and stochastic systems; minimum valiance controllers; Kalman filtering; LQG control; introduction to ideas of adaptive control and robustness. Aspects of implementation are constantly emphasized.

ELEC4432
Computer Control and Instrumentation
Staff Contact: Dr K.W. Lim
SS L2 T3
Prerequisites: ELEC3014, ELEC3020,
Notes: ELEC3016 recommended prerequisite.

Design, evaluation and implementation of computer and microprocessor based control systems and instrumentation. The program is laboratory intensive. Topics covered include software systems for process control, the organisation of hardware systems for computer control, programmable logic controllers, robust implementation of digital controllers, smart sensors and instrumentation networks.

ELEC4483
Biomedical Engineering
Staff Contact: A/Prof B.G. Celler
SS L2 T3
Prerequisites: ELEC3402, ELEC3014, ELEC3016

Application of signals and systems theory to the analysis and computer modelling of dynamic properties of physiological systems. Topics include descriptions of typical biomedical signals, statistical properties of signals, optimal filtering of physiological signals, ARIMA stochastic models of time series, forecasting or prediction methods, estimation of transfer function - noise models using least squares procedures, identification of multivariable nonlinear systems, computer modelling of stochastic signals and dynamic systems, and physiological adaptive control processes. Several laboratory experiments will be run concerned with computer simulation and analysis of models of cardiac, respiratory and nervous systems.

ELEC4503
Advanced Electronic Circuits
Staff Contact: Prof G.A. Rigby
SS L2 T3
Prerequisites: ELEC2020, ELEC3011 (ELEC3016 recommended)

Electronic devices circuits and subsystems for use in communications and signal processing. The emphasis is on high performance applications which require an understanding of device behaviour and advanced circuit design techniques. Topics include: high frequency models for bipolar and field effect devices, noise in systems, tuned amplifiers, power amplifiers, controlled gain amplifiers, AGC, multipliers, modulators and phase-locked loops.

ELEC4512
Semiconductor Devices
Staff Contact: Prof M.A. Green
SS L2 T3
Prerequisite: ELEC3011

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.

ELEC4522
Microelectronics Design and Technology
Staff Contact: Dr C.Y. Kwok
SS L2 T3
Prerequisites: ELEC3011, ELEC3016

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: S&TTL 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.

ELEC4532
Integrated Digital Systems
Staff Contact: Prof G.R. Hellestrand
SS L2 T3
Prerequisites: ELEC2012 or COMP2021

Integrated circuit logic families with emphasis on MOS technologies, 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.

ELEC4540
Applied Photovoltaics
Staff Contact: Dr S.R. Wenham
SS L2 T3

The use of solar cells (photovoltaic devices) as electrical power supplies based on the direct conversion of sunlight into electricity. The emphasis is placed on applications including system design and construction, although the properties of sunlight, the operating principles of solar cells and the interaction between sunlight and the cells are also treated.

ELEC4903
Industrial Training
Staff Contact: Dr D. Sutanto
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.

Students will formally enrol in this subject as part of the program for year 4.

ELEC4910
Thesis Part A
Staff Contact: Dr D.H. Irving
S1 HPW6

ELEC4911
Thesis Part B
Staff Contact: Dr D.H.Irving
S2 HPW12

This is done in the last two sessions of the BE degree course. for full-time students, six hours per week in the first session, and twelve 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.

Graduate Study

The formal graduate courses offered are: Master of Engineering Science in Electrical Engineering **8501**; Graduate Diploma in Electrical Engineering **5458**. Opportunities are provided for graduate research leading to the award of the degrees of Master of Engineering **2660**, Master of Science **2760** and Doctor of Philosophy **1640**.

Course Work Programs

8501
Master of Engineering Science in Electrical Engineering

MEngSc

Candidates may commence in Session 1 or Session 2 and must 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: 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

Program Co-ordinator: Dr R.A. Zakarevicius
Programs:
1. Communication Electronics
2. Digital Communication and Systems
3. Microwave and Optical Communications
4. Signal Processing

Electric Power

Program Co-ordinator: Dr T.R. Blackburn
Programs:
1. Power Systems Engineering
2. Electrical Power Technology

Electronics

Program Co-ordinator: Dr R.S. Huang
Programs
1. Solid State Devices
2. Microelectronics
3. Photovoltaics

Systems and Control

Program Co-ordinator: Professor N.W. Rees
Programs:
1. Digital Systems and Control
2. Cybernetic Engineering and Advanced Robotics
3. Biomedical Engineering (see co-ordinator)

Programs listed would normally consist of 12 or 18 credits of course work and correspondingly a 12 or 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 30 credits by course work only.

Specialist Programs

Communications

Candidates must normally do 18 credits from the Communications area (an 18 credit project or 18 credits of coursework within one of the following programs).

1. Communication Electronics
One elective subject may be chosen from outside this program.

Compulsory subject		**C**
ELEC9340	Communication Electronics	3
Elective subjects		
COMP9215	VLSI System Architecture and Design	3
COMP9221	Microprocessor Systems	3
ELEC9338	Television Systems	3
ELEC9341	Signal Processing 1 – Fundamental Methods	3
ELEC9343	Principles of Digital Communications	3
ELEC9353	Microwave Circuits: Theory and Techniques	3
ELEC9354	Microwave and Optical Devices	3
ELEC9403	Real Time Computing and Control	3
ELEC9503	Integrated Circuit Design	3

2. Digital Communication and Systems
At least three subjects must be taken from the following list and the remaining subjects from other graduate programs within the Department and School.

ELEC9336	Digital Communication Networks	3
ELEC9337	Data Networks 2	3
ELEC9338	Television Systems	3
ELEC9343	Principles of Digital Communications	3
ELEC9347	Digital Modulation	3

3. Microwave and Optical Communications
One of the three elective subjects may be chosen from outside this program.

Compulsory subjects		
ELEC9350	Theory of Optical Fibres and Optical Signal Processing	3
ELEC9351	Propagation and Transmission of Electromagnetic Waves	3
ELEC9354	Microwave and Optical Devices	3

Elective subjects		C
ELEC9352	Antenna Design and Applications 3	3
ELEC9353	Microwave Circuits: Theory and Techniques	3
ELEC9355	Optical Communications Systems	3

4. Signal Processing
One of the four elective subjects may be chosen from outside the program.

Compulsory subjects		
ELEC9341	Signal Processing 1 – Fundamental Methods	3
ELEC9342	Signal Processing 2 – Advanced Techniques	3
Elective subjects		
ELEC9340	Communications Electronics	3
ELEC9343	Principles of Digital Communications	3
ELEC9350	Theory of Optical Fibres and Optical Signal Processing	3
ELEC9370	Digital Image Processing Systems	
MATH5054	Advanced Mathematics for Electrical Engineers	3

Electric Power

Normally 12 or 18 credits of coursework and an 18 or 12 credit project as appropriate. A program in another area offered by the School may be substituted for the project.

At least three subjects should be chosen from one of the two programs below (items 1 and 2), with the remainder from the other program or from the list of relevant subjects in item 3.

1. Power Systems Engineering		C
ELEC4202	Power Engineering 1	3
ELEC4215	Industrial Electrical Systems	3
ELEC9201	Power System Planning and Economics	3
ELEC9202	Power Systems Operation and Control	3
ELEC9203	Power System Analysis	3
ELEC9204	Protection of Power Apparatus and Systems	3
ELEC9222	Power Engineering Seminars (Occasional Elective)	3

2. Electrical Power Technology		
ELEC4202	Power Engineering 1	3
ELEC4215	Industrial Electrical Systems	3
ELEC9204	Protection of Power Apparatus and Systems (Occasional Elective)	3
ELEC9214	Power System Equipment	3
ELEC9215	Fields and Materials	3
ELEC9231	Electrical Drive Systems	3
ELEC9226	Electrical Services in Buildings	3

3. Relevant Subjects from other areas and disciplines
Relevant coursework subjects from other areas and disciplines are listed below. A limited number of credits from this group may be taken as part of an Electric Power program. Subject to the approval of the Postgraduate Advisor, a limited number of other elective subjects offered in the School of Electrical Engineering may also be included in the program.

		C
ACCT9062	Accounting for Engineers	3
COMP9221	Microprocessor Systems	3
ELEC4240	Power Electronics	3
ELEC9401	Computer Control Systems 1	3
ELEC9504	Solar Energy Conversion	3
ELEC9507	Solar Cells and Systems	3
MANF9400	Industrial Management	3
MANF9660	Energy Modelling, Optimization and Accounting	3
MECH9740	Power Plant Engineering	3
MECH9741	Energy Conservation and Systems Design	3
MECH9742	Power Production Assessment	3
SAFE9213	Introduction to Safety Engineering M	3
ELEC9224	Special Topics in Power (when available)	2 or 3

Electronics

Normally 12 or 18 credits of coursework and an 18 or 12 credit project as appropriate. At least three subjects should be chosen from one of the programs below.

The remaining subjects may be chosen from one of the program lists or from the list of electives appropriate to that program.

Subject to the approval of the Electronics Department Program Co-ordinator, previously listed, a limited number of other subjects outside these lists may also be included in the program.

1. Solid State Devices		C
ELEC4540	Applied Photovoltaics	3
ELEC9354	Microwave and Optical Devices	3
ELEC9501	Advanced Semiconductor Devices	3
ELEC9502	Integrated Circuit Technology	3
ELEC9504	Solar Energy Conversion	3
ELEC9507	Solar Cells and Systems	3

2. Microelectronics		
COMP9215	VLSI Systems Architecture Design	3
ELEC9340	Communication Electronics	3
ELEC9501	Advanced Semiconductor Devices	3
ELEC9502	Integrated Circuit Technology	3
ELEC9503	Integrated Circuit Design	3
Additional elective subjects for both programs:		
COMP9221	Microprocessor Systems	3
ELEC4532	Integrated Digital Systems	3
ELEC4540	Applied Photovoltaics	3
ELEC9341	Signal Processing 1 – Fundamental Methods	3
ELEC9342	Signal Processing 2 – Advanced Techniques	3
ELEC9343	Principles of Digital Communications	3
ELEC9353	Microwave Circuits: Theory and Techniques	3

3. Photovoltaics		
ELEC4540	Applied Photovoltaics	3
ELEC9501	Advanced Semiconductor Devices	3
ELEC9502	Integrated Circuit Technology	3
ELEC9504	Solar Energy Conversion	3
ELEC9507	Solar Cells and Systems	3
ELEC9508	High Efficiency Silicon Solar Cells	3
Additional electives for the above program:		
COMP9221	Microprocessor Systems	3
ELEC4202	Power Systems	3
ELEC4240	Power Electronics	3
ELEC9201	Power System Planning and Economics	3

		C
ELEC9202	Power System Operation, Control and Protection 3	
MECH9720	Solar Thermal Energy Design	3
MECH9741	Energy Conservation and Systems Design	3
SAFE9213	Introduction to Safety Engineering M	3

Systems and Control

1. Digital Systems and Control
Normally 18 credits of course work and a 12 credit project.

Compulsory subjects		C
ELEC9401	Computer Control Systems 1	3
ELEC9402	Computer Control Systems 2	3
ELEC9403	Real Time Computing and Control	3
ELEC9404	Topics in Digital Control	3
Elective subjects		
COMP9221	Microprocessor Systems	3
ELEC9342	Signal Processing 2 – Advanced Techniques	3
ELEC9405	Advanced Control Topics	3
ELEC9410	Robotics, Automation and Productivity Technology	3
ELEC9415	Optimization and Optimal Control	3
ELEC9416	Non-Linear Systems and Simulation	3

2. Cybernetic Engineering and Advanced Robotics
Normally 9 credits of course work and a 12 credit project. Remaining 9 credits may be taken from the elective list or other programs and subjects.

Compulsory subjects		
ELEC9407	Cybernetic Engineering	3
ELEC9409	Cybernetic, Machine and Robot Vision	3
ELEC9410	Robotics, Automation and Productivity Technology	3
Elective subjects		
COMP9221	Microprocessor Systems	3
ELEC9342	Signal Processing 2 – Advanced Techniques	3
ELEC9370	Digital Image Processing Systems	3
ELEC9403	Real Time Computing and Control	3
ELEC9405	Human Movement Control Systems	3

5458
Graduate Diploma in Electrical Engineering

GradDip

Details of the recommended programs of study may be obtained from the Head of the School of Electrical Engineering. Subjects offered in the Masters programs can be taken in the Graduate Diploma programs subject to the approval of the course coordinator.

In addition the following subjects are offered specially for Graduate Diploma candidates. Not all electives are necessarily offered in any particular year.

		C
ELEC9224	Special Topic in Power	2
ELEC9225	Special Topic in Power	2
ELEC9411	Introductory Physiology for Engineers	3

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

Department of Electric Power Engineering

ELEC9201
Power System Planning and Economics
Staff Contact: A/Prof H.R. Outhred
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.

ELEC9202
Power Systems Operation and Control
Staff Contact: Dr R.J. Kaye
C3

Introduction to the main techniques currently used in the operation and control of power systems, including operations planning. Current trends in the evolution of the structure of electricity industries in various parts of the world and their implications for power system operations. The subject is in three parts: A: Practices in Power System Operation and Control, B: Trends in Power Industry Structure, C: Operations and Scheduling in a Decentralised Power System.

ELEC9203
Power System Analysis
Staff Contact: Dr D. Sutanto
C3 S2
Prerequisite: Assumed knowledge ELEC4202 or equivalent
Notes: 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.

ELEC9204
Protection of Power Apparatus and Systems
Staff Contact: Prof I.F. Morrison
C3
Prerequisite: Assumed knowledge ELEC4202 or equivalent

Overview of the analytical procedures and applications of relaying techniques in power system protection. Aims and purposes of protection. Fault calculations and symmetrical components. Fuses. Overcurrent relays and grading. Earth fault protection. Differential protection. Transformer protection. CT and VT requirements - transient and steady-state responses. Bushar protection. High impedance faults. Pilot-wire feeder protection. Protection of capacitor banks. Motor protection. Generator protection. Transmission line protection. Back-up protection.

ELEC9214
Power System Equipment
Staff Contact: Dr T.R. Blackburn
C3
Prerequisite: Assumed knowledge ELEC4202 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.

ELEC9215
Fields and Materials
Staff Contact: Dr T.R. Blackburn
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.

ELEC9221
Special Topic in Power
Staff Contact: Prof I.F. Morrison
C3

This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

ELEC9222
Special Topic in Power
Staff Contact: Prof I.F. Morrison
C3

This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

ELEC9223
Power Engineering Seminar
Staff Contact: Dr R.J. Kaye, Prof I.F. Morrison
C3

Weekly seminars given by members of the staff, postgraduate students and invited speakers, covering aspects of power and energy engineering. Outside speakers will be drawn from other universities, research institutions and industry. The purpose of the course is to expose students to the range of research and development activities within the power engineering discipline.

ELEC9224
Special Topic in Power
Staff Contact: Prof I.F. Morrison
C2

The content of this subject changes to allow presentation of a special topic of current interest in a short course format.

ELEC9225
Special Topic in Power
Staff Contact: Prof I.F. Morrison
C2

The content of this subject changes to allow presentation of a special topic of current interest in a short course format.

ELEC9226
Electrical Services in Buildings
Staff Contact: Dr D. Sutanto
C3
Prerequisite: Assumed knowledge: ELEC3010, ELEC3015

Principles, standards and current technology involved in the provision of electrical services in large buildings. Distribution. Wiring/Cabling. Protection. Voltage considerations. Lighting DEsign. Sub-system design (security, fire, communications). Emergency supplies. Lightning protection. Energy management. Building Monitoring Systems. Documentation and Contracts.

ELEC9231
Electrical Drive Systems
Staff Contact: A/Prof C. Grantham, Dr F. Rahman
C3
Notes: Excluded ELEC4216

Electrical Drive Systems. Elements of Drive Systems and their requirements for servo and industrial drive applications. Drive representation, quadrant operation, dynamic and regenerative braking. Transfer function representations of dc motor and converter and drive performance analysis. Space vector representation. Performance analysis of induction motor drives with variable voltage, voltage source, current source and variable frequency supply. Performance analysis of synchronous and reluctance motors with variable frequency supply. Transducers in electric drive systems. Computer aided design. Slip power recovery schemes for

induction motor drives. Vector controlled induction motor drives. Brushless DC drives.

Department of Communications

ELEC9330
Special Topic
Staff Contact: Dr R.A. Zakarevicius
C3

This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

ELEC9336
Digital Communication Networks
Staff Contact: Prof T.B. Vu
C3
Notes: Excluded ELEC9337, ELEC4351, ELEC4352.

Introduction to data communication. Analog versus digital transmission. Transmission media. LAN's; WAN's, ISDN. Protocols: IEEE standards for LAN's; fibre optic networks; satellite networks. OSI reference model. Some design issues and examples: topics include error detection and correction; routing and congestion control; internetworking; connection management; data representation and coding; file management; electronic mail.

ELEC9337
Data Networks 2
Staff Contact: Dr W.J. Dewar
C3
Prerequisite: ELEC4351.

Data transmission on telephone networks. Local area network interconnection. Analysis of protocols for data link, network and transport layers. TCP/IP protocols. Operating system views of communications; network protocol drivers, network servers.

ELEC9338
Television Systems
Staff Contact: Dr R.A. Zakarevicius
C3
Prerequisites: ELEC9351, ELEC9341
Notes: Excluded ELEC4333.

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.

ELEC9340
Communication Electronics
Staff Contact: Dr R.A. Zakarevicius
C3
Prerequisite: Assumed knowledge ELEC3016 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.

ELEC9341
Signal Processing 1 – Fundamental Methods
Staff Contact: Dr R. Radzyner, A/Prof W.H. Holmes
C3
Notes: Excluded ELEC4042.

Analysis and processing of analogue and digital signals with emphasis on digital methods. The topics covered are: Convolution, correlation, energy and power density spectra for signals and linear systems; sampling and analogue to digital conversion; the discrete Fourier transform (DFT) and fast Fourier transform (FFT) algorithms and applications;fundamentals of digital filter design and realization; finite word length effects in digital filters; digital processing of analogue signals, especially implementations on programmable digital signal processing (DSP) chips.

ELEC9342
Signal Processing 2 – Advanced Techniques
Staff Contact: Dr R. Radzyner, A/Prof W.H. Holmes
C3
Prerequisite: ELEC4042, ELEC9341 or similar

Advanced techniques and applications of digital signal processing. Topics covered are: advanced frequency domain signal analysis, including spectral estimation; advanced digital filtering methods: signal processing with finite word lengths; sampling rate conversion and multirate signal processing; least square detection and estimation methods,including linear prediction; adaptive filtering in detection and estimation problems; nonlinear digital signal processing; two and three dimensional signal processing; applications in communications, control, radar, sonar and in the processing of speech, audio, image and seismic signals (e.g. equalization, echo cancellation, noise reduction , deconvolution).

ELEC9343
Principles of Digital Communications
Staff Contact: A/Prof I. Korn
C3
Prerequisite: ELEC3012 or similar
Notes: Excluded ELEC4323.

Random variables:Probability density, probability distribution and characteristic functions; averages and moments. Random processes: Autocorrelation and power spectral density. Modulation and detection of binary and M-ary symbols: Error probability, bandwidth, energy-to-noise ratio and complexity. Information Theory; Entropy, source coding, mutual information, channel capacity. Coding theory; Block, cyclic and convolutional codes; Viterbi decoding; Trellis coded modulation.

ELEC9347
Digital Modulation
Staff Contact: A/Prof I. Korn
C3
Prerequisite: ELEC9343 or similar

A research orientated, advanced treatment of digital modulation and detection in Gaussian and fading channels.

Modulation includes: M-ary ASK, PSK, DPSK, QASK, OQASK, FSK and CPM (including MSK).

Detection includes: coherent, partially coherent and noncoherent like differential phase detection for DPSK, FSK and CPM and limiter-discriminator detection and limiter-discriminator-integrator detection for FSK and CPM. Channels include: Gaussian, Rician (Satellite Mobile), Rayleigh (Land Mobile) with frequency selective fading and Doppler frequency shifts. Analysis and design includes: probability of error formulas and bounds; power spectral density and bandwidth; effect of intersymbol, cochannel and adjacent channel interference; symbol constellations, eye diagrams, equalization; partial response, full response and Nyquist signals; complexity and comparisons.

ELEC9350
Theory of Optical Fibres and Optical Signal Processing

Staff Contact: Prof P.L. Chu
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.

ELEC9351
Propagation and Transmission of Electromagnetic Waves

Staff Contact: Dr E.H. Fooks
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 difference method. Tropospheric and ionospheric propagation. Basic antenna theory. Aperture antennas. Phased Arrays.

ELEC9352
Antenna Design and Applications

Staff Contact: Prof T.B. Vu
C3
Prerequisite: ELEC9351

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.

ELEC9353
Microwave Circuits: Theory and Techniques

Staff Contact: Dr E.H. Fooks
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.

ELEC9354
Microwave and Optical Devices

Staff Contact: Dr R.A. Zakarevicius
C3

Principles and applications of microwave amplifying and control devices. Includes microwave transistors, Gunn and impatt diodes and recent developments in ultra high speed transistors. Principles and applications of optical sources and detectors. Includes lasers, LEDS, optical detectors.

ELEC9355
Optical Communications Systems

Staff Contact: Prof P.L. Chu
C3
Prerequisites: ELEC9350, ELEC9354

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.

ELEC9370
Digital Image Processing Systems

Staff Contact: Dr C.J.E. Phillips
C3

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.

Department of Systems and Control

ELEC9401
Computer Control Systems 1

Staff Contact: A/Prof P.D. Neilson
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.

ELEC9402
Computer Control Systems 2
Staff Contact: A/Prof P.D. Neilson
C3
Prerequisite: ELEC9401

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.

ELEC9403
Real Time Computing and Control
Staff Contact: Dr T Hesketh
C3
Prerequisites: ELEC9401 or assumed knowledge equivalent to ELEC4432 or ELEC4413

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.

ELEC9404
Topics in Digital Control
Staff Contact: Prof N.W. Rees
C3
Prerequisites: ELEC9401, ELEC9402

Possible modules include: identification, estimation, multivariable systems, robust control, optimatisation, adaptive control, biomedical applications, instrumentation and sensors, robotics, industrial design case studies, variable structure systems, expert systems and fuzzy control.

ELEC9405
Advanced Control Topics
Staff Contact: A/Prof P.D. Neilson
C3
Prerequisites: ELEC9401, ELEC9402

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.

ELEC9407
Cybernetic Engineering
Staff Contact: A/Prof K.E. Tait
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; neural networks and neural computing; the albus approach to robotics, anthropomorphic robots; the social consequences of the dual evolution of robots.

ELEC9409
Cybernetic, Machine and Robot Vision
Staff Contact: A/Prof K.E. Tait
C3
Prerequisite: Assumed knowledge ELEC9370 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.

ELEC9410
Robotics, Automation and Productivity Technology
Staff Contact: A/Prof K.E. Tait
C3

Principles of Robotics relevant to trends in automating the manufacturing process. Such aspects as arm configurations, dynamics and control with relevant sensing methods; assembly and control together with trends in artificial intelligence for Robotics are discussed.

ELEC9411
Introductory Physiology for Engineers
Staff Contact: A/Prof B.G. Celler
C3 S1 L2 T2
Notes: Excluded ELEC3402.

This subject is intended primarily for Biomedical Engineering students. It is compulsory for Strand A, part-time students ONLY who are unable to do PHPH2112.

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.

ELEC9412
Biological Signal Analysis
Staff Contact: A/Prof P.D. Neilson
C3
Notes: Excluded ELEC9341.

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.

ELEC9415
Optimisation and Optimal Control
Staff Contact: Dr D.J. Clements
C3 SS
Prerequisites: 1 undergraduate Control subject plus MATH2501

Constrained and unconstrained optimisation, Euler, Bernouli, Lagrange. Linear quadratic and geometrical programming techniques, the simplex method, Kuhn-Tucker necessary conditions, gradient methods. Dynamic optimisation, dynamic programming, the optimum principle. Design control systems by optimisation methods, optimisation of parameters, decoupling and other methods. Introduction to integer programming.

ELEC9416
Non-linear Systems and Simulation
Staff Contact: Prof N.W. Rees
C3 SS
Prerequisites: 1 undergraduate Control subject plus MATH2501

Dynamic and static non-linear systems; Non-linear control, phase plane, describing function, stability, Liapunov, Popov and the circle criterion, special systems. Simulation and Non-linear systems, numerical methods, simulation languages and shells, CACE, intelligent interfaces, discrete event simulation.

Department of Electronics

ELEC9501
Advanced Semiconductor Devices
Staff Contact: Prof M.A. Green
C3
Notes: Excluded ELEC4512.

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.

ELEC9502
Integrated Circuit Technology
Staff Contact: Dr R.S. Huang
C3

Technologies for the fabrication of bipolar, CMOS, and BiCMOS VLSI integrated circuits. Includes technology modules of Crystal growth, wafer preparation, maskmaking, photolithography, oxidation, diffusion, ion implantation, plasma processing, thin film deposition and metallization. Advanced technologies such as GaAs high speed IC and SOI for radiation hard or 3-D integration are briefly discussed. Process integration and the link of device physics, circuit design to technology development are emphasized.

ELEC9503
Integrated Circuit Design
Staff Contact: Dr C.Y. Kwok
C3
Prerequisite: Assumed knowledge ELEC3016 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. Switch capacitor filters. Digital circuits include gates, compound functions, RAM, ROM, speed and power analysis. Economics and yield analysis for MSI, LSI and VLSI devices.

ELEC9504
Solar Energy Conversion
Staff Contact: Dr R.S. Huang
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.

ELEC9506
Special Topic in Electronics
Staff Contact: Dr R.S. Huang
C3

This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

ELEC9507
Solar Cells and Systems
Staff Contact: Dr. S. Wenham
C3
Prerequisite: ELEC4540 or similar

Harnessing of sunlight by using solar cells to convert it directly into electricity. The main emphasis is placed on applications including systems design, construction and operation with this subject building on the material introduced in the subject Applied Photovoltaics. Grid connected systems receive particular attention. Factors important in the design of solar cells are also studied with regard to their effects on spectral response, temperature sensistivity, resistive losses, current generation and open

circuit voltages. A range of solar cell technologies are considered both at the laboratory and commercial levels. Advanced concepts and designs for photovoltaic modules and batteries are considered. Experience will be gained with the computer aided design procedures for photovoltaic systems. Management and entrepreneurial approach in relation to starting a small business within the photovoltaic industry are considered.

ELEC9508
High Efficiency Silicon Solar Cells
Staff Contact: Prof M.A. Green
C3
Prerequisite: ELEC9501 (or equivalent)

This is an advanced level subject for those with a good background in semiconductor device physics and an interest in silicon solar cells or related devices. After a brief review of the crystal structure, energy bands and phonon spectra of silicon, the course examines silicon's optical, recombintation and transport properties in some detail. Next comes a discussion of efficiency limits upon photovoltaic energy conversion, with particular emphasis upon light trapping and the potential for exceeding conventional limits. After discussion of presently achievable surface and bulk material properties, the final section of the course studies in detail the design of silicon cells upon both crystalline and multicrystalline substrates and under concentrated and non-concentrated sunlight.

Project Reports

ELEC9912
Project Report
Staff Contact: A/Prof K.E. Tait
C12

The project is done in a major area, in which it is offered under the supervision of an academic member of staff. Where the work is carried out externally a suitable co-supervisor may be required. Projects can take many forms such as the design and construction of experimental equipment or a theoretical investigation. At the end of the work a comprehensive project report giving an account of the student's own research must be submitted. Information on the preparation of project reports is contained in the University Calendar. The 12 credit project is not available in all areas.

ELEC9918
Project Report
Staff Contact: A/Prof K.E. Tait
C18

As above. The 18 credit project is not available in all major areas.

School of Mechanical and Manufacturing Engineering*

*Incorporating Aerospace Engineering and Naval Architecture

Head of School
Professor B.E. Milton

Executive Assistant to Head of School
Dr E.M. Kopalinsky

Administrative Officer
Mr A.D. Bauman

The School comprises seven departments: **Aerospace Engineering** (design, manufacture, and operation of aircraft and spacecraft); **Applied Mechanics** (engineering mechanics and mechanics of solids); **Design** (conceptual design, machine systems design, optimization and failure analysis); **Fluid and Thermal Engineering** (energy utilization and power generation, refrigeration and air conditioning, gas and liquid handling); **Industrial Technology and Management** (economic analysis, production planning and control, product and process design, methods engineering and operations research); **Mechatronics** (interface between mechanical engineering and electronic engineering); **Naval Architecture** (analysis and design of marine vehicles such as ferries, catamarans, yachts and ships).

In addition, there are six Directed Programs of industry-oriented cross-disciplinary activity. These are Manufacturing and Automation; Mechanical Building Services; Maintenance Engineering; Energy and Power Systems; Vehicle and Transport Systems; Machine Systems Design.

The Centre for Advanced Numerical Computation in Engineering and Science and the Centre for Manufacturing and Automation are located in the School.

The School offers courses in Aerospace Engineering, Mechanical Engineering, Manufacturing Management and Naval Architecture, either singly or in combination with Science or Arts degree courses.

No formal part-time courses are offered by the School. However, it is possible for students to undertake studies with a reduced program. Students intending to take a reduced program are advised that very few undergraduate subjects are offered in the evening.

Formal graduate courses offered are: the Master of Engineering Science in Industrial Engineering **8531** and in Mechanical Engineering **8541**, and the Graduate Diploma in Industrial Engineering **5455** and Mechanical Engineering **5456**. Opportunities are provided for graduate research leading to the award of the degrees of Master of Engineering **2680** and **2692** and Doctor of Philosophy **1662**.

The Co-operative Program

The School offers the 'Co-op Program', an industry-linked course, for each of the above 4 degrees. In the Co-op Program, students are funded from scholarships awarded by Australia's premier industries.

Co-operative scholars are selected largely on the basis of academic attainment, personal skills and motivation, as well as on non-academic achievements. Together with receiving a rigorous and broadly-based academic education, scholars gain first-hand experience in a wide variety of industries during 5 industrial training periods. These take place at the end of year 1, end of year 2, second half of year 3, first half of year 4 and end of year 4. Hence, the total duration of the course is 5 years, comprising the normal 4 academic years and more than 1 year of experience in industry.

Because of this pattern, the normal third academic year is not taken over consecutive sessions but is incorporated into years 3 and 4 of the program. This twelve month period is spent at two different industries. Scholars must be prepared to sacrifice leisure during non-academic periods to gain the considerable practical training available.

Undergraduate Study

Course Outlines

Summary of Courses

The courses, which lead to the award of the degree of Bachelor of Engineering (BE) are planned to provide the appropriate academic training for the professional engineer in the fields of aerospace, manufacturing and mechanical engineering, and for the naval architect.

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 specialty.

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 Engineering, Manufacturing Management and Aerospace 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 year in the Mechanical Engineering course, in addition to core subjects and disciplinary requirements, provision is made for a limited degree of specialization in one or more elective subjects. A student with a good academic record may also take, subject to the approval of the Head of School, some 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.

General Education Program

Requirements for General Education elective and prescribed subjects are as follows: year 2 - one 56 hour or two 28 hour subject/s from Category A; year 3 - one 56 hour or two 28 hour subject/s from Category B. The key questions and issues to be addressed in Category C will be considered in the following subjects: MECH1000/ MECH2000/MECH3000/MECH4001 Professional Studies 1-4, MECH1100/MECH2100/MECH3100 Mechanical Engineering Design 1-3, MANF3400 Engineering Economics, MANF4400 Engineering Management, MECH4002 The Engineer in Society.

Industrial Experience

Industrial experience is an integral part of the courses. This can be taken within Australia or overseas. Students must complete forty working days of approved industrial experience between both years 2 and 3 and years 3 and 4. Students are strongly recommended to gain as much industrial experience as possible between years 1 and 2. Students who have had suitable experience in industry may qualify for exemption from certain subjects. The Head of School should be contacted for details.

Recognition

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 degree courses by overseas engineering institutions.

The award of the BE degree in Aerospace 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 BE degree 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

The student's attention is directed to the Faculty's General Rules for Progression contained in this Handbook. As well, the following points should be noted.

- 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 subjects must be chosen from the higher year's selection.
- The subjects MECH4000 Thesis and MECH4001 Professional Studies 4 can be taken only in the final year of a student's program.

3610
Aerospace Engineering

3663
Manufacturing Management

3680
Mechanical Engineering

3700
Naval Architecture

Bachelor of Engineering
BE

		HPW S1	HPW S2
Years 1 and 2 of all courses			
CHEM1807	Chemistry 1ME	6	0
MANF1100	Workshop Technology	3	0
MANF1110	Manufacturing Technology	0	3
MATH1032	Mathematics 1	6	6
MECH1000	Professional Studies 1	1	0
MECH1100	Mechanical Engineering Design 1	1	2
MECH1110	Graphical Analysis and Communication	0	3
MECH1300	Engineering Mechanics 1	4	0
MECH1400	Mechanics of Solids 1	0	3
MECH1500	Computing 1M	0	3
PHYS1919	Physics 1 (Mechanical Engineering)	4	4
Totalling		25	24

An alternative 'Science compatible' course which can be undertaken by all students, and which must be undertaken by potential combined degree BE BSc students, is:

		HPW S1	HPW S2
Year 1			
CHEM1807	Chemistry 1ME	6	0
MANF1100	Workshop Technology	3	0
MANF1110	Manufacturing Technology	0	3
MATH1032	Mathematics 1	6	6
MECH1000	Professional Studies 1	1	0
MECH1100	Mechanical Engineering Design 1	1	2
MECH1110	Graphical Analysis and Communication	0	3
MECH1300	Engineering Mechanics 1	4	0
MECH1400	Mechanics of Solids 1	0	3
PHYS1002	Physics 1	6	6
and			
CHEM1201	Chemistry 1B (required for Materials Science majors)	0	6
or			
COMP1011	Computing 1A (required for Computer Science majors)	0	6
or			
1 relevant level I unit from the School of Physics or Mathematics undergraduate offerings in the Science Handbook		0	6
Totalling		27	29

		HPW S1	HPW S2
Year 2			
ELEC0805	Electronics for Measurement and Control	0	3
MATH2009	Engineering Mathematics 2	4	4
MATH2839	Statistics SM	2	2
MATS9520	Engineering Materials	3	0
MECH2000	Professional Studies 2	0	0
MECH2100	Mechanical Engineering Design 2	3	3
MECH2300	Engineering Mechanics 2A	3	0
MECH2310	Engineering Mechanics 2B	0	2
MECH2400	Mechanics of Solids 2	3.5	3.5
MECH2600	Fluid Mechanics 1	2	2
MECH2700	Thermodynamics 1	2	2
General Education subject/s (Cat A)		2	2
Totalling		24.5	23.5

For MATH2009 students may substitute MATH2501, MATH2510,MATH2100 and MATH2120. Also, if they satisfy prerequisites, they may take one or more of these at the higher level.

3610
Aerospace Engineering

Bachelor of Engineering
BE

Years 3 and 4

The Aerospace Engineering course covers the analysis, design and operation of aircraft and spacecraft. Graduates work mainly on the design and manufacture of flight vehicles, their operation with major or satellite airlines and research for civil and military aerospace organisations. Owing to the international nature of the aerospace industry, the topics studied cover a similar area and to, in general, the same depth of understanding as professional training programmes in aerospace in other industrial countries. The aerospace industry is one of Australia's major exporters of high value added manufactured goods.

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 Aerospace Engineering.

		HPW S1	HPW S2
Year 3			
AERO3100	Aerospace Design 1	4	2
AERO3400	Analysis of Aerospace Structures 1	0	4
AERO3601	Aerodynamics 1	4	0
AERO3602	Flight Dynamics 1	4	0
ELEC0802	Electrical Power Engineering	0	3
MANF3400	Engineering Economics	2	0
MECH3000	Professional Studies 3	0	2
MECH3010	Industrial Training 1	0	0
MECH3200	Engineering Experimentation	1.5	1.5
MECH3211	Linear Systems	3	0

		HPW	
Year 3		S1	S2
MECH3212	Principles of Control of Mechanical Systems	0	3
MECH3310	Vibration Analysis	0	2
MECH3400	Mechanics of Solids 3	4	0
MECH3500	Computing 2M	2	0
MECH3800	Numerical Methods	0	3
General Education subject/s (Cat B)		2	2
Totalling		24.5	22.5
Year 4			
AERO4100	Aerospace Design 2	3	3
AERO4201	Aerospace Systems	2	0
AERO4202	Space Engineering	0	2
AERO4400	Analysis of Aerospace Structures 2	3	3
AERO4601	Aerodynamics 2	2	2
AERO4602	Flight Dynamics 2	3	0
AERO4700	Aerospace Propulsion	2	2
MANF4400	Engineering Management	2	0
MECH4000	Thesis	6	6
MECH4001	Professional Studies 4	0	2
MECH4002	The Engineer in Society	0	2
MECH4010	Industrial Training 2	0	0
Totalling		23	22

3663
Manufacturing Management

Bachelor of Engineering
BE

Years 3 and 4

The Manufacturing Management course is designed for students with engineering ability whose interests lie in the planning, development and control of manufacturing or service operations.

In the Manufacturing Management subjects, the problems associated with the practical economics of manufacturing operations are stressed. The aim is to provide students 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 Manufacturing Management. 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.

An engineer trained in Manufacturing Management may initially be employed in any of the following major areas of industrial activity: industrial economic analysis; planning and control of production; product and process design; methods engineering; operations research.

		HPW	
Year 3		S1	S2
ACCT9001/2	Introduction to Accounting A/B	1.5	1.5
MANF3200	Product Design and Manufacturing Technology	4	0
MANF3300	Design of Manufacturing Facilities	10	4
MANF3400	Engineering Economics	2	0
MANF3410	Quality Systems 1	4	0
MANF3500	Computers in Manufacturing 1	0	4
MANF3600	Information and Decision Making Technology 1	4	2
MANF3800	Introduction to Numerical Methods	0	1.5
MECH3000	Professional Studies 3	0	2
MECH3010	Industrial Training 1	0	0
MECH3211	Linear Systems	3	0
MECH3212	Principles of Control of Mechanical Systems	0	3
MECH3500	Computing 2M	2	0
General Education subject/s (Cat B)		2	2
Totalling		22.5	20
Year 4			
MANF4010	Manufacturing Systems Design	2	2
MANF4300	Design of Manufacturing Facilities 2	0	4
MANF4410	Quality Systems 2	2	0
MANF4420	Management of Manufacturing Systems	6	2
MANF4500	Computers in Manufacturing 2	2	0
MANF4600	Information and Decision Making Technology	4	0
MECH4000	Thesis	6	6
MECH4001	Professional Studies 4	0	2
MECH4002	The Engineer in Society	0	2
MECH4010	Industrial Training 2	0	0
Totalling		18	22

3680
Mechanical Engineering

Bachelor of Engineering
BE

Years 3 and 4

The Mechanical Engineering course provides a versatile, comprehensive coverage of areas involving the conception and design of machinery and mechanical plant, the supervision of its construction, operation and maintenance, the planning and supervision of large engineering projects, and general engineering management. Due to its wide range, a number of options are provided as Technical

Electives in the final year. These are preferentially linked to provide a direction appropriate to the needs of Australian industry and to the specific interests of students, although some flexibility is available if required. Typical fields which may be encompassed by the course include building services, computer-aided design, power generation, energy and environmental systems, gas and liquid handling, bio-mechanics, materials handling, control systems, mechatronics and robotics, and transport. An emphasis is placed on the application of engineering science, development and management in these fields.

		HPW	
Year 3		S1	S2
MECH3000	Professional Studies 3	0	2
MECH3010	Industrial Training 1	0	0
MECH3100	Mechanical Engineering Design 3	3	3
MECH3200	Engineering Experimentation	1.5	1.5
MECH3211	Linear Systems	3	0
MECH3212	Principles of Control of Mechanical Systems	0	3
MECH3300	Engineering Mechanics 3	2	0
MECH3310	Vibration Analysis	0	2
MECH3400	Mechanics of Solids 3	4	0
MECH3500	Computing 2M	2	0
MECH3600	Fluid Mechanics 2	2	0
MECH3701	Thermodynamics 2	0	2
MECH3702	Heat Transfer	2	0
MECH3800	Numerical Methods	0	3
MANF3400	Engineering Economics	2	0
ELEC0802	Electrical Power Engineering	0	3
General Education subject/s (Cat B)		2	2
Totalling		23.5	21.5
Year 4			
MANF4400	Engineering Management	2	0
MECH4000	Thesis	6	6
MECH4001	Professional Studies 4	0	2
MECH4002	The Engineer in Society	0	2
MECH4010	Industrial Training 2	0	0
MECH4500	Computing 3M	2	0
Program Options/Technical Electives12		9	
Totalling		22	19

Mechanical Engineering Technical Electives

Technical Electives must be chosen primarily in accordance with the Directed Program nominated by each student and, in any case, at least 12 session-hours must be selected from the Mechanical Engineering list. The remaining ones may be taken from years 3 or 4 of other courses in the School, provided that pre- and corequisites can be satisfied. Appropriate details of the Directed Programs and the recommended electives will be provided to students to enable them to make selections before proceeding to the final year. A student with a good academic record may be permitted to choose some post-graduate subjects as Technical Electives. Express approval is also required for the selection of a subject from outside the School and such choice will normally be limited to three session-hours. The selection of certain subjects or combinations of subjects might require the approval of the Head of School as will any variation from the foregoing guidelines.

It is unlikely that all of the Technical Electives listed below can be offered each year. Those to be made available 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.

		HPW	
Applied Mechanics		S1	S2
MECH4301	Plane Mechanism Kinematics	3	
	or		3
MECH4310	Advanced Vibration Analysis	3	
	or		3
MECH4321	Engineering Noise 1	3	0
MECH4322	Engineering Noise 2	0	3
MECH4361	Lubrication	0	3
MECH4400	General Mechanics of Solids	3	
	or		3
MECH4410	Engineering Applications of Finite Elements	3	
	or		3
MECH4420	Plates and Shells	3	
	or		3
MECH4430	Theory of Elasticity	3	
	or		3
MECH4440	Theory of Plasticity	3	
	or		3
MECH4450	Structural Instability	2	0
Design			
MECH4110	Design Project	3	3
MECH4120	Design Technology	3	0
MECH4130	Computer-Aided Engineering Design	0	3
Fluid and Thermal Engineering			
MECH4600	Viscous Flow Theory	3	
	or		3
MECH4690	Special Fluid Mechanics Elective	3	
	or		3
MECH4700	Turbomachines and Engines	3	
	or		3
MECH4710	Convection Heat Transfer	3	
	or		3
MECH4720	Solar Energy	3	
	or		3
MECH4730	Multiphase Flow	3	
	or		3
MECH4740	Thermal Power Plants	3	
	or		3
MECH4751	Refrigeration and Air Conditioning	3	
	or		3
MECH4790	Special Thermodynamics Elective	3	
	or		3
General			
MECH4020	Group Engineering Project	3	
	or		3
or			
MECH4800	Optimal Engineering Strategies	3	0
Recommended External Technical Electives			
MATS9530	Materials Engineering	3	
	or		3
SAFE9213	Introduction to Safety Engineering M	3	0

3700
Naval Architecture

Bachelor of Engineering
BE

Years 3 and 4
Naval Architecture is the branch of engineering which is concerned with the design, building and utilisation of all types of ships and marine vehicles. Naval architects must be conversant with a wide variety of skills, including most forms of engineering and architecture. This is because a ship or a boat must be a completely self-sufficient vehicle containing a number of systems and able to withstand the loads from the sea. Yachts, fishing boats, frigates, ferries, catamarans and pleasure craft are just a few of the types of vessels that are studied during the course, which is the only Naval Architecture degree (Bachelor) course in Australia.

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.

		HPW	
Year 3		S1	S2
NAVL3100	Principles of Ship Design 1	1.5	1.5
NAVL3400	Ship Structures 1	2	2
NAVL3600	Ship Hydrostatics	2.5	2.5
NAVL3610	Ship Hydrodynamics	2.5	2.5
MECH3000	Professional Studies 3	0	2
MECH3010	Industrial Training 1	0	0
MECH3200	Engineering Experimentation	1.5	1.5
MECH3211	Linear Systems*	3	0
MECH3212	Principles of Control of Mechanical Systems	0	3
MECH3310	Vibration Analysis	0	2
MECH3400	Mechanics of Solids 3	4	0
MECH3500	Computing 2M	2	0
MECH3800	Numerical Methods	0	3
ELEC0802	Electrical Power Engineering	0	3
General Education subject/s (Cat B)		2	2
Totalling		21.5	25
Year 4			
NAVL4000	Ship Management Economics	2	0
NAVL4100	Principles of Ship Design 2	4	2
NAVL4110	Ship Design Project	3	4
NAVL4400	Ship Structures 2	2	2
NAVL4700	Ship Propulsion and Systems	4	4
MECH4000	Thesis	6	6
MECH4001	Professional Studies 4	0	2
MECH4002	The Engineer in Society	0	2
MECH4010	Industrial Training 2	0	0
MECH4500	Computing 3M	2	0
Totalling		23	22

Combined Courses
Bachelor of Engineering/ Bachelor of Science

3611
BE BSc in Aerospace Engineering

3664
BE BSc in Manufacturing Management

3681
BE BSc in Mechanical Engineering

3701
BE BSc in Naval Architecture

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 compatible' course in the School may enrol directly into this course. Continued enrolment in year 2 requires a pass in all subjects by the end 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 passed all subjects of the 'Science compatible' course by the end of year 1.

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 Education requirements for the Science degree,

3. obtained approval from the Board of Studies in Science and Mathematics.

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 compatible' course in the School of Mechanical and Manufacturing 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 relevant undergraduate offerings in the Science Handbook, or in exceptional circumstances, some other equivalent subject with the permission of the Head of the School of Mechanical and Manufacturing Engineering.

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.

General Education requirements correspond to whatever is required in year 2 of the normal Mechanical Engineering, Manufacturing Management, Aerospace Engineering or Naval Architecture degree course.

Year 2
Years 2 and 3 are requirements pertaining to students who commenced year 1 in 1989 or later. Students who commenced in earlier years should consult the Handbook appropriate to their year.

All students should note that the Mathematics subjects are also offered at a higher level.

		HPW S1	HPW S2
MECH1500	Computing 1M	0	3
MECH2300	Engineering Mechanics 2A	3	0
MECH2400	Mechanics of Solids 2	3.5	3.5
MATH2100	Vector Calculus	2.5	0
MATH2120	Mathematical Methods for Differential Equations	0	2
MATH2501	Linear Algebra	2.5	2.5
MATH2510	Multivariable Calculus	2.5	0
MATH2520	Complex Analysis	0	2.5
	4.5 Level II units[1]	9+	9+
Totalling		23+	23+
Year 3			
MECH2000	Professional Studies 2	0	0
MECH2100	Mechanical Engineering Design 2	3	3
MECH2310	Engineering Mechanics 2B	0	2
MECH2600	Fluid Mechanics 1	2	2
MECH2700	Thermodynamics 1	2	2
At least 5 appropriate Level II or III units of which at least 4 must be Level III[1]		10+	10+
One 56-hr or two 28-hr General Education subject/s Cat A		2	2
Totalling		19+	21+

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

Computer Science Majors

Quota restrictions apply to certain Computer Science Level III units and application must be made in writing to the Head of the School of Computer Science and Engineering 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.

Year 2
COMP1021, COMP2011, COMP2021, COMP2031
MATH2501 (or MATH2601), MATH2510 (or MATH2610), MATH2520 (or MATH2620), MATH2100 (or MATH2110), MATH2120 (or MATH2130)
MATS9520
MECH2300, MECH2400, MECH1500[2]

Year 3
ELEC0805
MATH2841 (or MATH2839)
MECH2000, MECH2100, MECH2310, MECH2600, MECH2700
4 Level III units from undergraduate offerings of the School of Computer Science and Engineering for course **3681** in the Science Handbook.
One 56-hr or two 28-hr General Education subject/s Cat A.

Materials Science Majors

Year 2
CHEM2011[6], CHEM2021[6]
MATH2501 (or MATH2601), MATH2510 (or MATH2610), MATH2520 (or MATH2620) MATH2100 (or MATH2110), MATH2120 (or MATH2130)
MATS4363[3] (Units 1 and 3), MATS1002, MATS1253, MATS1072
MECH2300, MECH2400, MECH1500

Year 3
ELEC0805
MATH2841 (or MATH2839)
MATS4363 (Units 2 and 4), MATS9323[3] (Units 1 and 3), MATS1263, MATS1083, MATS1042
MECH2000, MECH2100, MECH2310, MECH2600, MECH2700
POLY3010
3 appropriate Level III units from the School of Materials Science and Engineering undergraduate offerings for course **3681**[3] in the Science Handbook.
One 56-hr or two 28-hr General Education subject/s Cat A.

Mathematics Majors

Year 2
Same year 2 as for Computer Science[4] or Materials Science[4] or Physics or Statistics[5] majors
or
ELEC0805
MATH2501 (or MATH2601), MATH2510 (or MATH2610), MATH2520 (or MATH2620), MATH2100 (or MATH), MATH2120 (or MATH2130)
MATS9520
MECH2300, MECH2400, MECH1500
3.5 appropriate Level II units from undergraduate offerings for course **3681** in the Science Handbook including some from the School of Mathematics[6].

Year 3
MECH2000, MECH2100, MECH2310, MECH2600, MECH2700, MATH2841 (or MATH2839)

4 Level III units from School of Mathematics undergraduate offerings in the Science Handbook.

One 56-hr or two 28-hr General Education subject/s Cat A.

Physics Majors

Year 2
MATH2501 (or MATH2601), MATH2510 (or MATH2610), MATH2520 (or MATH2620), MATH2100 (or MATH2110)
MATH2120 (or MATH2130)
MATS9520
MECH2300, MECH2400, MECH1500
PHYS2001, PHYS2011, PHYS2021, PHYS2031

Year 3
MATH2841 (or MATH2839)
MECH2000, MECH2100, MECH2310, MECH2600, MECH2700
PHYS3010[7], PHYS3021, PHYS3030[7], PHYS3041[7]
1 Level III unit from School of Physics undergraduate offerings in the Science Handbook.
One 56-hr or two 28-hr General Education subject/s Cat A.

Statistics Majors

Year 2
ELEC0805[6]
MATH2501 (or MATH2601), MATH2510 (or MATH2610), MATH2520 (or MATH2620), MATH2100 (or MATH2110), MATH2120 (or MATH2130), MATH2801 (or MATH2901), MATH2821 (or MATH2921), MATH2810 (or MATH2910), MATH2830 (or MATH2930)
MATS9520
MECH2300, MECH2400, MECH1500
0.5 appropriate Level II unit.[5]

Year 3
MECH2000, MECH2100, MECH2310, MECH2600, MECH2700
4 Level III units from Statistics undergraduate offerings in the Science Handbook
1 Level II or III unit from School of Mathematics or School of Physics undergraduate offerings in the Science Handbook.
One 56 hour or two 28 hour General Education subject/s Cat A.

Notes

1. The following considerations pertain to the choice of additional units in years 2 and 3 listed in undergraduate offerings in the Science Handbook:

(a) The Level III units satisfy the relevant major requirements.

(b) They be from the Schools of Chemistry, Computer Science and Engineering, Electrical Engineering, Mathematics, Materials Science and Engineering and/or Physics.

(c) They include MATH2841 Statistics or MATH2839 Statistics SM or MATH2821 Basic Inference.

(d) They include PHYS2031 Laboratory or ELEC0805 Electronics for Measurement and Control.

(e) They include MATS9520 Engineering Materials or MATS1253 Ferrous Alloys.

(f) They exclude MATH2301 Mathematical Computing.

(g) All pre and corequisites are satisfied.

2. With permission of the School of Mechanical and Manufacturing Engineering, students may delay this subject till year 3.

3. Provided MECH2400 is taken concurrently or has been taken, the pre or corequisite requirement of MATS1062 is assumed to be satisfied.

4. These Mathematics Majors need to add ELEC0805 Electronics for Measurement and Control to year 3.

5. These Mathematics Majors should substitute 1 Level II or III units from the Schools of Physics, Chemistry or Mathematics undergraduate offerings for MATH2841 Statistics in Year 3.

6. Students may substitute PHYS2031 Laboratory for ELEC0805 plus a 0.5 Level II unit.

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

8. Students who have satisfactorily completed CHEM1807 Chemistry 1ME and CHEM1201 Chemistry 1B will be considered to have satisfied the prerequisites for CHEM2011 Physical Chemistry and CHEM2021 Organic Chemistry.

Combined Courses
Bachelor of Engineering/Bachelor of Arts

3612
BE BA in Aerospace Engineering

3665
BE BA in Manufacturing Management

3682
BE BA in Mechanical Engineering

3702
BE BA in Naval Architecture

The BE BA Program

With these combined degree courses students can add their choice of an Arts program to any of the standard, professionally accredited engineering courses offered by the School of Mechanical and Manufacturing Engineering. The full range of Arts programs is available.

Because the Engineering and Arts programs have common content, such as mathematics and physics, only one more year of study is normally required to gain the additional qualification of Bachelor of Arts.

Eligibility

Anyone who meets the entry requirements for both Engineering and Arts is eligible for the combined course. Students may enter directly in year 1 or may apply to transfer from the normal engineering course later, although with late transfer it might not be possible to complete the course in minimum time.

Organization

The BE BA course is administered by the School of Mechanical and Manufacturing Engineering.

Students should start discussing their program with representatives of the School and the Faculty of Arts and Social Sciences as soon as possible - preferably well before enrolment. Enquiries should be directed to the Executive Assistant to the Dean of the Faculty of Arts and Social Sciences.

Students should work out for themselves the arts program they would like to add to their chosen engineering course. The Arts and Social Sciences Faculty Handbook describes the options, and the School of Mechanical and Manufacturing Engineering can supply sample programs showing what previous students have arranged.

There are no special rules on what to include in each year. Students should schedule the arts and engineering components to suit their preferences while meeting the constraints of timetables and prerequisites. The sample programs can help here too.

The Arts component must be approved by the Faculty of Arts and Social Sciences.

The final program and schedule must be approved by the School.

Rules

1. In addition to their chosen BE course, students must complete a major sequence offered within the BA course and meet the additional requirements from the Faculty which provides the chosen major. The required Arts credits points are:

Faculty of Arts and Social Sciences:
48 total including major sequence.

Other Faculties:
Major sequence plus at least 12 credit points from Schools of the Faculty of Arts and Social Sciences.

Mathematics majors are not usually permitted. BE BSc double degrees are more appropriate for this.

2. The requirements of the General Education Program must be met. In some cases subjects within the combined course may satisfy the Category A and/or Category B guidelines. Students should consult the Centre for Liberal and General Studies for advice.

3. There will be a testamur for each part of the combined degree course.

4. Students who complete the BE program first may proceed to graduation with the degree of Bachelor of Engineering in the usual way.

5. Students who complete the requirements for their Arts program and the first two years of the BE program may proceed to graduation with the degree of Bachelor of Arts.

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

Aerospace Engineering

AERO3100
Aerospace Design 1
Staff Contact: Mr J.R. Page
S1 HPW4 S2 HPW2
Prerequisites: MATS952, 0MECH2100, MECH2300, MECH2400
Corequisites: AERO3400, AERO3601, AERO3602

Introduction to the special constraints involved in the design of an aerospace vehicle. The development of detail design skills and the methodology of aerospace design. An introduction to airworthiness regulations, ESDU data sheets and the use of computer-aided design techniques. The production of engineering design reports on selected areas and the design work carried out.

AERO3400
Analysis of Aerospace Structures 1
Staff Contact: A/Prof D.W. Kelly
S2 L3 T1
Prerequisites: MECH2300, MECH2400, MATH2009
Corequisite: MECH3400

Aerospace applications of plane frames and space structures. Open and closed section thin walled beams, tapered beams. Semi-monocoque structures, ribs and bulkheads. Stresses due to torsion and shear in multicell tubes. DEflections. Structural instability, buckling of perfect and imperfect columns, bending and buckling of thin flat plates. Introduction to composite materials, sandwich panels.

AERO3601
Aerodynamics 1
Staff Contact: Dr N.E.A. Ahmed
S1 HPW4
Prerequisites: MECH2600, MECH2700, MATH2009
Corequisites: AERO3602
Notes: Excluded 5.811.

Potential flow. Airfoil and wing theory: Inviscid conservation relations. Source, sink, doublet and point vortex; superposition with uniform flow. Airfoil formation and Kutta condition. Computational methods. Lifting line and Prandtl

wing theory, spanwise lift, induced drag and downwash. Low speed aerodynamics: viscous boundary layers, transition, separation, wakes-Reynolds number. Form drag. Wind tunnels. Isolated airfoil characteristics. Cascade characteristics. One-dimensional gas flow. Conservation thermodynamics and sonic speed relations. Mach number. Isentropic, variable area flow. Diabatic, inviscid and viscous adiabatic channel flow. Normal shock waves. Supersonic wind tunnels and diffusers.

AERO3602
Flight Dynamics 1
Staff Contact: Mr J.R. Page
S1 HPW2
Prerequisites: MECH2300, MECH2310, MECH2600
Corequisite: AERO3601
Notes: Excluded 5.811.

Introduction to atmospheric and space environment; standard atmospheric gas law; pressure, temperature and density profiles; turbulence, gusts and atsmospheric disturbances. Aerospace vehicle performance: drag, drag power, thrust, thrust power, excess power. Minimum and maximum speeds and endurance. Climb rates and engineering height methods. Mission profiles. Longitudinal static stability; elevator control; balance and trim. Neutral and manoeuvre points and margins. Flight test measurements and handling qualities.

AERO4100
Aerospace Design 2
Staff Contact: Mr J.R. Page
F L2 T1
Prerequisites: AERO3100, AERO3601, AERO3602
Corequisites: AERO4400, AERO4601, AERO4602, AERO4700
Notes: Excluded AERO4109.

The students are formed into project teams to carry out initial design of an aerospace vehicle. A lecture program supports this work, along with tutorials and project team meetings.

AERO4201
Aerospace Systems
Staff Contact: Mr J.R. Page
S1 HPW2
Prerequisites: AERO3601, AERO3602, MECH3212, MECH3310
Corequisite: AERO4602

A basic understanding of information, power and mass transport systems used on current craft; how the systems inteface with the flight management on the vehicle.

AERO4202
Space Engineering
Staff Contact: Mr J.R. Page
S2 HPW2
Prerequisites: AERO3602
Corequisite: AERO4201

Introduction to the particular problems in vehicles that operate outside the sensible atmosphere. The dynamics of such vehicles, their on-board systems and their management and control.

AERO4400
Analysis of Aerospace Structures 2
Staff Contact: A/Prof D.W. Kelly
F L2 T1
Prerequisites: AERO3400, MECH3400
Notes: Excluded MECH4410, MECH9410.

Finite element analysis of aerospace structures. Selection of applications from linear and nonlinear elasticity using commercial finite element programs. Fracture mechanics including residual strength of cracked components, crack growth, arrest and damage tolerance. Introduction to aeroelasticity. Thermal stresses. Advanced analysis of composite structures.

AERO4601
Aerodynamics 2
Staff Contact: Dr N.E.A. Ahmed
F L1.5 T.5
Prerequisite: AERO3601
Notes: Excluded AERO4609.

Concentrates on high-speed flow and viscous compressible flows. As well as obtaining a good theoretical grounding, the student is introduced to the measurement of the properties of these flows in the laboratory and the use of computer modelling techniques (CFD).

AERO4602
Flight Dynamics 2
Staff Contact: Mr J.R. Page
S1 L2 T1
Prerequisites: AERO3602, MECH3211
Notes: Excluded AERO4609.

An introduction to the dynamic stability and control of atmospheric vehicles, including an understanding of the characteristics of such vehicles, and their testing in flight and evaluation.

AERO4700
Aerospace Propulsion
Staff Contact: Mr J.R. Page
F L1.5 T.5
Prerequisites: MECH2600, MECH2700 or AERO3601

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

Manufacturing Management

MANF0420
Production Management
Staff Contact: Prof H. Kaebernick
S1 HPW6

Manufacturing industry dynamics. Porters Model; bases for competition. Meaning of waste; value adding management. Dynamics of materials flow. Hierarchical planning; MRP; OPT; JIT; maintenance management. Manufacturing performance monitoring. Use of production planning and control systems in a simulated production company.

MANF1100
Workshop Technology
Staff Contact: Dr Y.L. Yao
SS HPW3

The implementation of design and its interaction with manufacturing equipment and processes. Manufacturing capabilities and tolerancing. Approximately 30 hours of practical training including 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.

MANF1110
Manufacturing Technology
Staff Contact: Dr P. Mathew
S2 HPW3
Corequisites: MECH1100, MECH1300, MECH1400

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.

MANF3200
Product Design and Manufacturing Technology
Staff Contact: Dr L.E. Farmer
S1 HPW4
Corequisites: MECH2100, MECH2400, MANF3410
Notes: Excluded 18.403.

Design of products so that they can be manufactured economically. Material on: geometric analysis of product designs and the technology and economics of manufacturing, assembly, storage and transportation processes provides a basis for rational process selection and the refinement of product design to suit the chosen manufacturing methods.

MANF3300
Design of Manufacturing Facilities 1
Staff Contact: Dr L.E. Farmer
S2 HPW4
Corequisites: MANF3200, MANF3410, MANF3500, MATH2839
Notes: Excluded 18.303.

The design of workplace elements in which operations such as assembly, measurement and loading/unloading are performed by a human operator or robot. Material on: documentation of manufacturing processes, characteristics of human operators and robots, workplace and methods design, measurement of workplace element characteristics.

MANF3400
Engineering Economics
Staff Contact: Prof H. Kaebernick
S1 HPW2
Prerequisite: MECH1500
Notes: Excluded 18.603.

An analytic framework for decision making from an economic viewpoint which included: cost information, engineering and investment decision, cost/benefit analysis, replacement analysis, capital recovery models, breakeven analysis and decision trees.

MANF3410
Quality Systems 1
Staff Contact: Dr P. Mathew
S1 HPW4
Prerequisites: MANF1110, MATH2839, MECH3000
Notes: Excluded 18.003, MANF4429.

An introduction to the role of national and international standards in manufacturing, the principle and technology underlying dimensional metrology. The design and analysis of experiments to investigate the performance of manufacturing processes and introductory statistical process control.

MANF3500
Computers in Manufacturing 1
Staff Contact: Prof H. Kaebernick
S2 HPW4
Prerequisites: MANF1110, MECH1500, ELEC0805
Notes: Excluded 18.224.

The selection and use of computer-controlled devices such as robots, machines and vehicles in manufacturing systems: components of computerized systems. Control of devices by PLCs and computers is also examined.

MANF3600
Information and Decision Making Technology 1
Staff Contact: Prof H. Kaebernick
S1 HPW4 S2 HPW2
Prerequisites: MECH1500, MATH2839
Notes: Excluded MANF3609, MANF4610, MANF9620, MANF9629.

An introduction to the quantitative aspects of decision making and relevant computing tools including: decision theory, data modelling and data base management systems, operations research, spreadsheets, fourth generation languages and decision support systems.

MANF3800
Introduction to Numerical Methods
Staff Contact: Dr I. Maclaine-cross
S2 HPW1.5
Prerequisites: MECH1500, MATH2009
Notes: Excluded 18.003. Combined degree course students who have taken MATH3101 or 10.222A Numerical Analysis, should substitute a Technical Elective or a half Level II or Level III unit from relevant undergraduate offerings in the Science Handbook for this subject.

An introduction to the processes, data structures and numerical algorithms required for the solution of engineering problems including: numerical solution of equations, sets of simultaneous equations interpolation, differentation and integration.

MANF4010
Manufacturing Systems Design
Staff Contact: Dr Y.L. Yao
F HPW2

Students will work in project teams to perform a complete manufacturing system design, involving activities such as: selection of a product for manufacture, engineering and industrial design, design for manufacture, process selection, tolerance optimization, manufacturing system system design, including selection of production elements, workplace design, factory layout, production control system, detailed budget, containing discounted cash flow analysis, projected position and income statements.

Prominent engineers will give lectures on their experiences. topics covered formally will include: steps in starting up a company, statutory requirements, finance, feasibility analysis, manufacturing goal setting, industrial design, import replacement, the economic environment of manufacturing.

MANF4300
Design of Manufacturing Facilities 2
Staff Contact: Mr K.C. Chan
S2 HPW4
Corequisite: MANF3300

Introduction to plant layout design; strategies and criteria for locating a manufacturing facility; process locations, safety aspects. Materials handling system: automatic guided vehicles, conveyor systems, robots. Storage and retrieval systems: palletization, warehousing, containers, overhead cranes, forklifts, robots. Simulation of various systems: computerized manufacturing facilities planning, including simulation and associated data acquisition and manipulation.

MANF4400
Engineering Management
Staff Contact: Dr B. Kayis
S1 HPW2
Prerequisite: MANF3400
Notes: Excluded 18.603

Engineering and management, summary of macro- and micro-economic issues from an engineering management perspective, management science models, marketing management, the legal environment of business, industrial relations, engineering project management, quality assurance and total quality management, entrepreneurship and management of technical change and innovation.

MANF4410
Quality Systems 2
Staff Contact: Dr B. Kayis
S1 HPW2
Prerequisite: MANF3410
Notes: Excluded MANF4429, MANF9410.

Management and philosophies of quality systems; quality planning in design and manufacture; selection of quality systems and statistical process control; total quality - quality circles and zero defects; accreditation for quality; economic selection of quality systems; preparation and use of quality manuals - national and international standards; legal aspects of product design and quality; some experiments and analyses for statistical process control; case studies/project.

MANF4420
Management of Manufacturing Systems
Staff Contact: Prof H. Kaebernick
S1 HPW6 S2 HPW2
Prerequisites: MANF3400, MANF3410, MANF3600
Notes: Excluded MANF4429.

Nature and scope of manufacturing management, key bases for competition, Porter's model, manufacturing performance factors and their strategic significance; meaning of waste, value added and total quality; design for manufacture and the market; basic dynamics of materials flow in an organization. Demand forecasting and master planning, role of inventory, production smoothing. Production control, bottlenecks and capacity constraining resources, product and layout rationalization, mechanics of scheduling. Purchasing, vendor selection, vendor performance monitoring; physical distribution, warehouse location and operations. Maintenance management: planning and control, total preventative maintenance. Role and fit of packaged approaches: MRP, JIT, OPT.

MANF4500
Computers in Manufacturing 2
Staff Contact: Prof H. Kaebernick
S1 HPW2
Prerequisite: MANF3500

Introduction to computer integrated manufacture (CIM): what is CIM, skills required when designing and implementing CIM, unsolved problems in CIM. Integration: CAD, CAM, CAD/CAM integration technology, MAP/TOP. Flexible Manufacturing Systems (FMS): FMS system architecture, material handling and storage systems in FMS, auxiliary devices in FMS, FMS operation control. Project on cmputer integration with data aquisition and control.

MANF4600
Information and Decision Making Technology 2
Staff Contact: Prof H. Kaebernick
S1 HPW4
Prerequisite: MANF3600
Notes: Excluded MANF3609, MANF4610, MANF9620, MANF9629.

Combinatorial optimization; integer and dynamic programming; branch and bound technique; elementary multiple-criteria decision analysis; goal programming; examples from production planning and scheduling. Data, information and knowledge; problem decomposition; techniques for knowledge representation; rule-based systems; examples from manufacturing process planning, scheduling, and diagnostic maintenance. Intelligent DSS: deductive databases; integration of algorithmic and knowledge-based problem solving approaches; examples from process planning and scheduling. More advanced simulation topics; discrete event simulation languages; factory simulation packages; simulation model and experimental design. Organizational issues; distributed vs centralized decision making, knowledge bases and data bases; goal integration; importance of common data and procedural semantics for coordinated decision making; examples from CIM environments.

Mechanical Engineering

MECH0130
Engineering Drawing and Descriptive Geometry
Staff Contact: A/Prof A.E. Churches
SS L1 T3
Notes: This is a servicing subject taught within courses offered by other schools and faculties.

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

MECH0160
Introductory Engineering Design and Drawing Practice
Staff Contact: A/Prof A.E. Churches
S1 L3 T2
Notes: Excluded MECH0130, MECH1110.

This subject is intended specifically for Electrical Engineering students, and is to be taken in conjunction with MECH0360.

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.

MECH0330
Engineering Mechanics
Staff Contact: Dr R.A.J. Ford
SS L2 T2
Prerequisites: As for MECH1300 Engineering Mechanics 1
Notes: Excluded MECH0360, MECH1300. This is a servicing subject taught within courses offered by other schools and faculties.

Composition and resolution of forces, laws of equilibrium. Friction. Statics of rigid bars, pin-jointed frames and beams. Simple states of stress. Statics of fluids. Rectilinear motion, curvilinear motion using rectangular and natural co-ordinates. Simple rotation. Equations of motion. Work, energy and power. Impulse and momentum.

MECH0360
Introductory Engineering Mechanics
Staff Contact: A/Prof J.E. Baker
S1 L2 T1
Prerequisite: HSC Exam Score Range Required - Either 2 unit Science (Physics) 53-100, or 3 unit Science 90-150, or 4 unit Science multistrand 1- 50, or 2 unit Industrial Arts (Engineering Science) 53-100, or 3 unit Industrial Arts (Engineering Science) 1- 50
Notes: Excluded MECH0330, MECH0440, MECH1300. This subject is intended specifically for Electrical Engineering students, and is to be taken in conjunction with MECH0160.

Equilibrium. Friction. Systems of multiforce 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.

MECH0440
Engineering Statics
Staff Contact: Dr R.A.J. Ford
SS L2 T1
Prerequisites: As for MECH1300 Engineering Mechanics 1.
Notes: Excluded MECH0330, MECH0360, MECH1300.

Composition and resolution of forces, laws of equilibrium. Friction. Statics of rigid bars, pin-jointed frames and beams. Simple states of stress. Statics of fluids.

MECH0760
Mechanical Engineering
Staff Contact: A/Prof E. Leonardi
S1 L3 T1
Prerequisites: MATH2100, MATH2120 or equivalent, PHYS1969
Notes: This subject is intended specifically for Electrical Engineering students.

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. Turbo-machinery velocity diagrams. Incompressible and compressible flow in adiabatic ducts. Conduction, convection and radiation heat transfer with applications.

MECH1000
Professional Studies 1
Staff Contact: A/Prof J.A. Reizes
S1 HPW1
Prerequisite: HSC Exam Score Range Required - 2 unit English (General) 53-100, or 2 unit English 49-100, 3 unit English 1-50, or 2 unit Contemporary English 60-100
Notes: Excluded 5.061. If these prerequisites are not met, other remedial English studies can be taken concurrently.

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.

MECH1100
Mechanical Engineering Design 1
Staff Contact: A/Prof A.E. Churches
S1 HPW1 S2 HPW2
Corequisite: MECH1000

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.

MECH1110
Graphical Analysis and Communication
Staff Contact: A/Prof A.E. Churches
S2 L1 T2
Notes: Excluded MECH0130, MECH0160.

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.

MECH1300
Engineering Mechanics 1
Staff Contact: Dr K. Zarrabi
S1 or S2 L2 T2
Prerequisite: HSC Exam Score Range Required - Either 2 unit Science (Physics) 53-100, or 3 unit Science 90-150, or 4 unit Science multistrand 1-50 or 2 unit Industrial Arts (Engineering Science) 53-100, or 3 unit Industrial Arts (Engineering Science) 1-50
Notes: Excluded MECH0330, MECH0360. Students who wish to enrol in this subject in courses other than the full-time courses in Aerospace Engineering, Electrical Engineering, Manufacturing Management, 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 multiforce 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.

MECH1400
Mechanics of Solids 1
Staff Contact: Dr M. Chowdhury
S1 or S2 L2 T1
Corequisite: MECH1300 or MECH0330 or MECH0360 or MECH0440

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.

MECH1500
Computing 1 M
Staff Contact: Dr R.A. Willgoss
S2 HPW3

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. The computer language employed in this subject is FORTRAN.

MECH2000
Professional Studies 2
Staff Contact: Mr A.J. Barratt
HPW4 total
Prerequisite: MECH1000

To introduce the student to the engineering working environment. To get the student curious about the engineering environment. To give further practice in report writing. Preparation for Industrial Training; Industrial Training, report on Industrial Training.

MECH2100
Mechanical Engineering Design 2
Staff Contact: A/Prof A.E. Churches
F L1 T2
Prerequisites: MANF1110, MECH1110, MECH1400

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.

MECH2300
Engineering Mechanics 2A
Staff Contact: Dr S.S. Leong
S1 or S2 L2 T1
Prerequisites: MATH1032 or MATH1042, MECH1300 or MECH0360

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.

MECH2310
Engineering Mechanics 2B
Staff Contact: Dr S.S. Leong
S1 or S2 HPW2
Corequisite: MECH2300

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

MECH2400
Mechanics of Solids 2
Staff Contact: Dr H.L. Stark
F L1.5 T2
Prerequisites: MATH1032 or MATH1042, MECH1400

Mechanical properties of materials: tensile and compressive behaviour; hardness; testing machines.

Analysis of stress and strain at a point (2D, 3D, Mohr's Circles); generalised Hooke's Law; modulus of rigidity; bulk modulus; interdependence of elastic moduli; strain energy (total, volumetric and distortion); yield criteria; combined loads in beams; fatigue, stress concentrations, Miner's Rule; membrane stresses; bending of composite beams; bending and unsymmetrical beams; direct shear stresses in beams, shear centre; elastic and inelastic buckling of columns.

MECH2600
Fluid Mechanics 1
Staff Contact: A/Prof G. Morrison
F L1 T1
Prerequisites: MATH1032 or MATH1042, PHYS1919

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.

MECH2700
Thermodynamics 1
Staff Contact: A/Prof E. Leonardi
F L1 T1
Prerequisites: MATH1032 or MATH1042, PHYS1919

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. Heat transfer.

MECH3000
Professional Studies 3
Staff Contact: Dr R. A.J. Ford
S2 HPW2
Prerequisites: MECH2000, MECH3010

Technical report writing. Oral reports on Industrial Training 1. Professional ethics, responsibility, liability and intellectual property. Preparation for Industrial Training 2.

MECH3010
Industrial Training 1
Staff Contact: Mr A.J. Barratt
S1
Notes: Report to be submitted by end of the second week of Session1 detailing involvement and experience gained prior to year 3.

Practical work in industry at the process or shop floor level to gain experience of people, industrial problems and relations, and process equipment.

MECH3100
Mechanical Engineering Design 3
Staff Contact: Mr R.B. Frost
F L2 T1
Prerequisite: MECH2100
Corequisites: MECH3300, MECH3400

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

MECH3200
Engineering Experimentation
Staff Contact: Dr R.A. Willgoss
F HPW1.5
Prerequisites: ELEC0805, MECH2400, MECH2600, MECH2700
Notes: Excluded 5.034.

Scientific method, engineering method; report writing; error analysis; principles of transducers; dynamic response of instruments; digital data acquisition; interfacing transducers to computers; computer control of experiments; signal processing.

MECH3211
Linear Systems Analysis
Staff Contact: Mr R. A. Willgoss
S1 L2 T1
Prerequisites: MATH2009, MECH1300
Notes: Combined degree course students who have taken MATH3181 or 10.222M Optimal Control theory should substitute a Technical Elective or a half Level II or III unit from relevant undergraduate offerings in the Science Handbook.

Models of physical systems: differential equations for physical systems including mechanical, electrical, hydraulic, thermal and pneumatic systems; linearisation. 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.

MECH3212
Principles of Control of Mechanical Systems
Staff Contact: Dr M.J. Tordon
S2 L2 T1
Prerequisite: MECH3211

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.

MECH3300
Engineering Mechanics 3
Staff Contact: A/Prof K.P. Byrne
S1 HPW2
Prerequisites: MATH2009, MECH2300

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: co-ordinate transformations, general screw motion, angular momentum, inertia tensor, kinetic energy, Euler's equations of motion, planetary and satellite motions, gyroscope.

MECH3310
Vibration Analysis
Staff Contact: Prof C. Patterson
S2 HPW2
Prerequisites: MATH2009, MECH2310

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.

MECH3400
Mechanics of Solids 3
Staff Contact: A/Prof E.J. Hahn
S1 L3 T1
Prerequisites: MATH2009, MECH2400

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 and rectangular finite elements.

MECH3500
Computing 2M
Staff Contact: Dr J. Katupitiya
S1 HPW2
Prerequisite: MECH1500
Notes: Excluded MECH4509.

Techniques for writing, debugging and documenting elegant, portable, robust and reliable programs quickly and economically. Material on the programming environment, programming style, numerical precision, storage management, database processing and program libraries. The computer languages employed in this subject are FORTRAN and C.

MECH3600
Fluid Mechanics 2
Staff Contact: A/Prof J.A. Reizes
S1 HPW2
Prerequisites: MATH2009, MECH2600, MECH2700
Notes: Excluded 5.630, 5.653, 5.663.

Dimensional Analysis, dynamic similarity, turbomachines; incompressible, inviscid flow; compressible flow.

MECH3701
Thermodynamics 2
Staff Contact: Prof B.E. Milton
S2 HPW2
Prerequisite: MECH2700
Notes: Excluded 5.623, 5.624, 5.636.

Availability - open and closed systems; general thermodynamic relations; kinetic theory of gases; non-reactive ideal gas mixtures; high-temperature gas properties; combustion.

MECH3702
Heat Transfer
Staff Contact: Dr M. Behnia
S1 HPW2
Corequisite: MECH3600
Notes: Excluded 5.336.

Basic concepts of heat transfer, units, dimensions. One dimensional steady state conduction; multi dimensional conduction. Internal and external forced convection. Heat exchangers. Natural convection. Radiation.

MECH3800
Numerical Methods
Staff Contact: Dr I.L. Maclaine-cross
S2 L2 T1
Prerequisites: MATH2009, MECH1500
Notes: Combined degree course students who have taken MATH2220 Applied Mathematics 2 – Continuous Time Systems or 10.2216 Higher Applied Mathematics 2 – Continuous Time Systems or MATH3101 or 10.222A Numerical Analysis, should substitute a Technical Elective or a half Level II or Level III unit from relevant undergraduate offerings in the Science Handbook for this subject.

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

MECH4000
Thesis
Staff Contact: Dr M. Chowdhury
F T6
Corequisite: MECH4001

To be taken in year of completion of course.

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

MECH4001
Professional Studies 4
Staff Contact: Dr I.L. Maclaine-cross
S2 HPW2
Prerequisites: MECH3000
Corequisite: MECH4000, MECH4002
Notes: Excluded MECH4019.

Development of skills in the use of various media of communication. Presenting oral and written reports. Conference organization and participation. Group projects in communications.

MECH4002
The Engineer in Society
Staff Contact: A/Prof J.A. Reizes
S2 HPW2
Corequisite: MECH4001
Notes: This subject satisfies the requirements of Category C of the General Education Program.

Reading, instruction and project work concerned with the organisational, environmental and social aspects of engineering.

The subject is intended to integrate a student's prior and current studies over the range of scientific, technological and contextual areas and general education. Students will

undertake socially directed projects in large groups and follow them up with more reflective individual tasks.

MECH4010
Industrial Training 2
Staff Contact: Mr J.A. Barratt
S1
Notes: Report to be submitted in Session 1 detailing responsibilities and experience gained in vacation period between Years 3 and 4.

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.

MECH4020
Group Engineering Project
Staff Contact: Dr M. Behnia
S1 HPW6 or F HPW3

Subject integrates the engineering science and creativity aspects of previous years. Students work in groups on an engineering project. Aspects of the project include project management, a basic assessment of the market development of the design and other engineering features, consideration of environmental and safety impacts, procedures for manufacture and/or construction and the industrial design (presentation and packaging of the completed item).

MECH4110
Design Project
Staff Contact: A/Prof A.E. Churches
F L1 T2
Prerequisite: MECH3100

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

MECH4120
Design Technology
Staff Contact: Mr R.B. Frost
S1 L2 T1
Prerequisite: MECH2100

Aspects of mechanical engineering technology which form the basis for machinery design including: performance matching; hydraulic power components and circuits. Fluid couplings and torque converters; power flow analysis in multi-path machinery, and other selected topics.

MECH4130
Computer-Aided Engineering Design
Staff Contact: A/Prof A.E. Churches
S2 L2 T1
Prerequisite: MECH2100
Notes: Excluded MANF3819, MANF9630.

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

MECH4301
Plane Mechanism Kinematics
Staff Contact: A/Prof J.E. Baker
SS L2 T1
Prerequisite: MECH2300
Notes: Excluded MECH9301.

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.

MECH4310
Advanced Vibration Analysis
Staff Contact: Mr R.B. Randall
SS L2 T1
Prerequisite: MECH3310
Notes: Excluded MECH9310.

Introduction to experimental vibration analysis using Fast Fourier Transform (FFT) techniques. Typical sources of vibration in machines. Analysis of continuous systems via classical and finite element techniques. Experimental modal analysis. Torsional vibrations including geared shaft systems.

MECH4321
Engineering Noise 1
Staff Contact: A/Prof K.P. Byrne
SS L2 T1
Notes: Excluded MECH9321.

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.

MECH4322
Engineering Noise 2
Staff Contact: A/Prof K.P. Byrne
SS L2 T1
Prerequisite: MECH4321
Notes: Excluded MECH9322.

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

MECH4361
Lubrication
Staff Contact: A/Prof E.J. Hahn
SS HPW3
Prerequisites: MECH2600, MATH2009
Notes: Excluded MECH9361.

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 pressurised bearings, squeeze films.

MECH4400
General Mechanics of Solids
Staff Contact: Dr K. Zarrabi
SS L2 T1
Prerequisite: MECH3400
Notes: Excluded MECH9400, 5.424.

Fracture mechanics and its applications to various industries, including aerospace, power generation, etc. Review of mathematical theory of elasticity. Plastic collapse. Overview of damage tolerance analysis. Geometric stress concentration factor. Linear and nolinear fracture mechanics. Residual strength diagram. Crack growth analysis. Damage tolerance analysis. Fracture control. Applications.

MECH4410
Engineering Applications of Finite Elements
Staff Contact: A/Prof D.W. Kelly
SS L2 T1
Prerequisite: MECH3400
Notes: Excluded AERO4400, MECH9410.

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.

MECH4420
Plates and Shells
Staff Contact: Dr H.L. Stark
SS L2 T1
Prerequisite: MECH3400
Notes: Excluded MECH9421.

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.

MECH4430
Theory of Elasticity
Staff Contact: A/Prof J.E. Baker
SS L2 T1
Prerequisites: MECH2300, MECH3400

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

MECH4440
Theory of Plasticity
Staff Contact: School Office
SS L2 T1
Prerequisite: MECH3400

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.

MECH4450
Structural Instability
Staff Contact: School Office
S1 L1.5 T.5
Prerequisite: MECH3400

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.

MECH4500
Computing 3M
Staff Contact: Dr J. Katupitiya
S1 HPW2
Prerequisite: MECH3500

Computer environments; PC and mainframe. User and machine interfacing with terminal controls, menus, mouse and I/O hardware. Use of graphics and special packages, e.g., spreadsheets for man/machine interaction. Communications protocol, serial and parallel transmission, interrupts polling and general housekeeping routines. Use of C language and comparison with other high level languages.

MECH4600
Viscous Flow Theory
Staff Contact: A/Prof E. Leonardi
SS HPW3
Prerequisites: MATH2009, MECH2600, MECH2700

Review of vector analysis and Cartesian tensors. Kinematics of fluid motion. Reynold's 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.

MECH4690
Special Fluid Mechanics Elective
This subject is variable in content in order to allow the presentation of material of particular interest and merit by a visiting expert in a field not otherwise covered.

MECH4700
Turbomachines and Engines
Staff Contact: Prof B.E. Milton
SS HPW3
Prerequisite: MECH3701

Definition, classes and characteristic of turbomachines, sizing using dimensional analysis. Thermodynamics, blade element analysis of axial stage, cascade data, design of a fan. Centrifugal machines, slip factor, design of a centrifugal pump. Review of air-standard cycles in relation to real engine cycles for reciprocating engines and gas turbines. Engine control. Engine flow process. Fuel preparation, combustion and combustion chambers, heat transfer, turbomachinery in engines. Control of emissions from engines.

MECH4710
Convection Heat Transfer
Staff Contact: A/Prof J.A. Reizes
SS L2 T1
Prerequisite: MECH3600
Notes: Excluded MECH9710.

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.

MECH4720
Solar Energy
Staff Contact: A/Prof G.L. Morrison
SS L2 T1
Prerequisites: MATH2009, MECH3702
Notes: Excluded MECH9720.

Ambient energy systems. Solar radiation characteristics. Solar radiation measurement, data sources. Beam and diffuse components on inclined and tracking surfaces. Solar collector performance measurement. Heat transfer processes in solar collectors. Evaluation of long-term performance, heat tables, F chart and detailed simulation. Solar air heating systems, utilisability/unutilisability methods for passive space heating systems.

MECH4730
Multiphase Flow
Staff Contact: Dr M. Behnia
SS L2 T1
Prerequisite: MECH3600
Notes: Excluded MECH9730

Nature of multiphase flow. Flow patterns. Gas-liquid multi-component flows. Two phase flow models. Pressure drop correlations. Mechanisms of boiling and condensation. Design of boilers, evaporators and condensors. Design of refrigeration heat exchangers. Design of oil and gas pipelines. Measurement techniques.

MECH4740
Thermal Power Plants
Staff Contact: Dr M. Behnia
SS L2 T1
Prerequisites: MECH2600, MECH2700
Notes: Excluded MECH9740.

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.

MECH4751
Refrigeration and Air Conditioning
Staff Contact: A/Prof E. Leonardi
SS HPW3
Corequisite: MECH3702

Psychrometry and air conditioning calculations; heating and cooling load calculations; refrigerants; vapour compression refrigeration; multipressure systems; air conditioning systems; components of refrigeration and air conditioning systems; air distribution; refrigeration and air conditioning controls.

MECH4790
Special Thermodynamics Elective
This subject is variable in content in order to allow the presentation of material of particular interest and merit by a visiting expert in a field not otherwise covered.

MECH4800
Optimal Engineering Strategies
Staff Contact: A/Prof J.E. Baker
SS L2 T1
Prerequisites: MATH2009, MECH2300

Optimization: a selection of techniques and their applications from the calculus of variations, geometric programming, network analysis, linear programming, non-linear programming, etc. Strategies for design and analysis: system structure; variable classification; procedure generation; recycle optimisation; the adjacency matrix.

Naval Architecture

NAVL3100
Principles of Ship Design 1
Staff Contact: Dr P.K. Pal
S2 L2 T1
Corequisites: NAVL3600, NAVL3610

Development of ship and ship building. Ocean environment. Trading environment. Ship operations. Ship types. Freeboard. Tonnage. Mathematics of ship design: optimisation techniques. Mathematical modelling.

NAVL3400
Ship Structures 1
Staff Contact: Dr M. Chowdhury
F L1.5 T.5
Prerequisites: MATH2009, MATS9520, MECH2400
Corequisite: MECH3400

Ship structural loading and response. Bending of the hull girder – deterministic aspects. Statistical prediction of wave loads and hull 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.

NAVL3600
Ship Hydrostatics
Staff Contact: A/Prof L.J. Doctors
F L2 T.5
Prerequisites: MATH1032, MECH1300, MECH1500, PHYS1919

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. Representation of hull surfaces for computer applications. Analysis of hull hydrostatics and stability by an integrated computer package.

NAVL3610
Ship Hydrodynamics
Staff Contact: A/Prof L.J. Doctors
F L2 T.5
Prerequisites: MATH2009, MECH2300, MECH2310, MECH2600

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. Linearised uncoupled motion of a ship. Coupled heave and pitch motion of a ship. Ocean waves and their properties.

NAVL4000
Ship Management Economics
Staff Contact: Dr P.K. Pal
S2 L1.5 T.5
Prerequisite: MATH2009

Basic concepts and definitions. Interest relationships. Present worth. Average annual cost. Capitalised 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.

NAVL4100
Principles of Ship Design 2
Staff Contact: Dr P.K. Pal
S1 L3 T1 S2 L1.5 T.5
Prerequisite: NAVL3100
Corequisite: NAVL4400

Techniques of ship design. Blocking out a ship's dimensions. Weight equation. Estimation: weights, capacity, freeboard and stability. Preliminary powering and selection of main engine. Lines plan. General arrangements. Design for construction. Classification rules: scantling development, structural arrangement. Safety and protection of ships. Cargo handling arrangements. Ship building methods. Modular construction. Quality control and ship production. Contract, tendering and specification. Shipyard layout. Shipyard management. Cost estimation.

NAVL4110
Ship Design Project
Staff Contact: Dr P.K. Pal
S1 T3 S2 T4
Prerequisites: NAVL3100, NAVL3600, NAVL3610
Corequisites: NAVL4000, NAVL4100

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. 8. Specification.

NAVL4400
Ship Structures 2
Staff Contact: Dr M. Chowdhury
F L1.5 T.5
Prerequisite: NAVL3400
Corequisite: MECH3400

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 optimisation methods. Automated and computer aided design.

NAVL4700
Ship Propulsion and Systems
Staff Contact: Dr P.K. Pal
F HPW4
Prerequisites: NAVL3600, NAVL3610

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.

Graduate Study

Formal graduate courses offered are: the Master of Engineering Science in Industrial Engineering **8531** and in Mechanical Engineering **8541**, and the Graduate Diploma in Industrial Engineering **5455** and Mechanical Engineering **5456**. Opportunities are provided for graduate research leading to the award of the degrees of Master of Engineering **2680** and **2692** and Doctor of Philosophy **1662**.

8531
Industrial Engineering

8541
Mechanical Engineering

Master of Engineering Science
MEngSc

A major field of study is required to be nominated and two-thirds of the 30 credits required for the degree must be taken in that major field. (Examples of major fields are applied mechanics, fluid mechanics, manufacturing management, mechatronics and design. Consult School Advisers for further details.)

All candidates take a 12 credit project on a topic in their major field.

Formal lecture subjects are not restricted to the School of Mechanical and Manufacturing 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 Manufacturing Engineering and which are described below. Some of these specialist programs may not run if the resources are not available.

Specialist Programs

1. Computer Integrated Manufacturing — **C**

12 credits of core subjects:

MANF9470	Production Management 1	3
MANF9560	Computer Integrated Manufacturing	3
MANF9543	CAD/CAM	3
MANF9544	Concurrent Product and Process Design	3
MANF9040	Seminar	0

and 12 credit project

MANF9010	Research Project	12

The remaining 6 credits may be selected from the following electives:

MANF9410	Total Quality Management	3
MANF9601	Economic Decisions in Industrial Management	3
MANF9400	Industrial Management	3
MECH9410	Finite Element Applications	3
MANF9340	Flexible Manufacturing Systems	3
MANF9500	Computer-Aided Programming for Numerical Control	3

2. Industrial Management

Before enrolling in the program, a student should have had one year's relevant industrial experience and have access to industry for his/her project topic.

12 credits of core subjects:

MANF9400	Industrial Management	3
MANF9470	Production Management 1	3
MANF9410	Total Quality Control	3
MANF9040	Seminar	0
SAFE9224	Principles of Ergonomics	3

and 12 credit project

MANF9010	Research Project	12

The remaining 6 credits may be selected from the following electives:

ACCT9062	Accounting for Engineers	3
MANF9601	Economic Decisions in Industrial Management	3
MANF9340	Flexible Manufacturing Systems	3
MANF9543	CAD/CAM	3
MANF9544	Concurrent Product and Process Design	3
MANF9560	Computer Integrated Manufacturing	3
SAFE9213	Introduction to Safety Engineering M	3

3. Refrigeration and Air Conditioning

12 credits of core subjects:

MECH9751	Refrigeration and Air Conditioning 1	3
MECH9752	Refrigeration and Air Conditioning 2	3
MECH9753	Refrigeration and Air Conditioning Design 1	3
MECH9754	Refrigeration and Air Conditioning Design 2	3

and 12 credit project

MECH9010	Research project	12

The remaining 6 credits may be selected from:

MECH9321	Acoustic Noise 1	2
MECH9322	Acoustic Noise 2	2
MECH9710	Numerical Fluid Dynamics and Heat Transfer	3
MECH9711	Analysis of Heat Transfer	4
MECH9720	Solar Thermal Energy Design	3
MECH9730	Two Phase Flow and Heat Transfer	3
MECH9741	Energy Conservation and System Design	3
MECH9757	Ambient Energy Air Conditioning	2
SAFE9232	Introduction to Occupational Health and Safety Law	3
SAFE9583	Ventilation	3

or such other subjects (based on availability) as may be approved by the Head of School.

4. Industrial Automation

9 credits of core subjects must be selected from:

MECH9201	Digital Fundamentals for Mechanical Engineers	3
MECH9202	Microprocessor Fundamentals	3

		C
MECH9203	Industrial Applications for Microprocessors	3
MECH9211	Modelling and Control of Mechatronic Systems	3
MECH9221	Industrial Robots	3
MECH9222	Artificially Intelligent Machines	3
MANF9500	Computer Aided Programming for Numerical Control	3

and 12 credit Project

MECH9010	Research Project	12

The remaining 9 credits may be selected from the above list or from other subjects as approved by the Head of School.

5. Advanced Analysis for Design

12 credits of core subjects:

MECH9410	Finite Element Applications	3
MECH9421	Stress Analysis for Mechanical Engineering Design 1	3
MECH9400	Mechanics of Fracture and Fatigue	3
SAFE9224	Principles of Ergonomics	3

and 12 credit project

MECH9010	Research Project	12

The remaining 6 credits may be selected from:

CIVL9731	Project Management (or CIVL9732)	3
CIVL9732	Advanced Project Management Theory (or CIVL9731)	3
MANF9601	Economic Decisions in Industrial Management	3
MECH4120	Design Technology	2
MECH4130	Computer Aided Engineering Design	2
MECH9460	Experimental Stress Analysis	3

or other subjects approved by the Head of School.

6. Noise and Vibration

9 credits of core subjects:

MECH9321	Acoustic Noise 1	3
MECH9311	Fundamentals of Vibration	3
MECH9312	Fundamentals of Noise and Vibration Measurement	3

and 12 credit project

MECH9010	Research Project	12

The remaining 9 credits may be selected from:

MECH9322	Acoustic Noise 2	3
MECH9310	Advanced Vibration Analysis	3
MECH9323	Environmental Noise	3
MECH9324	Building Acoustics	3

or such other subjects (based on availability) as may be approved by the Head of School.

5455
Graduate Diploma in Industrial Engineering

GradDip

5456
Graduate Diploma in Mechanical Engineering

GradDip

Details of recommended programs of study may be obtained from the Head of School. Subjects from the Masters degree programs are offered in the Graduate Diploma programs subject to the approval of the course coordinator.

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

Industrial Technology and Management

MANF9010
Research Project
Staff Contact: Prof H. Kaebernick
C12

MANF9019
Project
C9

MANF9029
Project Report
C18

MANF9039
Thesis
C36

MANF9040
Seminar Industrial Management
C0
Staff Contact: Dr Y.L.Yao

MANF9340
Flexible Manufacturing Systems
Staff Contact: Prof H. Kaebernick
C3 SS HPW3
Prerequisite: MANF9520

Technical aspects of FMS components, including automated material-handling devices, job selection design and their aggregation. Hierarchical structure of FMS; mathematical models of FMS.

MANF9400
Industrial Management
Staff Contact: Dr B. Kayis
C3 SS HPW3

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; coordination 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.

MANF9410
Total Quality Management
Staff Contact: Dr B. Kayis
C3 SS HPW3

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.

MANF9470
Production Management 1
Staff Contact: Prof H. Kaebernick
C3 SS HPW3
Notes: Excluded MANF9420

Framework and functions of production management; industry dynamics, competitive advantage, Porter's model; meaning of waste and value added; competitive advantage and its implications for management of materials flow. Dynamics of materials flow in a manufacturing organisation; role of inventory; push vs pull systems of production; bottlenecks; VIT and A plants. Hierarchical production planning; the Master Production Schedule; translating the MOS into operational requirements. Mechanics of MRP, JIT and OPT. Role of Total Quality Management. Matching Production Management system to type and strategic positioning of company.

MANF9491
Special Topic in Industrial Engineering
C3 SS HPW3
Notes: This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

MANF9492
Special Topic in Industrial Engineering
C3 SS HPW3
Notes: This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

MANF9500
Computer Aided Programming for Numerical Control
Staff Contact: Dr P. Mathew
C3 SS HPW3
Prerequisite: Assumed knowledge MECH1500 or equivalent
Notes: Excluded MANF4509.

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.

MANF9543
CAD/CAM
Staff Contact: Dr K. Hoang
C3 SS HPW3
Note: Student numbers are limited due to computer availability. Preference will be given to CIM Program students. Students must contact the Department of Industrial Technology and Management one week after enrolment to confirm enrolment.

Topics to be covered include: Manufacturing systems; elements of CAM; computer process monitoring and control; production systems at the plant and operation levels; principles underlying the interactive computer graphics packages such as Auto CAD and CATIA; applications to design and engineering processes.

MANF9544
Concurrent Product and Process Design
Staff Contact: Dr Y.L.Yao
C3 SS HPW3

Topics to be covered are selected from: concurrent engineering concepts, producibility, maintainability, technical and economic considerations, design for manufacturing, design for assembly, inspectability, computer-aided concurrent engineering, knowledge-based approaches, environmental and ecological impacts.

MANF9560
Computer Integrated Manufacturing
Staff Contact: Dr K. Hoang
C3 SS HPW3
Prerequisite: MANF9520

Systems analysis and design of computer integrated manufacturing, including flexible manufacturing systems and automated factories.

MANF9601
Economic Decisions in Industrial Management
Staff Contact: Prof H. Kaebernick
C3 SS HPW3
Notes: Excluded MANF3619.

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.

Mechanical Engineering

MECH9010
Project
C12

MECH9201
Digital Logic Fundamentals for Mechanical Engineers
Staff Contact: Dr M.J. Tordon
C3 SS HPW3
Notes: Excluded 6.021E, 6.631 and equivalent.

Introduction. Review of number theory. Symbolic logic. An introduction to TTL compatible devices. Formulation and implementation of problems in logic. Microprocessor architecture. Components of a microprocessor based system. Memory maps. Input/Output devices. Dedicated and special purpose computers. Principal features of a microprocessor based system. Laboratory complement to lectures.

MECH9202
Microprocessor Fundamentals for Mechanical Engineers
Staff Contact: Dr M.J. Tordon
C3 SS HPW3
Prerequisite: MECH9201 or equivalent
Notes: Excluded 6.0318, 6.613, COMP9221, ELEC4432, ELEC9406, ELEC4351 and equivalent.

Introduction to microprocessor programming. Machine code programming. Instruction sets. Program branching and condition codes. Addressing modes. Interrupts. Address decoding and memory interface. Input/Output interfacing techniques. Programmable peripheral devices. Serial and parallel interfaces. Microprocessor control of electromechanical devices. Laboratory complement to lectures.

MECH9203
Industrial Applications of Microprocessors
Staff Contact: Dr R.A. Willgoss
C3 SS HPW3
Prerequisite: MECH9202 or equivalent
Notes: Excluded ELEC4432, ELEC9406, ELEC4351 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.

MECH9204
Elements of Industrial Automation
Staff Contact: Dr R.A. Willgoss
C3 SS HPW3

An introductory overview of the elements of Industrial Automation systems and the factors governing their use in industry.

MECH9205
The Analysis and Use of Integrated CAD/CAM Systems
Staff Contact: Dr R.A. Willgoss
C3 SS HPW3
Prerequisite: MECH9204

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.

MECH9211
Modelling and Control of Mechatronic Systems
Staff Contact: Dr J. Katupitiya
C3 SS HPW3
Prerequisite: MECH9212

Development of modelling technique and design of controllers using digital computers, with special emphasis on motion control. Typical examples of mechatronics systems.

MECH9212
Control and Modelling of Mechanical Systems 2
Staff Contact: Dr R.A. Willgoss
C3 SS HPW3
Prerequisite: MECH3211 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.

MECH9221
Industrial Robotics
Staff Contact: Dr R.A. Willgoss
C3 SS HPW3

Applications survey. System structure, hardware, software, han- dling. 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.

MECH9222
Artificially Intelligent Machines
Staff Contact: Dr R.A. Willgoss
C3 SS HPW3

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.

MECH9301
Advanced Mechanism Analysis and Synthesis 1
Staff Contact: A/Prof J.E. Baker
C3 SS HPW3
Prerequisite: Assumed knowledge MECH2300 or 5.333 or

equivalent
Notes: Excluded MECH4301.

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.

MECH9302
Advanced Mechanism Analysis and Synthesis 2
Staff Contact: A/Prof J.E. Baker
C3 SS HPW3

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.

MECH9310
Advanced Vibration Analysis
Staff Contact: Mr R.B. Randell
C3 SS HPW3
Prerequisite: Assumed knowledge MECH3310 or equivalent
Notes: Excluded MECH4310.

Introduction to experimental vibration analysis using Fast Fourier Transform (FFT) techniques. Typical sources of vibration in machines. Analysis of continuous systems via classical and finite element techniques. Experimental modal analysis. Torsional vibrations, including geared shaft systems.

MECH9311
Fundamentals of Vibration
Staff Contact: Mr R.B. Randell
C3 SS HPW3
Prerequisite: Assumed knowledge MECH2300, MATH2009 or equivalent
Notes: Excluded MECH3310

Single-degree of freedom vibrating systems: free/forced, undamped/damped, response/transmissibility. Whirling of shafts. Harmonic analysis. Vibration measuring instruments. Linear vibrations of multi-degree-of-freedom systems: normal modes. Introduction to the analysis of continuous systems.

MECH9312
Fundamentals of Noise and Vibration Measurement
Staff Contact: A/Prof K.P. Byrne
C3 SS HPW3

Parameters used to describe and measure noise and vibration. Characteristics of microphones and vibration transducers and their associated signal conditioning devices. The performance of analogue, digital,linear and exponential averaging detectors. Frequency analysis using analogue and digital filters. FFT analysers. Sound intensity measurement. Tape recording.

MECH9320
Random Vibrations
Staff Contact: School Office
C2 SS HPW2
Prerequisite: Assumed knowledge MECH3310

Probability, vibration theory review, linear mechanical system response to random vibrations. Statistical characteristics: autocorrelation, spectral density, convolution, narrow band processing, consistency, applications.

MECH9321
Acoustic Noise 1
Staff Contact: A/Prof K.P. Byrne
C3 SS HPW3
Notes: Excluded MECH4341.

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.

MECH9322
Acoustic Noise 2
Staff Contact: A/Prof K.P. Byrne
C3 SS HPW3
Prerequisite: MECH9321 or equivalent
Notes: Excluded MECH4322.

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

MECH9323
Environmental Noise
Staff Contact: A/Prof K.P. Byrne
C3 SS HPW3
Prerequisite: MECH4321 or equivalent

Prediction of source strengths of transport and construction noise. Noise propagation models including atmospheric and topological effects. Propagation in urban and rural areas. Attenuation by barriers. Strategies for controlling environmental noise. Prediction models. Environmental noise exposure concepts.

MECH9324
Building Acoustics
Staff Contact: A/Prof K.P. Byrne
C3 SS HPW3
Prerequisite: MECH4321 or equivalent

Room acoustics viewed from modal and energy aspects. Absorption and transmission performance of building elements such as carpets, windows and walls. Relationship between laboratory and field performance measurements. Noise problems associated with building services.

MECH9361
Hydrodynamic Lubrication Theory and Design
Staff Contact: A/Prof E.J. Hahn
C3 SS HPW3
Notes: Excluded MECH4361.

Types of hyrdodynamic bearings and bearing operation; properties of lubricants; theory of steady state hydrodynamic lubrication; hydrostatic and squeeze film

lubrication applied to slider and journal bearings; bearing design with side leakage; thermal balance. Journal bearing dynamics; instability analysis. Elastohydrodynamic lubrication. Bearing materials; friction and wear. Grease lubrication.

MECH9362
Lubrication Theory and Design 2
Staff Contact: A/Prof E.J. Hahn
C2 SS HPW2
Prerequisite: MECH9361 or equivalent

Continuum equations of hydrodynamic lubrication. Journal bearing dynamics. Rolling contacts. Elastohydrodynamic lubrication. Grease lubrication. Plasto-elastohydrodynamic lubrication. Metal forming, cutting lubrication.

MECH9400
Mechanics of Fracture and Fatigue
Staff Contact: Dr K. Zarrabi
C3 SS HPW3
Notes: Excluded MECH4400.

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.

MECH9410
Finite Element Applications
Staff Contact: A/Prof D.W. Kelly
C3 SS HPW3
Notes: Excluded MECH4410, MECH4400.

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.

MECH9421
Stress Analysis for Mechanical Engineering Design 1
Staff Contact: A/Prof A.E. Churches
C3 SS HPW3
Prerequisite: Assumed knowledge MECH3400 or equivalent

Plates, shells: primary, secondary and peak stresses, relations to strength. Pressure vessels. Current design philosophies.

MECH9422
Stress Analysis for Mechanical Engineering Design 2
Staff Contact: A/Prof A.E. Churches
C3 SS HPW3
Prerequisite: Assumed knowledge MECH3400 or equivalent

Topics selected from: Plastic collapse. Limit state design. Stress concentrations. Plate girder panel structures. Lightweight structures. Machine frames. High temperature components. Gears.

MECH9460
Experimental Stress Analysis
Staff Contact: School Office
C3 SS HPW3

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.

MECH9620
Computational Fluid Dynamics
Staff Contact: A/Prof J.A. Reizes
C3 HPW3

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.

MECH9631
Gasdynamics 1
Staff Contact: School Office
C2 SS HPW2
Notes: Excluded AERO3601.

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.

MECH9632
Gasdynamics 2
Staff Contact: School Office
C2 SS HPW2
Prerequisite: MECH9631 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.

MECH9710
Numerical Fluid Dynamics and Heat Transfer
Staff Contact: A/Prof J.A. Reizes
C3 SS HPW3
Prerequisite: Assumed knowledge MECH3800 or equivalent
Notes: Excluded MECH4710

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.

MECH9711
Analysis of Heat Transfer
Staff Contact: Dr M. Behnia
C4 SS HPW4
Prerequisite: Assumed knowledge MECH3701 or equivalent
Notes: Candidates wishing to specialize in Refigeration and Air Conditioning should select this subject.

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.

MECH9720
Solar Thermal Energy Design
Staff Contact: A/Prof G.L. Morrison
C3 SS HPW3
Notes: Excluded MECH4720 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.

MECH9730
Two Phase Flow and Heat Transfer
Staff Contact: Dr M. Behnia
C3 SS HPW3
Prerequisite: Assumed knowledge MECH3701 or equivalent
Notes: Excluded MECH4720.

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.

MECH9740
Power Plant Engineering
Staff Contact: Dr M. Behnia
C3 SS HPW3
Prerequisite: Assumed knowledge MECH2600 and MECH2700 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.

MECH9741
Energy Conservation and System Design
Staff Contact: A/Prof J.A. Reizes
C3 SS HPW3

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.

MECH9742
Power Production Assessment
Staff Contact: Dr M. Behnia
C3 SS HPW3
Prerequisite: Assumed knowledge MECH3600 and MECH3701 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.

MECH9751
Refrigeration and Air Conditioning 1
Staff Contact: A/Prof E. Leonardi
C3 SS HPW3

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.

MECH9752
Refrigeration and Air Conditioning 2
Staff Contact: A/Prof E. Leonardi
C3 SS HPW3
Prerequisite: Assumed knowledge MECH9751 or equivalent
Notes: Candidates wishing to specialize in Refigeration and Air Conditioning should select this subject.

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.

MECH9753
Refrigeration and Air Conditioning Design 1
Staff Contact: Dr I.L. Maclaine-cross
C3 SS HPW3
Prerequisite: Assumed knowledge MECH9730, MECH9751, MECH9752 or equivalent

MECH9754
Refrigeration and Air Conditioning Design 2
Staff Contact: Dr I.L. Maclaine-cross
C3 SS HPW3
Prerequisite: MECH9753 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.

MECH9755
Refrigeration and Air Conditioning Applications
Staff Contact: A/Prof E. Leonardi
C3 SS HPW3

Industrial, commercial and domestic applications of refrigeration and air conditioning. Refrigeration technology. The science and technology of foods. Building design and construction.

MECH9756
Refrigeration and Air Conditioning Experimentation
Staff Contact: A/Prof E. Leonardi
C3 SS HPW3
Prerequisites: MECH9751, MECH9752
Corequisites: MECH9753, MECH9754

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.

MECH9757
Ambient Energy Air Conditioning
Staff Contact: Dr I.L. Maclaine-cross
C2 SS HPW2
Prerequisite: Assumed knowledge MECH3701 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.

MECH9761
Internal Combustion Engines 1
Staff Contact: Prof B.E. Milton
C3 SS HPW3

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.

MECH9762
Internal Combustion Engines 2
Staff Contact: Prof B.E. Milton
C3 SS HPW3
Prerequisite: MECH9761 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.

MECH9800
Ordinary Differential Equations in Mechanical Engineering
Staff Contact: A/Prof J.E. Baker
C3 SS HPW3

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.

MECH9900
Special Topic in Mechanical Engineering
C2 SS HPW2

MECH9910
Special Topic in Mechanical Engineering
C2 SS HPW2

MECH9920
Special Topic in Mechanical Engineering
C3 SS HPW3

MECH9930
Special Topic in Mechanical Engineering
C3 SS HPW3

These syllabi change to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

School of Surveying

Head of School
Professor J.C. Trinder

Administrative Assistant
Mr L. Daras

Surveying is a professional science dealing with measuring processes and the handling and computation of data. Traditionally, surveyors measure land and water areas and produce maps for use in development projects such as land subdivision, town planning, building construction, engineering works (eg dams and railways), mining and navigation.

Today in Australia, a surveyor may choose to work in one of the specialised areas of: **Satellite Surveying** (position determination techniques using satellite signals); **Geodetic Surveying** (determining the mathematical model of the Earth, and its gravity field, and the practice of surveying on the Earth's surface); **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 two undergraduate degrees in the School are the Bachelor of Surveying course **3740** and the combined degree in Bachelor of Surveying, Bachelor of Science in Computer Science **3745.**

Formal graduate courses lead to the award of the degree of Master of Surveying Science **8651** and of the graduate diploma in Surveying **5491,** and opportunities are provided for graduate research leading to the award of the degrees of Master of Surveying **2720** and Doctor of Philosophy **1680.**

The School of Surveying is also involved in the Centre for Remote Sensing and Geographic Information Systems in association with the School of Geography in the Faculty of Applied Science. The Centre supports graduate programs leading to the award of the degree of Master of Engineering Science **8641** or Master of Applied Science **8026** or the Graduate Diploma in Remote Sensing and Geographic Information Systems **5026** or **5496** in addition to supervision for the degree of Doctor of Philosophy.

Bachelor of Surveying Course

The School offers a full-time course of four years duration leading to the award of the degree of Bachelor of Surveying (BSurv). 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. The BSurv degree course is a well rounded course aimed at preparing the graduate for a broad range of career opportunities in the various branches of Surveying and in associated fields referred to above. The course recognises that its graduates may be called on to act as survey practitioners, consultants, managers, teachers or researchers, and indeed a single graduate may take on several of these roles during his or

her career. To this end, the BSurv degree course covers general scientific principles with special emphasis on computing, as well as specialised surveying applications. Throughout the course, theoretical studies are complemented by practical exercises in the field and in the laboratory.

The Bachelor of Surveying/Bachelor of Science in Computer Science Course

This new combined degree course of five years full-time study enables a student to qualify for the award of the two degrees of Bachelor of Science in Computer Science and Bachelor of Surveying. The course authority for the combined degree is the School of Surveying. All students admitted to the combined course will be part of the Surveying UAC quota (NSU Code) but must also have achieved a level equivalent to the Computer Science cut-off (NCS) for the year of admission.

The course is specifically designed for students wishing to enter a career in computer science specializing in surveying, satellite positioning, spatial data handling for land and geographic information systems, remote sensing, digital mapping and terrain analysis. The content of the course comprises subjects from the BSc in Computer Science and BSurv degree courses with some variations to accommodate the requirements of both degrees. It should be possible to complete the requirements for the award of the BSc degree after four years study and the BSurv degree after five years.

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, Australia 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.

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 Revision

The BSurv degree course was recently revised. Years 1 and 2 of the new course have been introduced in 1989, while year 3 was introduced 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.

Undergraduate Study

Course Outlines

3740
Surveying

Bachelor of Surveying
BSurv

		HPW S1	HPW S2
Year 1			
MATH1032	Mathematics 1	6	6
MECH0130	Engineering Drawing and Descriptive Geometry	4	0
PHYS1929	Physics 1	4	4
SURV1111	Introduction to Computing	4	0
SURV1711	Introduction to Surveying (General Education Cat.C)	3	3
SURV2041	Survey Data Presentation	0	3
SURV2111	Principles of Computer Processing	0	4
SURV2221	Introduction to Geodetic Science	0	3
Totalling		21	23
Year 2			
MATH2009	Engineering Mathematics 2	4	4
MATH2829	Statistics SU	3	0
PHYS2969	Physics of Measurements	3	0
SURV3011	Surveying Instruments	4	0
SURV3111	Survey Computations	3	0
SURV3231	Geodetic Computations	3	0
SURV4051	Survey Camp 1	0	3
SURV4011	Surveying Techniques	0	6
SURV4111	Data Analysis and Computing 1	0	3
SURV4221	Geodetic Positioning 1	0	3
General Education Subject Cat.A		4	4
Totalling		22	23
Year 3			
CIVL0646	Engineering for Surveyors 1	3	0
PLAN9111	Town Planning	2	0
SURV5011	Engineering Surveying	4	0
SURV5111	Data Analysis and Computing 2	3	0
SURV5221	Geodetic Positioning 2	3	0
SURV5621	Cadastral Surveying 1	3	0
SURV5722	Project Management 1	3	0
CIVL0656	Engineering for Surveyors 2	0	3
SURV6051	Survey Camp 2	0	4
SURV6121	Computer Graphics	0	3
SURV6511	Photogrammetry and Mapping 1	0	3
SURV6621	Cadastral Surveying 2	0	3
SURV6722	Project Management 2	0	3
SURV6811	Land Economics and Valuation	0	3
28-hr General Education Subject Cat.B		2	2
Totalling		23	25

		HPW S1	HPW S2
Year 4			
SURV7051	Survey Camp 3	7	0
SURV7311	Offshore Surveying	3	0
SURV7511	Photogrammetry and Mapping 2	3	0
SURV7521	Remote Sensing and Resource Surveys	3	0
SURV7531	Spatial Information Systems 1	3	0
SURV7712	Land Management and Development Project 1 (General Education Subject Cat. C)	2	0
SURV7811	Land Subdivision and Development	3	0
SURV8001	Project	1	8
SURV8011	Project Surveying	0	3
SURV8221	Advanced Geodesy	0	3
SURV8531	Spatial Information Systems 2	0	3
SURV8711	Professional Practice	0	2
SURV8712	Land Management and Development Project 2 (General Education Subject Cat. C)	0	2
Totalling		25	21

Combined Course 3745
Bachelor of Surveying/Bachelor of Science in Computer Science

BSurv BSc in Computer Science

The structure of this new course is flexible to accommodate timetabling but a recommended program which will satisfy prerequisites throughout the course is:

Year 1
MATH1032,
MECH0130,
PHYS1929,
SURV1711(General Education Cat.C), SURV1111,
SURV2041, SURV2221, SURV3011, SURV4011

Year 2
COMP1011, COMP1021,
MATH2841, MATH2501, MATH2510, MATH2520,
PHYS2969,
SURV3111, SURV3231, SURV4051, SURV4111,
SURV4221,
General Ed. Cat. A

Year 3
COMP2011, COMP2021, COMP2031, SURV5011,
MATH2100, MATH2120,
PLAN9111,
SURV5111, SURV5221, SURV5721, SURV6051,
SURV6511, SURV6721, SURV6811,
General Ed. Cat. B.

Year 4
CIVL6140, CIVL6150,
COMP3111, COMP3121, COMP3311, COMP3421
SURV5621, SURV6621,
Plus 2 units (4 or 5 hours per week each) at level II or higher either from Table 1 of the Sciences Handbook, or from Table 2 for Program 0600.

Year 5
SURV7051, SURV7311, SURV7511, SURV7521, SURV7531, SURV7711, SURV7712(General Education Cat.C), SURV7811, SURV8001, SURV8011, SURV8221, SURV8531, SURV8711, SURV8712 (General Education Cat.C)

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

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.

SURV0411
Surveying for Builders
Staff Contact: School Office
C2 S1 L1 T2
Notes: This is a servicing subject taught within courses offered by other schools and faculties.

A compulsory subject.

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.

SURV0441
Surveying for Engineers
Staff Contact: School Office
S2 L2 T2.5
Notes: This is a servicing subject taught within courses offered by other schools and faculties.

Principles of surveying; co-ordinate systems, levelling, linear and angular measurement. Traversing, tacheometry and electronic distance measurement. Areas and Volumes. Horizontal and vertical curves. Control, underground and construction surveys. Outline of photogrammetry.

SURV0491
Survey Camp
Staff Contact: School Office
Notes: *This is a servicing subject taught within courses offered by other schools and faculties.*
A one-week field camp for students studying SURV0441 Surveying for Engineers.

SURV0580
Mining Surveying
Staff Contact: School Office
S1 L2 T1
Prerequisite: SURV0441
Notes: This is a servicing subject taught within courses offered by other schools and faculties.

Revision of traverse, set out and levelling (14 hours field work).

Surface surveys. Map projections, the Integrated Survey Grid (I.S.G.). Electronic Distance Measurement. Correlation of surface surveys with I.S.G. Subsidence. Shaft plumbing. Transfer of height and coordinates. Transfer of azimuth. Gyrotheodolite. Underground mapping. Dip, fault and three dimensional coordinate calculations. Borehole surveying.

SURV0752
Remote Sensing Techniques and Applications
Staff Contact: School Office
S1 L3 T1
Notes: This is a servicing subject taught within courses offered by other schools and faculties.

The physics of various remote sensing techniques; interpretation of conventional aerial photography in exploration; Infra-red remote sensing techniques; side-looking airborne radar; theory and applications of Landsat imagery; interpretation of Landsat photographic products. 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.

SURV0901
Introduction to Mapping
Staff Contact: School Office
S1 L1 T.5
Notes: This is a servicing subject taught within courses offered by other schools and faculties.

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.

SURV1111
Introduction to Computing
Staff Contact: School Office
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.

SURV1711
Introduction to Surveying
Staff Contact: School Office
F L2 T1

Historical development of surveying. Principles of survey observations and the control of observation errors. Discussion of the prupose, methods and products of: geodetic positioning, photogrammetry and remote sensing; cadastral surveying and land information management; engineering, mining, geophysical and hydrographic surveying; mapping. Principles and practical aspects of levelling. Planimetry. Survey data; structures, collection, storage, processing and presentation. The key values of the surveying profession, professional ethics. The role of a surveyor in practice. Current and future challenges of the surveying profession.

SURV2041
Survey Data Presentation
Staff Contact: School Office
S2 L2 T1

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.

SURV2111
Principles of Computer Processing
Staff Contact: School Office
S2 L2 T2
Corequisite: SURV1111

Operating systems; VAX/VMS, or command language. Software; spreadsheets, compilers. Program structure; subroutines, functions, control structures. Program libraries; creation, system libraries. Data structures; arrays, stacks, lists, queues, trees. Data files; types and organisations. Sorting, searching, merging. Data bases; concepts, types, information access.

SURV2221
Introduction to Geodetic Science
Staff Contact: School Office
S2 L2.5 T.5

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.

SURV3011
Surveying Instruments
Staff Contact: School Office
S1 L2.5 T1.5
Prerequisite: SURV1711

Survey tapes and bands; measurement, calibration, reductions. Precise levelling instruments; principles, construction, applications, testing and adjustment, ancillary equipment. Optical and electronic theodolites; principles, construction, testing and adjustment.

SURV3111
Survey Computations
Staff Contact: School Office
S1 L2 T1
Prerequisite: SURV1111

Intersection, resection, trilateration, with and without redundant data, semigraphic solutions. Missing data problems, road intersections. Subdivision calculations. Transformations. Traverse computations. Introduction to PCs and MS DOS.

SURV3231
Geodetic Computations
Staff Contact: School Office
S1 L2 T1
Corequisites: MATH2009, SURV1111

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.

SURV4011
Surveying Techniques
Staff Contact: School Office
S2 L4.5 T1.5
Prerequisite: SURV2041
Corequisites: SURV3011, SURV3111

Principles, reduction of observations and errors in survey techniques of horizontal and zenith angle measurement, trigonometric heighting, traversing, vertical staff tacheometry. Electronic distance measurement; principles, corrections, reductions, calibration, electro-optical distance meters.

SURV4051
Survey Camp 1
Staff Contact: School Office
S2 T3
Prerequisite: SURV1711
Corequisites: SURV3011, SURV4011
Notes: Students are required to attend a one-week survey camp, which is equivalen to 3 class contact hours per week.

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.

SURV4111
Data Analysis and Computing 1
Staff Contact: School Office
S2 L2 T1
Prerequisites: MATH1032, SURV2111
Corequisite: SURV3111

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.

SURV4221
Geodetic Positioning 1
Staff Contact: School Office
S2 L2 T1
Prerequisite: SURV2221
Corequisites: SURV1111, SURV3231

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.

SURV5011
Engineering Surveying
Staff Contact: School Office
S1 L3.5 T.5
Corequisites: SURV3111, SURV4011

Design and computation of horizontal and vertical curves, volume determination, route surveys. Setting out surveys: techniques, setting out of roads, buildings and large structures. Introduction to mine surveying: height and azimuth transfer.

SURV5111
Data Analysis and Computing 2
Staff Contact: School Office
S1 L2 T1
Prerequisite: MATH2829
Corequisite: SURV3111, MATH2009

Applications of least squares analysis in surveying, geodesy and photogrammetry. Statistical testing. Detection of outliers. Use of software packages. Software design and optimisation.

SURV5221
Geodetic Positioning 2
Staff Contact: School Office
S1 L2 T1
Prerequisite: SURV4221
Corequisite: SURV4111

Introduction to satellite positioning; review of reference systems in satellite geodesy; absolute and relative positioning; ranging methods and review of satellite technology. Introduction to the GPS system; measurement modes. Surveying with GPS; planning a survey, instrumentation, field and office procedures. Modelling the observations; principles of data processing. Combination of terrestrial and GPS data. Height determination using GPS. Case studies.

SURV5621
Cadastral Surveying 1
Staff Contact: School Office
S1 L2 T1

The legal system in Australia and NSW; the nature of land law including land tenure, estates in land, interests in land. Land title systems. Land administration in Australia and NSW. Boundary surveying principles. Cadastral mapping in NSW.

SURV5722
Project Management 1
Staff Contact: School Office
S1 L2 T1

Types of business. Organizational 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: organization, management, planning responsibilities, information control. Communication: meeting, negotiation, conflict, dialectic for managers. Financial management reporting, accounting systems, cash flow, cash flow analysis. Budgeting (financial, personnel, equipment), personnel planning. Management of the project resources.

SURV6051
Survey Camp 2
Staff Contact: School Office
S2 T4
Prerequisite: SURV4051
Corequisite: SURV5011
Notes: Students are required to attend a one week Survey Camp which is equivalent to 3 class contact hours per week together with 1 hour per week evaluation.

One week survey project of substantial extent, followed by one hour per week computations, plan and report preparation at the School of Surveying.

SURV6121
Computer Graphics
Staff Contact: School Office
S2 L2 T1

Overview of graphics systems and their relation to computer assisted mapping and information systems. Acquisition, processing, presentation of data. Graphics data structures, algorithms and transformations. Graphics programming using a high level language and graphics language. Use of interactive graphics display terminals.

SURV6511
Photogrammetry and Mapping I
Staff Contact: School Office
S2 L2 T2

Properties of photogrammetric and remotely sensed images; photography, electro-optical, linear array, microwave systems. Photograph geometry; camera calibration, inner orientation, collinearity equations, deviations from collinearity. Stereoscopic vision; Principles of instrumentation for analogue and analytical photogrammetry. Exterior orientation; relative and absolute orientation, ground control point selection.

SURV6621
Cadastral Surveying 2
Staff Contact: School Office
S2 L2 T1
Corequisite: SURV5621

Survey investigation for both artificial and natural boundaries; survey and title searching. Field note preparation for cadastral surveying. Survey marking and preparation of plans of survey. Study of appropriate

statutes and regulations. Cadastral survey techniques for urban and rural properties; the status of roads in NSW, strata plan surveys, identification surveys, consents for MHWM, railways, rivers, kerbs in Sydney. The role of coordinates in cadastral surveying.

SURV6722
Project Management 2
Staff Contact: School Office
S2 L2 T1
Corequisite: SURV5722

Aims and forms of project organization. Preparation of contracts and specifications: contract law, subcontracting, contract work, bidding. Project scheduling, control and documentation. Project teams in a corporation. Psychology of professionals. Qualifications of a project manager. Decision making process in project management: authority, power, interaction, leadership, assignments. Human resource management: small group behaviour, learning curve, management of teams in professional practice, professional liabilities and responsibilities. Short term field planning. Logistics of field work. Case studies in the application of project management to surveying projects.

SURV6811
Land Economics and Valuation
Staff Contact: School Office
S2 L2 T1

The surveyor's role in the economic use of land. Variation of land use and land value. Temporal change in land use due to supply and demand, and its effect on land development and urbanisation. Location theory. public measures for directing land use. introduction to valuation; factors affecting value of land, valuation principles and practice.

SURV7051
Survey Camp 3
Staff Contact: School Office
S1 T7
Prerequisites: all Year 3 subjects

Two weeks survey camp for projects (equivalent to 6 class contact hours per week) selected from areas of cadastral, engineering and geodetic surveying, followed by (one hour per week) computations, plan and report preparation at the School of Surveying.

SURV7311
Offshore Surveying
Staff Contact: School Office
S1 L2 T1

Introduction to offshore and hydrographic surveying. Charts. Law of the sea. Datums at sea, tides, chart datum. Review of visual fixing. Electronic position fixing. Satellite positioning techniques: navigation and kinematic GPS. Platform positioning. Elements of hydrographic surveying. Echo sounding, side scan sonar. Seafloor mapping. Applications and case histories.

SURV7511
Photogrammetry and Mapping 2
Staff Contact: School Office
S1 L2 T1
Prerequisite: SURV6511

Aerial triangulation; semi and analytical methods, block adjustment by models and bundles, control requirements for block adjustment. Differential rectification; orthophotos. Map production; map compilation by photogrammetric techniques, map production processes. Project planning. Non-topographic methods of photogrammetry.

SURV7521
Remote Sensing and Resources Surveys
Staff Contact: School Office
S1 L2 T1

Land resource inventory surveys: general procedures. Remote sensing and its application to resource surveys. Variations of electromagnetic energy. Sensing systems. Elements of image interpretation. Computer assisted image analysis procedures. Sampling methods. Elementary statistics applied to areal sampling. Land classification systems. Reliability of class boundaries. Integrated resource surveys: concepts and specifications. Thematic and parametric surveys.

SURV7531
Spatial Information Systems 1
Staff Contact: School Office
S1 L2 T1

Overview and background of Spatial Information Systems. Explanation of definitions and terminology; LIS, GIS, MPC. Management and institutional issues; land information as maps and records; existing systems; problems. Technological issues; digital maps and data base management; data acquisition; data storage; editing; raster and vector representations; topology. Modelling and analysis.

SURV7712
Land Management and Development Project
Staff Contact: School Office
S1 L1 T1
Corequisite: SURV7811

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 raod hierarchy.

SURV7811
Land Subdivision and Development
Staff Contact: School Office
S1 L2 T1

Subdivision and development control in New South Wales. Administration of subdivision and development under Local Government and environmental planning and assessment legislation; procedures and legal controls. Statutory requirements for land development and subdivision of land, particularly as they apply to broad-acre subdivisions.

SURV8001
Project
S1 T1 S2 T8
Prerequisite: all Year 3 subjects

The project is undertaken in the final year of the BSurv Course with one hour per week in the first session and 8 hours per week in the second session. Students must undertake surveying projects or research tasks in the field or laboratory on a topic approved by the Head of School,

under the guidance of academic staff. Each student is required to submit a written report in prescribed format by a specific date at the end of the second session.

SURV8011
Project Surveying
Staff Contact: School Office
S2 L2 T1
Corequisites: SURV5011

Selected topics from: monitoring of deformations and settlement of terrain, structures and machines; design and optimization of precise engineering networks; high precision distance measurement; 3-D measuring systems; computer controlled surveying; length transducers; alignment surveys; interferometer applications; collimation and auto-collimation techniques; optical tooling; principal and use of gyrotheodolite; electronic tiltmeters; inertial surveys.

SURV8221
Advanced Geodesy
Staff Contact: School Office
S2 L2 T1
Prerequisite: SURV5221

Selected topics from: space technologies including GPS for high precision positioning; satellite altimetry analysis; gravimetric geodesy; 4-D geodesy; inertial positioning technology; methods of kinematic positioning.

SURV8531
Spatial Information Systems 2
Staff Contact: School Office
S2 L2 T1

Management of Land Information Systems; system lifecycle; development; costs and benefits; examples in Australia and overseas. Data management; combination of attribute and graphical data; continuous mapping; indexing; computer considerations; standards for cartography, software, hardware and communications. Future developments. Modelling and analysis with a GIS software system.

SURV8711
Professional Practice
Staff Contact: School Office
S2 T2

Students must complete 60 days of approved professional practice prior to the commencement of this subject. Professional practice is to be taken during the vacation periods. Students are required to provide evidence of this practice in a special log-book (available from the School). A detailed report must be submitted and a seminar must be presented summarising the work done and the experience gained during the professional practice period. Students are required to perform several practical surveying tasks (including instrument adjustment, levelling, traversing and resection) which will be examined.

SURV8712
Land Management and Development Project 2
Staff Contact: School Office
S2 L1 T1
Prerequisite: SURV7712
Corequisite: SURV7811

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.

Graduate Study

Formal graduate courses lead to the award of the degree of Master of Surveying Science **8651** and of the graduate diploma in Surveying **5491**, and opportunities are provided for graduate research leading to the award of the degrees of Master of Surveying **2720** and Doctor of Philosophy **1680.**

The School of Surveying is also involved in the Centre for Remote Sensing and Geographic Information Systems in association with the School of Geography in the Faculty of Applied Science. The Centre supports graduate programs leading to the award of the degree of Master of Engineering Science **8641** or Master of Applied Science **8026** or the Graduate Diploma in Remote Sensing and Geographic Information Systems **5026** or **5496** in addition to supervision for the degree of Doctor of Philosophy.

8651
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 30 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 12 credits. Examples of suitable external subjects are electronic computing, statistics, oceanography, and a range of others.

8651
Surveying

Master of Surveying Science
MSurvSc in Geographic Information Systems

Candidates are required to complete a course totalling at least 30 credits made up of compulsory subjects, elective subjects and a project. Compulsory subjects not offered in a particular year may be substituted by an equivalent subject approved by the appropriate Head of School. The course normally comprises one year of full-time study or two years of part-time study.

Core subjects		**C**
GEOG9240	Principles of Geographic Information Systems	3
GEOG9241	Advanced Geographic Information Systems or	3
GEOG9280	Application and Management of GIS or	3
GEOG9330	Spatial Data/Processing and Integration	3
SURV9604	Land Information Systems	3
Elective subjects		
COMP9311	Data Base Systems	3
ELEC9336	Digital Communication Networks 1	3
GEOG9150	Remote Sensing Applications	3
GEOG9280	Image Analysis in Remote Sensing	3
LIBS0815	Economics of Information Systems	3
LIBS0817	Information Storage and Retrieval Systems	3
SURV9107	Special Topic in Surveying B	3
SURV9532	Data Acquisition and Terrain Modelling	3
SURV9600	Principles of Remote Sensing	3
SURV9608	Cadastral Systems	3
Project		12

Other elective subjects may be added with the approval of the Head of School.

The Masters degree program in 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.

8641
Remote Sensing

Master of Engineering Science
MEngSc

Candidates are required to complete a course totalling at least 30 credits, made up of compulsory subjects, elective subjects and a 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 15 credits) or two years of part-time study.

Compulsory subjects		**C**
GEOG9150	Remote Sensing Applications	3
GEOG9290	Image Analysis in Remote Sensing	3
SURV9600	Principles of Remote Sensing	3
SURV9605	Field Data Collection and Integration	3
SURV9606	Microwave Remote Sensing	3
Project in Remote Sensing (one elective project to be chosen from the list below)†		12

†The subject number for these subjects varies according to the school in which the candidate is enrolled.

Elective subjects
Candidates may 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 Schools.

		C
COMP1011	Computing 1A	4
COMP1021	Computing 1B	4
ELEC9370	Digital Image Processing Systems	3
ELEC9408	Computer Display Systems and Interactive Instrumentation	3
GEOG9210	Computer Mapping and Data Display	3
GEOG9240	Geographic Information Systems	3
GEOL0360	Remote Sensing Applications in Geoscience	3
SURV9213	Physical Meteorology	3
SURV9602	Remote Sensing Procedures	3
SURV9604	Land Information Systems	3

5496
Graduate Diploma in Remote Sensing

GradDip

5491
Graduate Diploma in Surveying

GradDip

Details of the recommended programs of study may be obtained from the Head of the School of Surveying. Subjects from the Masters programs can be taken in the Graduate Diploma programs subject to the approval of the course coordinator.

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

SURV9106
Special Topic in Surveying A
C3

This syllabus changes to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

SURV9107
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.

SURV9121
Network and Deformation Analysis
Staff Contact: School Office
C3 SS L2 T1

Selected topics from: Geodetic datum and invariant quantities, measures of accuracy, testing of hypotheses, out-lier detection, internal and external reliability and sensitivity criteria, variance component estimation, design and optimisation of deformation monitoring networks, two-epoch analysis, multi-epoch analysis, case studies of monitoring networks.

SURV9122
Elements of Geodetic Equipment
Staff Contact: School Office
C3 SS L2 T1

Selected topics from: Measuring system definition and design: principles of signal analysis, analogue to digital conversion, modulation techniques, phase and delay lock loops. Satellite receivers: design of satellite ranging systems, propagation effects, generation, reception and processing of GPS signals, GPS antenna and receiving design. Inertial sensors: principle and design of gyroscopes and accelerometers. Electronic theodolites: absolute and incremental angle encoders and electronic circle, tilt sensors, surveying robots. Electronic distance meters: principle of precision distance meters and laser interferometers, phase and time measuring techniques.

SURV9161
Advanced Estimation Techniques
Staff Contact: School Office
C3 SS L2 T1

Selected topics from: Generalised least squares estimation, sequential least squares estimation, matrix partitioning techniques, Kalman Filtering, covariance analysis, management of large data sets, application in satellite geodesy, network analysis and analytical photogrammetry.

SURV9162
Mathematical Methods
Staff Contact: School Office
C3 SS L2 T1

Selected topics from: Principles and applications of spectral analysis techniques, spherical harmonic expansion of the Earth's gravity field, methods of curve fitting, numerical

methods of differentiation and integration, case studies in satellite orbit dynamics.

SURV9210
Satellite Surveying
Staff Contact: School Office
C3 SS L2 T1

Concepts of satellite surveying: nomenclature, TRANSIT system, GPS for point and relative positioning, vertical control. Surveying 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.

SURV9211
Introduction to Geodesy
Staff Contact: School Office
C3 S1 L2 T1

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.

SURV9213
Physical Meteorology
Staff Contact: School Office
C3 S2 L2 T1

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.

SURV9217
Gravimetric Geoid Evaluations
Staff Contact: School Office
C3 SS L2 T1

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.

SURV9530
Analytical Photogrammetry
Staff Contact: School Office
C3 SS L2 T1

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.

SURV9532
Data Acquisition and Terrain Modelling
Staff Contact: School Office
C3 SS L2 T1

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.

SURV9600
Principles of Remote Sensing
Staff Contact: School Office
C3 S1 L2 T1

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.

SURV9602
Remote Sensing Procedures
Staff Contact: School Office
C3 S2 L2 T1

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 M

SS, TM, SPOT and SAR.

SURV9604
Land Information Systems
Staff Contact: School Office
C3 SS L2 T1

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.

SURV9605
Field Data Collection and Integration
Staff Contact: School Office
C3 S1 HPW3

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.

SURV9606
Microwave Remote Sensing
Staff Contact: School Office
C3 S1 HPW3

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.

SURV9906
Major Assignment
C6

SURV9608
Cadastral Systems
Staff Contact: School Office
C3 SS L2 T1

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.

SURV9909
Project
C9

SURV9912
Project
C12

SURV9918
Project Report
C18

Graduate School of Engineering

Head of School:
Professor C. Patterson

The Graduate School in the Faculty of Engineering is a special unit set up to take study program initiatives on a non-subject oriented basis. The courses that run under its auspices are those that cannot properly be positioned within a particular School.

The two courses currently offered by the School through the MBT Program are the Master of Business and Technology and the Graduate Diploma in Industrial Management. Although the MBT Program is a joint initiative of the Faculties of Applied Science and Engineering, candidates enrol through the Faculty of Engineering.

These courses aim to produce fully professional engineers with advanced management training. Principal amongst the aims and objectives of the MBT Program is a commitment to developing and enhancing links with industry and in so doing improve the quality and relevance of tertiary education and research services to the private and public sectors.

The skills and knowledge developed are directly related to candidates' roles within their organisations. It is, in effect, learning through working - organised learning with the opportunity to draw on examples from leading experts. The program should become an integral component of training strategies used by organisations for preparing their professional technologists and other staff for middle management. It will ultimately be used to prepare outstanding personnel for the challenges of functional and general management. In addition to the traditional management training route of the MBA employers have highlighted the need for managers capable of integrating the technical, commercial and managerial appropriate to their businesses.

The MBT program is strongly aligned to the open learning principles used in the Graduate Management Qualification (GMQ) developed by the Australian Graduate School of Management (AGSM) in order to maintain the University's unique standard of excellence in the professional development of managers.

Subjects from the Industrial Management Qualification (IMQ), the first in the series of articulated courses of the MBT Program, complement those of the GMQ so that is is possible to use subjects from both to qualify for the Master's award. Candidates successfully completing four MBT subjects will have the option of either being awarded an IMQ or proceeding to the second level, the Graduate Diploma in Industrial Management course. Those successfully completing the requirements for the Graduate Diploma will be eligible to transfer to the Master of Business and Technology award course subject to approval by the Head, Graduate School of Engineering. In each case candidates electing to continue to the higher award will normally be required to pass at credit level assessment tasks already undertaken. It is anticipated that a candidate may require a minimum of three years to complete all three levels of the MBT Program.

However, the time taken will depend upon a candidate's starting qualifications and attainment in the program. Special arrangements can be made subject to the approval of the Head of the Graduate School of Engineering.

Course Outlines

8616
Master of Business and Technology

MBT

The course can be completed in a minimum of six sessions and must be completed within ten sessions. To qualify for the Master of Business and Technology (MBT), a candidate must successfully complete 8 subjects (24 credits) and any one of the following options to give a total equivalent to 36 credits. At present, four subjects have been prepared, a second group will be available in 1993.

Core subjects		**C**
GSOE9101	Project Management	3
GSOE9102	Management of Manufacturing Systems	3
GSOE9103	Environmental Management	3
GSOE9104	Management of Innovation and Technological Change	3

Options

an intensive, industry-based research project or	12
an industry-based research project with one other subject to give a total of 36 credits or	9
an industry-based research project with two other subjects to give a total of 36 credits	6

One subject is to considered equivalent to 3 credits with 1 credit equivalent to a minimum of 1 hour per week in a semester/session.

This is because the open learning principles employed for the subjects require 1.5 hours per week per subject and two 3 hour workshops per session per subject face-to-face contact with an instructor. Further, each subject comprises 12 units with each unit requiring a minimum of 4 hours of self-guided learning activities. Consequently each subject requires an input of time in excess of 6 hours per week per session.

Courses of study leading to the award of a Master of Business and Technology provide technical graduates with opportunities to extend their career paths into management. Because the subjects that have been developed for the course require minimum contact hours, employment-based experience and self-paced learning based on open learning principles, it is anticipated that in most cases, candidates will choose only from those subjects. There are also opportunities to select subjects from other professional areas in which candidates may be interested particularly those that incorporate similar open learning strategies, such as the subjects required for the Graduate Management Qualification of the Australian Graduate School of Management (AGSM) provided more than half the credits are selected from the subjects listed above. Enrolment in such subjects will require the approval of the Graduate School of Engineering and other course authorities as appropriate.

5457
Graduate Diploma in Industrial Management

GradDipIndMgt

An applicant should submit an intended program to the Head, Graduate School of Engineering for approval. Candidates must complete a program of eight subjects totalling 24 credits and including core subjects from the Graduate School of Engineering. Those successfully completing all eight subjects may elect to graduate with the Graduate Diploma in Industrial Management or proceed to the third and final level, the Master of Business and Technology.

The Graduate Diploma in Industrial Management is offered only as a self-guided course. It can be completed in a minimum of four academic sessions. The maximum period of candidature is six academic sessions. In special circumstances extensions may be granted.

Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For further details and academic advice regarding the following subjects consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

GSOE9101
Project Management
Staff Contact: Prof D.G. Carmichael
C3

GSOE9102
Management of Manufacturing Systems
Staff Contact: A/Prof R.M. Kerr
C3

GSOE9103
Environmental Management
Staff Contact: Prof A.G. Fane
C3

GSOE9104
Management of Innovation and Technological Change
Staff Contact: Dr J. Carlopio
C3

GSOE9105
Risk Management
Staff Contact: School Office

GSOE9106
Information Systems Management
Staff Contact: School Office

GSOE9107
Maintenance Management
Staff Contact: School Office

Centres in the Faculty of Engineering

The University has established Centres to encourage research and teaching in areas not readily covered by the established programs in Schools and Faculties. Most Centres have concentrated on multidisciplinary fields and have focussed on new initiatives in the expansion of teaching, research and professional services in specialised areas. The majority of Centres are formed within a School or Faculty or groups thereof although some operate as autonomous units.

The Faculty of Engineering has 8 Centres either located within relevant Schools or in association with other Faculties.

Centre for Advanced Numerical Computation in Engineering and Science
Centre for Biomedical Engineering
Centre for Groundwater Management and Hydrogeology
Centre for Manufacturing and Automation
Centre for Photovoltaic Devices and Systems
Centre for Remote Sensing and Geographic Information Systems
Centre for Wastewater Treatment
Munro Centre for Civil and Environmental Engineering

One Centre offers programs which have their own subject identifier. This is the Centre for Biomedical Engineering (BIOM). The Centre's course details are listed later in this section. Information on study programs available through other Centres is located under the appropriate School section in this Handbook.

The Faculty is also closely associated with two of the 15 Cooperative Research Centres established under the Commonwealth Government's program of Cooperative Research Centres (CRCs) in 1991.

The CRC for Aerospace Structures provides an Australian focus for the generation of advanced aerospace technologies which fosters the development of an efficient and internationally competitive Australian aerospace industry. (Contact person: Mr J.R. Page, School of Mechanical and Manufacturing Engineering.)

The CRC for Waste Management and Pollution Control is developing new approaches which aim to lessen the threat to the environment caused by urban, industrial and agricultural wastes and in the process establish the basis for an environmental management industry. (Contact Mr R. Frost, Director, CRC for Waste Management and Pollution Control.).

Centre for Advanced Numerical Computation in Engineering and Science

Director:
Professor G. de Vahl Davis

The Centre for Advanced Numerical Computation in Engineering and Science (CANCES) was established by the University during 1992. Its two main purposes are to conduct sponsored research, involving heavy computational resources, on problems of industrial, scientific and national importance and to offer postgraduate and short courses in the field.

CANCES is a joint venture between the Faculties of Engineering and Science but the Centre is located in the School of Mechanical and Manufacturing Engineering. Its facilities include a two-processor Cray Y/MP-EL supercomputer available for research in the areas of computational science and engineering. PhD and Masters programs of the Faculties of Engineering and Science have been adapted to encourage specialization in computational engineering and science. Special courses in computational mathematics and supercomputing techniques are provided.

Centre for Biomedical Engineering

Director:
Professor K. Schindhelm

Centre Administration:
Ms R. Cuningham

The Centre for Biomedical Engineering is an interdisciplinary unit which promotes and co-ordinates biomedical engineering studies and research being conducted by various schools and departments within the University and its teaching hospitals. Biomedical engineering involves the application of engineering techniques to biomedical problems with particular emphasis on clinical medicine.

The Centre offers formal graduate programs leading to the award of the degree of Master of Biomedical Engineering 8660 and a Graduate Diploma in Engineering 5462. Opportunities are provided for graduate research leading to the award of the degrees of Master of Science 2795 and Doctor of philosophy 1710. The MBiomedE degree course is designed to cater for students with either a medical or engineering/physical science background. Initially, students with a medical background study basic engineering subjects such as mathematics, mechanics, electronics and computing, whilst students with a non-medical background take courses in physiology, anatomy, pathology and biochemistry. Later, both groups choose electives from biomechanics, biophysics, biomaterials, medical instrumentation and mass transfer in medicine, as well as undertaking a research project.

Graduate Study: Course Outlines

8660
Master of Biomedical Engineering

MBiomedE

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.

Period of candidature: The normal period is four academic sessions (full-time) or six academic session (part0time) from the date of enrolment. The maximum period of cadidature is eight academic sessions (full-time) and ten academic sessions (part-time). In special cases extensions may be granted. A candidate is not permitted to continue in the course if the credit value of the subjects failed totals more than twelve.

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)		C
ANAT2111	Introductory Anatomy (Strand A) HR	6
BIOM9028	Radiation Physics	3
BIOM9040	Analogue Electronics for Biomedical Engineers	4
BIOM9060	Biomedical Systems Analysis	3
BIOM9101	Mathematical Modelling for Biomedical Engineers (Strand B) C	4
BIOM9501	Computing for Biomedical Engineers (Strand B) HR	4
BIOM9510	Introductory Biomechanics	3
BIOM9551	Biomechanics of Physical Rehabilitation	3
BIOM9561	Mechanical Properties of Biomaterials	3
BIOM9601	Biomedical Applications of Microcomputers 1	3
BIOM9621	Biological Signal Analysis	3
BIOM9701	Dynamics of the Cardiovascular System	3
ELEC9411	Introductory Physiology for Engineers	3
PHPH2112	Physiology (1 full year) (Strand A) C	12
Session 2 (July-November)		
BIOM9010	Biomedical Engineering Practice C	2
BIOM9012	Biomedical Statistics	4
BIOM9018	Project Report C	18
BIOM9027	Medical Imaging	4
BIOM9030	Project Report	30
BIOM9050	Microprocessors and Circuit Design for Biomedical Engineers	4
BIOM9311	Mass Transfer in Medicine	4
BIOM9321	Physiological Fluid Mechanics	4
BIOM9332	Biocompatibility	3
		C
BIOM9541	Mechanics of the Human Body	3
BIOM9602	Biomedical Applications of Microcomputers 2	3
BIOM9603	Image and Flow Cytometry	3
BIOM9611	Medical Instrumentation	3
PHPH2112	Physiology 1 (continued)	
SAFE9533	Electrical Safety	3

C Compulsory
HR Highly recommended

5462
Graduate Diploma in Biomedical Engineering

GradDip

The program of study must total 30 credits and include at least 18 credits at graduate level. An applicant for admission to the graduate diploma course should be a graduate of an approved university or have other qualifications as may be approved by the Faculty of Engineering.

The normal period of candidature is two academic sessions (full-time) or four academic sessions (part-time). The maximum period of candidature is four academic sessions (full-time) and eight academic sessions (part-time). A

candidate is not permitted to continue in the course if the credit value of subjects failed totals more than six.

Subject choices are the same as for the Master of Biomedical Engineering course.

Graduate Study: Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

BIOM9010
Biomedical Engineering Practice
Staff Contact: Prof K. Schindhelm
C2 S2 L2
Notes: Compulsory for all students

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.

BIOM9012
Biomedical Statistics
Staff Contact: Dr R. Odell
C4 S2 L3 T1

Probability and distributions. Estimation and hypothesis testing. Associations between disease and risk factors. Linear models; analysis of variance, simple and multiple regression, discriminant analysis. Distribution-free methods. Analysis of survival data. Experiment design.

BIOM9018
Project Report
Staff Contact: Prof K. Schindhelm
C18
Notes: Compulsory for all students.

Projects are undertaken at the Centre or other relevant institutions towards the end of the course. Topics are chosen in collaboration with a supervisor from the Centre.

BIOM9027
Medical Imaging
Staff Contact: A/Prof C.D. Bertram
C4 S2 L2 T2
Prerequisites: Assumed knowledge/prerequisites BIOM9028, BIOM9010

Fundamentals of producing a medical image, image collection techniques, image reconstruction algorithms. Detailed examination of four main areas of medical imaging: Nuclear Medicine, Ultrasound, Diagnostic Radiology, Magnetic Resonance Imaging. Clinical application of each area.

BIOM9028
Radiation Physics
Staff Contact:Dr B.K. Milthorpe
C3 S1 L2 T1
Prerequisites: Mathematics at University year 1 level required.

Basic physics of interaction of photons and particles with matter. Nuclear/atomic structure, nuclear reactions, radioactivity counting statistics, dosimetry, detectors. Radiation biology, interaction of ionising radiation with water and tissues. X-ray therapy. Medical uses of non-ionising electro-magnetic radiation.

BIOM9030
Project Report
Staff Contact: Prof K. Schindhelm
C30
Notes: This subject can only be taken with permission of the Director.

Projects are undertaken at the Centre or other relevant institutions towards the end of the course. Topics are chosen in collaboration with a supervisor from the Centre.

BIOM9040
Analogue Electronics for Biomedical Engineers
Staff Contact: Dr B.K. Milthorpe
C4 S1 L2 T2
Notes: For students with no electronics background.

Basic theory of passive components, simple network analysis, small signal amplifiers, feedback and oscillators, operational amplifiers and their uses, analogue integrated circuits. Safety requirements for medical instruments, circuit diagram analysis and component identification. Laboratory work involves both design and construction of analogue circuits.

BIOM9050
Microprocessors and Circuit Design for Biomedical Engineers
Staff Contact: Dr B.K. Milthorpe
C4 S2 L2 T2
Prerequisite: BIOM9501, BIOM9040 or equivalents.
Notes: Students should NOT have a digital electronics background.

Examination of the fundamental digital and analogue 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.

BIOM9060
Biomedical Systems Analysis
Staff Contact: Dr R. Odell
C3 S1 L2 T1
Corequisite: BIOM9101 at least
Notes: Mathematics background required.

Analysis of compartmental systems in biology and medicine. Applications include pharmacology, physiology and nuclear medicine. Topics include the mathematics of linear compartmental systems, non-linear systems, tracer methods, parameter estimation by fitting models to date, the optimum design of experiments, and methods of control.

BIOM9101
Mathematical Modelling for Biomedical Engineers
Staff Contact: Dr R. Odell
C4 S1 L3 T1
Notes: Compulsory for Strand B students. This subject is also for students with 1 year university maths or less.

Calculus Bridging Course is recommended for those with less.

Model formulation and validation. Ordinary differential equations. Laplace transforms. Partial differential equations. Fourier series. Numerical methods.

BIOM9311
Mass Transfer in Medicine
Staff Contact: Dr R. Odell
C4 S2 L2 T2

Mass transfer in the living organism and in extracorporeal medical devices. Principles of diffusion and convection. Models of gas transfer in the lung. Transfer of solutes at the capillary level. Haemodialysis, haemofiltration, plasma filtration and blood oxygenators. Transfer across the peritoneal membrane-dialysis or drug delivery. Drug delivery across the skin.

BIOM9321
Physiological Fluid Mechanics
Staff Contact: A/Prof C.D. Bertram
C4 S2 L2 T2

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.

BIOM9332
Biocompatibility
Staff Contact: Prof. K. Schindhelm
C3 S2 L2 T1

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.

BIOM9501
Computing for Biomedical Engineers
Staff Contact: Prof K. Schindhelm
C4 S1 L2 T2
Notes: Highly recommended for Strand B students. This subject is for students with little or no previous computing experience.

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.

BIOM9510
Introductory Biomechanics
Staff Contact: A/Prof C.D. Bertram
C3 S1 L2 T1
Notes: Mechanics Bridging Course recommended for students with NO mechanics background.

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.

BIOM9541
Mechanics of the Human Body
Staff Contact: Prof N.L. Svensson
C3 SS L2 T1
Prerequisites: BIOM9510 and ANAT2111

Statics and dynamics of the musculoskeletal system: mathematical modelling and computer simulation, analysis of pathological situations.

BIOM9551
Biomechanics of Physical Rehabilitation
Staff Contact: Prof N.L. Svensson
C3 S1 L2 T1
Prerequisite: BIOM9541
Notes: This subject is not offered on a regular basis.

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.

BIOM9561
Mechanical Properties of Biomaterials
Staff Contact: Prof N.L. Svensson
C3 SS L2 T1
Prerequisite: BIOM9510
Notes: This subject is not offered on a regular basis.

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.

BIOM9601
Biomedical Applications of Microcomputers 1
Staff Contact: Dr A. Avolio
C3 S1 L3
Prerequisites: BIOM9040 and BIOM9050 or equivalents.
Notes: Excluded ELEC9406. A reasonably advanced background in microprocessors is required. Entry to course is by interview.

Microcomputer architecture; physiological data acquisition systems: input/output signals and devices; assembly language programming; interfacing to higher level languages; the numeric data co-processor; interrupts; graphics; practical sessions on use of Debug, Assembler, familiarisation with interrupt vector table and I/O ports. Major assignment on specific biomedical application (eg. bedside ECG monitor).

BIOM9602
Biomedical Applications of Microcomputers 2
Staff Contact: Dr A. Avolio
C3 S2 L3
Prerequisite: BIOM9601
Notes: A reasonably advanced background in microprocessors is required. Entry to course is by interview.

Data communication; serial and parallel ports; BIOS and DOS interrupts; interfacing to external devices; stepper motor control. Implementation and analysis of a range of microcomputer-based biomedical applications, eg. variable rate infusion pump, physiological reaction-time monitoring system; measurement of coronary sinus flow, temperature control; position control; operation of intra-aortic balloon pump.

BIOM9603
Image and Flow Cytometry
Staff Contact: Dr B.K. Milthorpe
C3 S2 L3
Notes: Basic electronics/computing background required.

Technology, techniques and uses of flow and static cytometry. Flow and 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.

BIOM9611
Medical Instrumentation
Staff Contact: A/Prof C.D. Bertram/ Dr A. Avolio
C3 S2 L2 T1
Prerequisite: BIOM9040 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.

BIOM9621
Biological Signal Analysis
Staff Contact: A/Prof C.B.Bertram
C3 S1 L3
Notes: Basic electronics and mathematics background required.

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.

BIOM9701
Dynamics of the Cardiovascular System
Staff Contact: A/Prof C.D. Bertram
C3 S1 L2 T1
Notes: Some mathematics background desirable.

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.

Centre for Groundwater Management and Hydrogeology

Director:
Associate Professor C. Dudgeon

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, to co-ordinate and develop postgraduate courses and continuing education programs, and to liaise with industry. The Schools involved in the Centre are the School of Mines, Department of Applied Geology, in the Faculty of Applied Science and the School of Civil Engineering in the Faculty of Engineering.

The Centre offers graduate programs leading to the award of the degree of Master of Applied Science 8021 in addition to supervision for the the degrees of Master of Science and Doctor of Philosophy. The programs are designed for geologists, engineers and others with appropriate background degrees. Graduate Diploma programs are also offered.

Detailed information on the programs available can be obtained from the Director of the Centre.

Centre for Manufacturing and Automation

Director:
Dr S.S. Leong

The Centre is located within the School of Mechanical and Manufacturing Engineering. Its main purpose is to offer short courses for professionals from industry to upgrade their technological and managerial skills

Centre for Photovoltaic Devices and Systems

Director:
Professor M. Green

The Centre for Photovoltaic Devices and Systems was established in 1991 under the Commonwealth Special Research Centres Scheme. Its function is to carry out research into improved performance, lower cost photovoltaic solar cells and develop a co-ordinated set of activities in the photovoltaic systems area. The Centre is housed in the School of Electrical Engineering.

Centre for Remote Sensing and Geographic Information Systems

Director:
Dr A.K. Skidmore

Deputy Director:
Professor J.C. Trinder

The Centre for Remote Sensing and Geographic Information Systems is a joint multidisciplinary 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, in association with schools in the Faculties of Engineering and Applied Science supports graduate

programs leading to the award of the degree of Master of Engineering Science 8641 or Master of Applied Science 8026 or the Graduate Diploma in Remote Sensing 5026 or 5496 in addition to supervision for the degree of Doctor of Philosophy. Students from a wide variety of backgrounds can undertake the programs which may include engineering, geography, geology, surveying, planning, biology and agricultural or environmental studies.

Entry into either the Faculty of Engineering or the Faculty of Applied Science depends on the background of the applicant and the orientation of the proposed program. The Schools involved in the Centre are the School of Geography in the Faculty of Applied Science and the School of Surveying in the Faculty of Engineering.

Centre for Wastewater Treatment

Director:
Position vacant

The Centre for Wastewater Treatment was established with a grant provided by the Australian Water Advisory Council. Wastewater treatment is concerned with the application of research to the solution of problems of wastewater and its treatment. The Centre's program comprises grant projects, sponsored research projects, consultancies, education and training elements. As well as supporting research students, the Centre provides professional refresher and other continuing education courses.

Munro Centre for Civil and Environmental Engineering

Director:
Emeritus Professor G.E. Roberts

The Munro Centre for Civil and Environmental Engineering has been established in the School of Civil Engineering. Its purpose is to support the School, and to facilitate interactiion between the School, the engineering profession, industry and government. The Centre promotes ongoing education in civil and environmental engineering by organizing conferences, courses and seminars.

Servicing Subject Descriptions

Descriptions of all subjects are presented in alphanumeric order within organizational units. For academic advice regarding a particular subject consult with the contact for the subject as listed. A guide to abbreviations and prefixes is included in the chapter 'Handbook Guide', appearing earlier in this book.

The following subjects are offered by other Faculties at UNSW, and contribute as either part of courses contained in this handbook, or as electives.

Accounting

Accounting is a School within the Faculty of Commerce and Economics

ACCT9001
Introduction to Accounting A
Staff Contact: School Office
S1 L1.5

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.

ACCT9002
Introduction to Accounting B
Staff Contact: School Office
S2 L1.5
Prerequisite: ACCT9001

An introduction for non-commerce students to managerial accounting. Long-range planning, budgeting and responsibility accounting: cost determination, cost control and relevant cost analyses.

ACCT9062
Accounting for Engineers
Staff Contact: School Office
F L1.5

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.

Anatomy

Anatomy is a School in the Faculty of Medicine

ANAT2111
Introductory Anatomy
Staff Contact: Dr P. Pandey
C6 S1 L2 T4
Prerequisites: BIOS1011, BIOS1021

Introduction to gross anatomy, based on a study of prosected specimens. Musculoskeletal, cardiovascular, respiratory, gastrointestinal, genito-urinary and nervous systems. General topographical and surface anatomy.

Biological Science

Biological Science is a School in the Faculty of Biological and Behavioural Sciences

BIOS1021
Biology B
Staff Contact: Dr R. Vickery
S2 L2 T4
Prerequisite: BIOS1011 (however, students without this prerequisite may seek the permission of the Co-ordinator of First Year Biology to enrol. Students enrolling in Environmental Engineering will be exempted)

The evolution, diversity and behaviour of living things and the ways in which they have adapted to varying environments. Emphasis on the structure and function of flowering plants and vertebrate animals, and their roles in Australian ecosystems. The theory covered in lectures and tutorials is illustrated by observation and experiment in laboratory classes which will include dissection of a toad and a rat.

BIOS3111
Population and Community Ecology
Staff Contact: A/Prof B. Fox
S1 L2 T4
Prerequisite: BIOS1021 and MATH1032 or MATH1042 ornd MATH1021

Factors regulating dynamics of interacting populations, renewable resource management, ecosystem stability,

cycles and chaos, simulation modelling in ecology, niche theory, competition, habitat selection, community structure,species diversity, island biogeography, ecological gradients. Succession in following disturbance (fire, mining, or logging). Participation in field work is essential.

Biotechnology

Biotechnology is a Department within the School of Applied Bioscience in the Faculty of Applied Science

BIOT7100
Biological Principles
Staff Contact: Dr S. Delaney
S1 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. Basic plant biology, plant structure and function; transport. Invertebrate zoology, evolution and animal behaviour. Microorganisms of commercial significance. Biodeterioration and biodegradation.

Chemical Engineering and Industrial Chemistry

Chemical Engineering and Industrial Chemistry is a School within the Faculty of Applied Science

CEIC0010
Mass Transfer and Material Balances
Staff Contact: Dr E. Curry-Hyde
F L1 T1
Prerequisites: CHEM1101, CHEM1201, CIVL2505

Fundamentals of Mass Transfer: diffusion, mechanisms of mass transfer, models for mass transfer at fixed and free interfaces. Calculation of mass transfer rates at surfaces with simple geometry. Mass transfer in dispersions. Material balances: applications of process calculations in chemical process operations, conventions in methods of analysis and measurement. The chemical equation and stoichiometry. Process calculations associated with gases, vapours and liquids. Problems involving bypass, recycle and purge. Differential material balances.

CEIC0020
Fluid/Solid Separation
Staff Contact: A/Prof N.R. Foster
SS L1.5 T.5

Particle Characterisation: Size analysis, sphericity, surface area, density. Fluid-particle Interactions: Drag coefficient, effect of Reynolds number. Terminal velocity, effect of shape, concentration. Drops and bubbles. Particle-particle interactions including flocculation. Flow through porous media. Darcy, Carmen-Kozeny, Ergun equation. Applications of Fluid-Particle Systems: Sedimentation and thickening, elutriation, cyclones, filtration, constant pressure filtration, specific resistance, equipment, filter aids, centrifugal separations.

CEIC0030
Environmental Protection in the Process Industries
Staff Contact: Dr P. Crisp
SS L3 T3
Prerequisites: CEIC0010, INDC3070, INDC4120

Selection of 3 topics from:

Environmental Pollutants
The characteristics of pollutants in air and water. Consequences of pollutions by aqueous, gaseous and solid wastes; case histories. Standards and regulations; legislative aspects. Measurement, analysis and sampling - modern techniques of environmental chemical analysis.

Pollution Control Techniques
Water - primary, secondary and tertiary treatment. Air - removal of particles, chemicals and odours. Solid - disposal procedures. Noise - reduction techniques.

Water Pollution Control Engineering
Screening. Settling tank design. Coagulation and flocculation (colloid chemistry, double-layer theory and flocculation theory). Clarifier design. Filtration technologies - deep bed filtration. Biological treatment plant design - trickling filters - activated sludge processes (and variants) -anaerobic digesters. Sludge processing and disposal.

Air Pollution Control
Case histories, statistics. Single component failure, failure rate data. Reliability theory, series, parallel and redundant systems. Hazard and operability studies. Quantitative risk assessment - hazard identification - failure frequency - consequence calculations (preliminary methods). Laboratory safety.

Laboratory for Environmental Analysis
14 hour laboratory unit developing techniques in modern environmental analysis.

Advanced Environmental Protection
This comprises a series of elective strands which build upon the core subject as follows:

1. Advanced treatment methods (water)
2. Advanced treatment methods (air)
3. Hazardous wastes
4. Computer-aided risk assessment
5. Advanced laboratory
6. Occupational Health Laboratory

CEIC5630
Industrial Water and Wastewater Engineering
Staff Contact: Prof A.G. Fane
C3 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.

CHEN3070
Process Control
Staff Contact: Dr D.C. Dixon
S2 L2
Prerequisites: CEIC2010, CEIC2020, MATH2021

Unsteady state modelling of simple processes: linearisation, transfer function, concept of input-output models. Lumped parameter versus distributed parameter systems. Process identification: transient, frequency, pulse and correlation analysis. Control system hardware: transducers, valves, measuring devices for flow, pressure, temperature.

INDC4120
Chemistry of the Industrial Environment
Staff Contact: Dr P. Crisp
S1 L2 T1
Prerequisites: CHEM1101, CHEM1201

Soil chemistry. Occupational diseases. Smogs and acid rain. Toxic elements and compounds. Toxic waste disposal. Industrial accidents. Atmospheric structure and chemistry. Greenhouse warming. The Ozone hole. Nuclear energy. Alternative energy sources. Water analysis. Air analysis. Occupational health.

Chemistry

Chemistry is a School in the Faculty of Science

Level I

CHEM1002
Chemistry 1
Staff Contact: Dr P. Chia
F L3 T3
Prerequisites: HSC Exam Score Range required - 2 unit Mathematics 55-100 or 3 unit Mathematics 1- 50 or 4 unit Mathematics 1-100 and 2 unit Chemistry 53-100, or 3 unit Science 90-150,or 4 unit Science 1- 50, or 2 unit Physics 53-100
Note: CHEM1002 is the normal prerequisite for Level II Chemistry.

Stoichiometry and solution stoichiometry. Atomic and molecular structure. Changes of state, phase diagrams, gases, liquids, solids, solutions. Thermodynamics, equilibrium constants, acid-base and solubility. Oxidation and reduction. Kinetics. Molecular hybridization of orbits. Periodicity of physical and chemical properties of elements and compounds. Organic chemistry including stereoisomerism.

CHEM1201
Chemistry 1B
Staff Contact: Dr P. Chia
S2 L3 T3
Prerequisites: CHEM1101
Note: The two subjects CHEM1101 and CHEM1201, taken sequentially, are equivalent to CHEM1002.

Molecular geometry, hybridization of orbitals. Periodicity of physical and chemical properties of elements and compounds. Organic chemistry, including stereoisomerism.

CHEM1806
Chemistry 1EE
Staff Contact: Dr P. Chia
S1 L2 T1
Prerequisites: HSC Exam Score Range Required - 2 unit Mathematics 67-100, or 3 unit Mathematics 1-50, or 4 unit Mathematics 1-100, and 2 unit Science (Physics) 53-100, or 2 unit Science (Chemistry) 53-100, or 4 unit Science 1-50, or 3 unit Science 90-150

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.

CHEM1807
Chemistry 1ME
Staff Contact: Dr P. Chia
S1 L3 T3
Notes: Excluded CHEM1101, CHEM1201, CHEM1002. Restricted to Course 3681.

Stoichiometry. Atomic and molecular structure. Chemistry of materials. Thermochemistry. Kinetics. Equilibrium. Oxidation and reduction, electrochemistry and corrosion of metals. Introduction to organic chemistry, structure and properties of polymers, fuels and lubricants. Surface chemistry.

CHEM1808
Chemistry 1CE
Staff Contact: Dr P. Chia
S2 L3 T3
Notes: Excluded CHEM1101, CHEM1201, CHEM1002. Restricted to Course 3730.

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.

Level II

CHEM2011
Physical Chemistry
Staff Contact: Dr D. Smith
S1 or S2 L3 T3
Prerequisites: CHEM1002, MATH1032 or MATH1042 or MATH1011 and MATH1021

First, second and third laws of thermodynamics. Applications of thermodynamics. Chemical and phase

equilibria. Solutions of electrolytes and nonelectrolytes. Principles and applications of electrochemistry. Reaction kinetics: order and molecularity; effect of temperature on reaction rate. Surface and colloid chemistry.

CHEM2031
Inorganic Chemistry and Structure
Staff Contact: Dr D. Phillips
S1 or S2 L3 T3
Prerequisites: CHEM1002

Experimental basis for theories of electronic structures of atoms and molecules. Concepts and consequences of quantum theory. Structure, energetics and bonding in the solid state. Principles of co-ordination chemistry. Occurrence, preparation, properties and reactions of selected compounds of transition and main group elements.

CHEM2041
Chemical and Spectroscopic Analysis
Staff Contact: Dr G. Moran
S1 or S2 L3 T3
Prerequisites: CHEM1002, MATH1032 or MATH1042 or MATH1011 and MATH1021

General procedures in analytical science, accuracy, propagation of errors, precision. Analytical equilibrium chemistry, titrimetric, and gravimetric, analysis. Solvent extraction. Electroanalytical methods. Chromatography. Optical spectroscopy, instrumental aspects of all major spectroscopic methods.

Level III

CHEM3311
Environmental Chemistry
Staff Contact: Dr W. Johnson
S2 L3 T3
Prerequisites: CHEM2011, CHEM2041

Physical chemistry of the environment. The chemistry of water in the environment; rivers, estuaries and oceans. The chemistry of the atmoshpere: photolysis., primary and secondary pollutants. The distribution of elements in ecosystems. Analysis of naturally occurring species and pollutants.

Economics

Economics is a School in the Faculty of Commerce and Economics

ECON1103
Staff Contact: A/Prof T. Parry
S1 L2 T1.5
Prerequisite: HSC minimum mark required - Contemporary English 60, or 2 unit English (General) 60, or 2 unit English 53, or 3 unit English 1
Notes: Excluded ECON1101 and ECON1102.

Introduction to economics as a social science, scarcity, resource allocation and opportunity cost. Consumer and producer behaviour as the basis for supply and demand analysis. Introduction to marginal analysis. Applications of supply and demand analysis. Efficiency concepts and market forces.

Fuel Technology

Fuel Technology is a Department within the School of Chemical Engineering and Industrial Chemistry.

FUEL0020
Fuels and Energy
Staff Contact: A/Prof G. Sergeant
S2 L3 T1

A servicing subject for students in Electrical Engineering which covers the topics, sources and properties of fuels and energy, energy use patterns, principles of combustion, combustion calculation, the technology of boilers and other fuel plant, thermodynamic cycles, new and emerging energy technologies, including solar, wind and nuclear energy.

FUEL5880
Unit Operations in Wastewater, Sludge and Solid Waste Management
Staff Contact: A/Prof G. Sergeant
C3

Please see subject description for FUEL5881.

FUEL5881
Unit Operations in Wastewater, Sludge and Solid Waste Management
Staff Contact: A/Prof G. Sergeant
C3
Notes: FUEL5881 is for external students

Physical wastewater treatment processes including sedimentation, flotation, flocculation, pecipitation. Sludge management including conditioning, filtering, lagoons, drying. Introductory fuel engineering. Combustion principles. Incineration. Pyrolysis. Gasifcation. Resource recovery and recycling. Incinerator and afterburner design.

FUEL5920
Practical Aspects of Air Pollution Measurement and Control
C3 S1 or S2 T3
Prerequisite: FUEL5910 or equivalent

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.

Geography

Geography is a School within the Faculty of Applied Science

GEOG1031
Environmental Processes
Staff Contact: Drs M. Fox, M. Melville and Mr A. Evans
S2 L2 T2
Notes: Excluded GENS4240.

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, and to movement of materials.

GEOG2021
Introduction to Remote Sensing
Staff Contact: Mr A. Evans
S2 L2 T2
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 airphoto 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.

GEOG2032
Geomorphology
Staff Contact: Dr W. Erskine, Dr I. Prosser
S2 L2 T2
Prerequisites: GEOG3051

Drainage basin processes including: weathering, the production of runoff and sediment, sediment tracing, sediment budgets and denudation histories. The processes of river channel change including sediment transport, hydraulics, hydrogeology, hydraulic geometry and channel patterns and floodplain formation. There will be an emphasis on the application of geomorphic principles to land management.

GEOG3011
Pedology
Staff Contact: Dr M. Melville
Prerequisites: GEOG1031 or GEOG1051 and one of CHEM1101 or CHEM1401 or both GEOL1101 and GEOL1201 or both BIOS1011 or BIOS1021

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.

GEOG3021
Biogeography
Staff Contact: A/Prof J. Dodson and Dr M. Fox
S1 L2 T2
Prerequisites: GEOG1031 or GEOG1051 or both BIOS1011 and BIOS1021

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 humans 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. Management of vegetation in different climate regimes.

GEOG3032
Remote Sensing Applications
Staff Contact: Mr A. Evans
S2 L2 T2
Prerequisite: GEOG2021 or SURV8711

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.

GEOG3042
Environmental Impact Assessment
Staff Contact: Drs W. Erskine, S. Walker
S1 L2 T2
Prerequisites: GEOG1031 or GEOG1051 or by permission from Head of School

Rationale and basic objectives; history and legislative framework; standardized types of environmental impact assessment EIA, including matrix approach, adopted methods of EIA in Australia. 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.

GEOG3051
Soils and Landforms
Staff Contact: Drs W. Erskine, I. Prosser
S1 L2 T2
Prerequisite: GEOG1031 or GEOG1051

An introduction to soil classification schemes with particular emphasis on the soils and landforms of floodplains and the

Riverina Plain, NSW. Long term development of landscapes with emphasis on the evolution of mountain ranges. Arid zone and coastal landforms emphasising currrent processes and Quaternary history.

GEOG3062
Environmental Change
Staff Contact: A/Prof J. Dodson
S2 L2 T2
Prerequisite: Successful completion of a Year 2 Programme in Applied Science, Science, or Arts or equivalent as approved by the Head of School

The nature of environmental change on the land, oceans, biosphere and atmosphere. Evolution of the continents, oceans, life and atmosphere. Techniques for environmental reconstruction and chronology building. Quaternary climatic change and modelling. Human impact on the atmosphere and climatic consequences.

GEOG3211
Australian Environment and Natural Resources
Staff Contact: Drs M. Fox and I. Prosser
S1 L2 T2
Prerequisite: GEOG1051 or GEOG1031
Notes: Two field tutorials equivalent to 16 tutorial hours are compulsory.

The characteristics of Australia's physical and biotic environment: geology, climate, geomorphology, soils, vegetation and fauna. The problems of exploiting Australia's water and land resources including the degradation of land by erosion, salinization and soil fertility decline; and habitat loss and fragmentation

GEOG9150
Remote Sensing Applications
Staff Contact: Drs A. Skidmore and Q. Zhou
C3 S1 L1 T2

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.

GEOG9210
Computer Mapping and Data Display
Staff Contact: Prof B. Garner
C3 S1 L2 T2

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 and GIMMS for cartographic manipulation and output.

GEOG9240
Principles of Geographic Information Systems
Staff Contact: Dr Q Zhou
C3 S1 L1 T3

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 and MAP for spatial data manipulation and display.

GEOG9290
Image Analysis in Remote Sensing
Staff Contact: Dr A. Skidmore
C3 S1 L1 T1

Techniques for extracting information from satellite imagery including image enhancement techniques, classification and feature recognition, statistical methods and related procedures. Emphasis is on appliications relating to vegetation cover and natural resource management. Practical work will be undertaken using the ERDAS image processing software.

GEOG9300
Vegetation Management
Staff Contact: Dr M. Fox
C3 S1 L2 T1
Notes: Fieldwork forms a compulsory part of this subject and students will incur personal costs.

The subject provides a background in theory and practice in vegetation management, particularly under Australian conditions. It covers the description and measurement of vegetation, vegetation dynamics, vegetation response to perturbation and human impacts, theories, and modelling of vegetation change. A third of the subject is devoted to management strategies of selected vegetation types.

GEOG9310
River Management
Staff Contact: Dr W. Erskine
C3 S1 L2 T1

The principles of river management including total or integrated catchment management, environment impact assessment, in-stream uses and hydrogeomorphic behaviour. Issues covered include regulated rivers, interbasin diversions, extractive industries, urbanization, river engineering, legislative controls and institutional responsibilities. The course develops an understanding of how and why rivers respond to human activities and ways of ameliorating negative impacts. Field work is an essential part of the subject and the Nepean River will be used as a case study of management problems.

GEOG9320
Soil Degradation and Conservation
Staff Contact: Dr M. Melville, Dr W. Erskine
C3 S2 L2 T1
Notes: Fieldwork forms a compulsory part of this subject and students will incur personal costs.

Identification, assessment and analysis of the main processes of soil degradation, including the role of climate, vegetation, geomorphology and pedology in controlling the processes. Discussions of appropriate management strategies for reducing degradation and for reclaiming

degraded landscapes. Topics include: surface wash, gully eosion, wind erosion, soil acidification, soil structure decline, salinization, accumulation of toxins and desertification.

GEOG9512
Project
Staff Contact: Dr M. Sant, Dr A. Skidmore
C12

An investigation of a problem in remote sensing or geographical information systems which involves an identifiable research-component. Such an investigation should be related to the research interests of particular Schools within the Faculty of Applied Science.

Applied Geology

Applied Geology is a Department within the School of Mines in the Faculty of Applied Science

GEOL5100
Geology for Civil and Environmental Engineers
Staff Contact: Dr P.G. Lennox
S1 L2 T1

An introduction to mineralogy, petrology, structural geology, stratigraphy and geomorphology. Weathering of rocks and development of soils. The role of the geologist in civil and environmental engineering.

GEOL5311
Geology for Mining Engineers 2
Staff Contact: Dr M.B. Katz
F L2 T2
Notes: a geology field excursion is held at the end of Session 1, attendance is compulsory.

Palaeontology and Stratigraphy: principles of stratigraphy; the use of fossils in stratigraphic correlation and bore logging. Structural Geology: elements of structural geology; stereographic projection and fracture analysis applied to mining operation. Geology of Fuels: origin and properties of coal, oil, oil shale and natural gas; stratigraphic and structural consideration in exploration and development of coal and petroleum deposits. Hydrogeology: principles of hydrogeology: transmission of groundwater in rocks and soils applied to mining operations. Ore Deposits:mineralogy of industrially imnportant metallic and non-metallic minerals; theories of ore formation including secondary enrichment processes. Exploration Procedures: theories and application of exploration techniques in mineral and coalfield exploration including geological and geophysical methods.

GEOL9010
Hydrogeology
Staff Contact: Applied Geology Office
C3 S1 L1.5 T1.5

Surface and sub-surface methods of geological and geophysical investigation; ground water exploration of confined and unconfined aquifiers. Geological and hydraulic characteristics of rocks; aquifer boundaries, groundwater storage and quality. Hydraulics of wells. Hydrogeological systems analysis, including computer methods, mapping techniques and groundwater resources evaluation. Hydrogeology of arid and semi-arid zones. Case history studies of groundwater fields.

GEOL9011
Hydrogeology G
Staff Contact: Applied Geology Office
C3 S1 L1.5 T1.5

Hydrologic and hydrochemical cycles, catchment hydrogeology and principles of groundwater flow. Elements of groundwater chemistry. Well hydraulics. Pumping tests. Hydrogeological environments. Groundwater exploration. Groundwater engineering. Drilling technologies. Geophysical bore logging. Dewatering of excavations. Groundwater resource evaluation.

GEOL9020
Geopollution Management
Staff Contact: Applied Geology Office
C3 S1 L1 T1

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.

GEOL9030
Geological Engineering
Staff Contact: Mr G. McNally
C3 S1 L1.5 T1.5

Geomechanical properties of intact rock. Geomechanical properties of discontinuities and rock masses. Weathering processes and geotechnical consequences. Engineering classification of rock masses. Excavation - rippability, mechanical excavation of tunnels, surface and tunnel blasting. Rock support for shallow underground structures. Dam engineering, dam size geology, embankment zoning, foundation treatment and grouting, materials selection and specificaiton, dispersive soils and filter design. Foundations on rock, buildings, temporary support of open excavations.

GEOL9060
Environmental Geology
Staff Contact: Mr G. McNally
C3 S1 L1.5 T1.5

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, uyse 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. Evironmental impact of dams, road, explorative and extractive stages of mining, impact statement techniques, case studies.

Communication of geological information to technical and non-technical people. Geological lesislation for water resources and waste disposal.

GEOL9110
Hydro and Environmental Geology
Staff Contact: Prof G. Hocking
SS L3 T1
Prerequisite: GEOL5100

Hydrogeology: Hydraulics of groundwater in fractured and porous media: hydrodynamic dispersion of contaminants; monitoring and sampling of contaminants.

Environmental Geology: Domestic, industrial and radioactive waste disposal. Geological hazards and urban planning. Environmental impact statement techniques.

Coastal Geology: Properties of sedimentary populations. The shore's processes, littoral and longshore drifts and net sand movement.

GEOL9120
Groundwater Contaminant Transport
Staff Contact: Prof G. Hocking
S1 L3 T1
Prerequisites: GEOL9110, CIVL3007

Hydrogeochemistry. Chemical composition of natural and contaminated groundwater. Chemical dispersion theories for contaminants, hydrochemical modelling for inorganic and organic contaminant plumes. Practical field measurement and laboratory analysis for determination of hydrochemical parameters. Types of groundwater models and their physical bases for porous and fractured rock aquifiers.

GEOL9320
Geopollution Management (External)
Staff Contact: School Office
C3 External

Please see subject description for GEOL9020.

Industrial Relations and Organizational Behaviour

Industrial Relations and Organizational Behaviour is a School in the Faculty of Commerce and Economics

IROB2721
Managing People
Staff Contact: Dr A. Donovan
S1 L2 T2

Managing in a rapidly changing environment. Leadership, decision-making and innovation. Power, legitimacy, and the socialization process. The structure and design of organizations, organisation and domination, the evolution of ethical awareness. Intergroup conflict and conflict resolution. Skills of managing: communication, negotiation, coaching and objectives setting. Organizational culture and transformation.

IROB5701
Industrial Relations A
Staff Contact: Dr M. Hess
C3 S1 L3

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; their instrumentalities; nature of industrial conflict and procedures for conflict resolution such as arbitration and bargaining; and national wage policy.

Information, Library and Archive Studies

Information, Library and Archive Studies is a School in the Faculty of Professional Studies

LIBS0815
Economics of Information Systems
Staff Contact: A/Prof C.J. Maguire
S1 HPW2

Information as a resource. Effects of information technology on work and the distribution of wealth. Copyright, patents, licences and other systems aimed at ensuring appropriability of economic benefits from information. Market research and the pricing and distribution of information products and services.

LIBS0817
Information Storage and Retrieval Systems
Staff Contact: Mrs C.S. Wilson
S2 HPW3

Automatic indexing; Automatic thesaurus construction and maintenance; Online searching and information retrieval; Database construction and database software evaluation; Advanced information retrieval techniques; systems analyis, design and costing; advanced technologies for information storage and retrieval.

Law

LAWS1010
Litigation
Staff Contact: Dr Jill Hunter
C6 F HPW4

An introduction to issues and problems in three areas:

Civil procedure: focus on selected topics - parties to an action; pleadings and the discovery and exchange of information. Supreme Court Rules are examined to determine the extent to which they facilitate just, accurate and speedy resolution of disputes.

Criminal procedure: the law and related issues associated with arrest, the use of warrants, police searches, interrogation and the formulation of pleadings. Comparisons drawn between the civil and criminal pre-trial processes.

Evidence: a basic understanding of the legal and philosophical principles related to the presentation of evidence in court. In particular, examination of the rules designed to protect the accused at trial; the rule against hearsay evidence; the use of expert evidence; the treatment of unreliable evidence and some analysis of the philosophy of proof and probability theory.

The effect of pre-trial procedures on the final outcome at trial highlighted.

LAWS1120
Legal System Torts
Staff Contact: Ms Prue Vines/Mr Angus Corbett
C6 F HPW4

The legal significance of the arrival of the British in Australia; the principal institutions of the legal system, particularly the courts, the legislature, and the executive arms of government; the judiciary; the legal profession; their history, roles, interrelationships, operation and techniques; general constitutional principles and institutions; the notion and consequences of federalism; Bill of Rights proposals; precedent and statutory interpretation, practice and theory; sources of Australian law, including the past and present status of Aboriginal customary law; origins of the common law; classifications within the common law; jurisdiction of Australian courts; the development of compensation law, with particular reference to workers' compensation and occupational health and safety; modern statutory compensation schemes; the rules and concepts of the law of torts, their origins, growth, operation and limitations; tort law protection from assault, injury and death; negligence; interests in another's life and services; false and misleading statements affecting economic interests; loss distribution; employers' liability; occupiers' liability; causation; remoteness of damage; product liability; interference with interests in land; interference with personal liberty. Some of these topics are dealt with in outline only.

LAWS1410
Contracts
Staff Contact: Mr Denis Harley
C6 F HPW4

This course examines the nature of contractual obligations and how parties make and break contracts.

Topics include: how contracts are formed and the necessary elements of a validly constituted contract; express and implied terms of a contract and how such terms are imported into the contract; how courts interpret the terms of a contract; the consequences where a contract is induced by misrepresentation, mistake or unconscionability; exemption clauses; estoppel and contract; contracts which are illegal under statute or contrary to public policy; remedies for breach of contract and the damages payable for such breach.

Students are encouraged to examine the role of contract law from an historical and contemporary standpoint.

LAWS1610
Criminal Law
Staff Contact: A/Prof David Brown
C6 F HPW4

The principles of criminal law and criminal liability. Aims to: promote and refine research and social policy analysis skills; develop a rigorous analytic and socially oriented approach to the study of criminal law; investigate the constitution of concepts like crime, criminal and criminal law; question traditional approaches which assume a unified set of general principles; suggest an approach to criminal law as a number of diverse fields of regulation; acknowledge the importance of forms of regulation outside the criminal law; examine empirical material on the actual operation of the N.S.W. criminal process such as court statistics and a court observation exercise; examine the substantive rules developed in selected criminal offence areas; stress the importance and relevance of criminal law in an understanding of law, even (and especially) for those who do not intend to practise in the area. Topics include: the phenomenon of crime, the criminal process, criminal responsibility, homicide offences, public order offences, drug offences, offences against the person, offences of dishonest acquisition, general defences, complicity, conspiracy, sentencing and penal practices.

LAWS2150
Federal Constitutional Law
Staff Contact: Prof George Winterton
C3 S1 or S2 HPW4

Federal constitutional law, stressing the legislative and judicial powers of the Commonwealth and the judicial interpretation by the High Court of the extent of those powers, in particular: trade and commerce, external affairs, corporations, appropriation, grants and taxation powers, family law and industrial law powers, inconsistency of Commonwealth and State laws, freedom of interstate trade and commerce, excise and implied limitations on Commonwealth and State powers. Techniques and approaches adopted by the High Court in interpreting the Australian Constitution, and occasionally, federal executive power.

Further study of constitutional law may be undertaken in LAWS2100 The High Court of Australia.

LAWS2160
Administrative Law
Staff Contact: Prof Garth Nettheim
C3 S1 or S2 HPW4

Principles and procedures for review of administrative action. Topics: relations between different agencies of government (legislative, administrative, judicial); delegated legislation; judicial power; the Ombudsman: the Administrative Appeals Tribunal; principles of judicial review (denial of natural justice, going beyond power, error of law); procedures for judicial review; the Administrative Decisions (Judicial Review) Act, 1977 (Cth.).

LAWS3010
Property and Equity
Staff Contact: Dr Chris Rossiter
C6 F HPW4

The basic principles of the law of property, transcending the traditional boundaries of real and personal property. For

reasons of time and convenience, most topics are those usually considered in the context of 'real property'.

Enquiry into the meaning of the concepts of property and the purposes that are or ought to be fulfilled by the law of property. Some of the traditional concepts and classifications adopted by the common law in the content of the study of fixtures. Topics: possession as a proprietary interest in land and goods; some basic concepts such as seisin and title; the fragmentation of proprietary interests, including the doctrines of tenure and estates; an introduction to future interests; the development of legal and equitable interests, including a comparative treatment of their nature, extent and sphere of enforceability and an introduction to trusts; legal and equitable remedies; the statutory regulation of proprietary interests in land, including an examination of the Torrens and deeds registration systems; co-ownership; an introduction to security interests; the acquisition of proprietary interests; the alienability of interests including trusts for sale; commercial transactions involving leasehold estates in land and bailment of goods.

LAWS3410
Environmental Law
Staff Contact: Mr Gerard Rowe/ Mr Steven Seidler
C3 SS HPW4

This subject examines environmental law in both a theoretical and a practical sense. From the theoretical point of view, environmental law is considered through interdisciplinary perspectives in a policy setting. The non-legal perspectives in terms of which environmental law is considered include ecology, economics and philosophy. The practical orientation of the course is toward developing an understanding of the legal framework for environmental decision making in Australia, particularly in N.S.W. Topics to be covered include the relevance of ecology to environmental law, environmental ethics, environmental economics, international environmental law, Commonwealth powers with respect to the environment, a range of Commonwealth and NSW legislation relating to the environment, and different legal techniques for enhancing protection of the environment (eg. regulation through the criminal law, through traditional common law techniques such as nuisance and private covenants, through economic incentive schemes, and through systems of consents and licenses). Alternative Dispute Resolution techniques will also be examined.

Attention is also paid to: (1) the part played by political and administrative discretion in the field of environmental decision-making, with some emphasis on the tensions which exist between various levels and arms of government; (2) the role of public participation in the decision making process; and (3) environmental law in other countries, particularly the U.S.

Students are encouraged to take an interest in topical environmental issues.

LAWS6210
Law, Lawyers and Society
Staff Contact: Dr. Stan Ross
C3 S1 or S2 HPW4

1. The lawyer-client relationship, including who exercises control and the lawyers' duties to accept work, to keep client confidences, to act competently and to avoid conflicts of interest; the social implications of lawyers' professional behaviour. 2. The adversary system of litigation and the lawyers' role therein, both generally and specifically as defence counsel and as prosecutor in criminal cases. 3. The structure of the profession and methods of regulation including discussion of the concept of professionalism, control of admission, discipline generally and conducting court specifically; selection and control of the judiciary. 4. Issues relating to the delivery of legal services, including specialization in lawyers' practice, the structure and availability of legal aid, the regulation of lawyers' fees, the extent of the lawyers' monopoly and the role of non-lawyers in delivering legal services.

LAWS7420
Legal Research and Writing 2
Staff Contact: Mr Joe Ury
C1 S2 HPW2

A revision of legal research skills acquired in LAWS741 Legal Research and Writing 1, particularly the use of Australian digests, law reform materials and indexes to legal periodicals. Practice in ascertaining delegated legislation, in using English, Commonwealth and US digests and in tracing recent amendments to case-law, statutes and regulations. Further instruction on the use of computers for retrieval of legal materials.

LAWS7430
Research Component
Staff Contact: A/Prof Adrian Brooks
Notes: Taken after or concurrently with LAWS7420.

This subject must be taken either concurrently with or after LAWS7420 Legal Research and Writing 2, though students are advised where possible to complete Legal Research and Writing 2 first so that they have a command of the relevant research techniques. Students must select one from amongst the subjects for which they are enrolled in which a piece of assessable work (a research essay or moot) will be allocated for Research Component, and must submit a Research Component Form to the Administrative Assistant (Undergraduate) by the end of Week 4 in the Session in which they elect to undertake Research Component. This form must identify the subject in which the work for Research Component will be undertaken, and must be signed by the teacher in the subject. Students must attach to the completed research essay or moot submission a written research report, outlining the research methods adopted in preparation for the essay or moot. The piece of assessable work chosen for allocation to Research Component must be worth 30% of the total mark (in the case of a three-credit point subject, or 15% of the total mark in the case of a six-credit point subject). The assessment of Research Component will be made on the basis of the research report, in addition to the separate assessment of the essay or moot for the purpose of the subject selected. All subjects offered in the Law School are prima facie available to Research Component students for this purpose. Where for compelling reason no provision for a suitable essay or moot is or can be made in a program of assessment of a particular subject, the teacher of that subject may ask the student to select another subject. There is no formal teaching in LAWS7430 Research Component and no credit points are awarded for it. It is compulsory for all students except those taking one or more of the Research Thesis electives (LAWS6510, LAWS6520, LAWS6530).

LAWS8320
Legal Theory
Staff Contact: A/Prof Martin Krygier
C3 S1 or S2 HPW4

Introduction to theoretical - particularly philosophical-questions which underline the practical workings of the law. The course concentrates on questions to do with the reasoning, particularly the reasoning of judges, and of moral reasoning; and the interrelationships between law and morals and law and politics.

LAWS8820
Law and Social Theory
Staff Contact: A/Prof Martin Krygier
C3 S1 or S2 HPW4

Examination of sociological assumptions about law, about society, and about the relationships between law, legal institutions and social ordering. Topics include: The role and functions of law within modern society, the extent to which law embodies implicit social theories and the nature of these theories, and the implications of empirical social research on our understanding of the place of law in society.

LAWS8320 and LAWS8820 form part of the compulsory core of the LLB and BJuris degree courses with respect to students who entered the Faculty in 1981 or later. Students are required to take one of these two subjects to fulfil compulsory requirements and are permitted to take the other as an elective.

Mathematics

Mathematics is a School within the Faculty of Science

MATH1032
Mathematics 1
Staff Contact: School of Mathematics First Year Office
U2 F HPW6
Prerequisites: HSC exam score range required: 2 unit Mathematics (67-100)(from 1994 this will be 90-100) or 2 and 3 unit Mathematics (100-150) or 3 and 4 unit Mathematics (100-200) or MATH1011 (2 unit Mathematics in this instance refers to the 2 unit Mathematics subject which is related to the 3 unit Mathematics subject. It does not refer to the subjects Mathematics in Society or Mathematics in Practice. These numbers may vary from year to year.)
Notes: Excluded MATH1011, MATH1021, MATH1042, ECON2200, ECON2201, ECON2202.

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

MATH1042
Higher Mathematics 1
Staff Contact: School of Mathematics First Year Office
U2 F HPW6
Prerequisites: HSC exam score range required: 3 unit Mathematics (145-150) or 4 unit Mathematics (186-200) (these numbers may vary from year to year.)
Notes: Excluded MATH1011, MATH1021, MATH1032, ECON2200, ECON2201, ECON2202.

As for MATH1032 Mathematics 1, but in greater depth.

MATH1081
Discrete Mathematics
Staff Contact: School of Mathematics First Year Office
U1 S1 or S2 HPW6
Prerequisites: As for MATH1032.
Corequisites: MATH1032 or MATH1042
Notes: Excluded MATH1090.

Role of proof in mathematics, logical reasoning and implication, different types of proofs. Sets, algebras of sets, operations on sets. Mathematical logic, truth tables, syntax, induction. Graphs and directed graphs, basic graph algorithms. Counting, combinatorial identities, binomial and multinomial theorems. Binary operations and their properties, groups and semigroups, ordered structures. Recursion relations. Application to network theory, assignment problems and population growth.

MATH1090
Discrete Mathematics for Electrical Engineers
Staff Contact: School of Mathematics First Year Office
S1 HPW3
Corequisite: MATH1032 or MATH1042
Notes: Excluded MATH1081.

The role of proof in mathematics, logical reasoning and implication, different types of proofs. Sets, algebra of sets, operations on sets, mathematical logic, truth tables, syntax, induction. Recursion, recursive logic, recurrence relations.

MATH2009
Engineering Mathematics 2
Staff Contact: School Office
F HPW4
Prerequisite: MATH1032
Notes: Restricted to Combined degree courses **3681, 3730**

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.

MATH2100
Vector Calculus
Staff Contact: School Office
U.5 S1 or S2 HPW2.5
Prerequisite: MATH1032 or MATH1042
Notes: Excluded MATH2110.

Properties of vectors and vector fields; divergence, gradient, curl of a vector; line, surface, and volume integrals. Gauss and Stokes' theorems. Curvilinear co-ordinates.

MATH2110
Higher Vector Analysis
Staff Contact: School Office
U.5 S1 HPW2.5
Prerequisites: MATH1032 or MATH1042 with a mark of at least 70
Notes: Excluded MATH2100.

As for MATH2100 but in greater depth.

MATH2120
Mathematical Methods for Differential Equations
Staff Contact: School Office
U.5 S1 or S2 HPW2.5
Prerequisite: MATH1032 or MATH1042.
Notes: Excluded MATH2130.

Introduction to qualitative and quantitative methods for ordinary and partial differential equations. The following topics are treated by example. Ordinary differential equations: linear with constant doefficients, first-order systems, singularities, boundary-value problems, eigenfunctions, Fourier series. Bessel's equation and Legendre's equation. Partial differential equations: characteristics, classification, wave equation, heat equation, Laplace's equations, separation of variables methods,applications of Bessel functions and Legendre polynomials.

MATH2130
Higher Mathematical Methods for Differential Equations
Staff Contact: School Office
U.5 S2 HPW2.5
Prerequisites: MATH1032 or MATH1042 with a mark of at least 70
Notes: Excluded MATH2120.

As for MATH2120 but in greater depth.

MATH2200
Discrete Dynamical Systems
Staff Contact: School Office
U.5 S2 HPW2
Prerequisite: MATH1032 or MATH1042
Corequisite: MATH2501 or MATH2601

The study of dynamical systems whose states change at discrete points in time. Difference equations, general properties. Linear systems, stability, oscillations, z-transforms. Nonlinear systems, critical points, periodic cycles, chaotic behaviour. Applications selected from engineering, biological, social and economic contexts.

MATH2220
Continuous Dynamical Systems
Staff Contact: School Office
U.5 S2 HPW2
Prerequisite: MATH1032 or MATH1042.

The study of continuous dynamical systems. One-dimensional systems, kinematic waves, applications include traffic flow and waves in fluids. An introduction to the modelling of physical, biological and ecological systems, stability, oscillations and resonance.

MATH2400
Finite Mathematics
Staff Contact: School Office
U.5 S1 HPW2
Prerequisite: MATH1032 or MATH1042
Notes: MATH1081 Discrete Mathematics is advised.

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.

MATH2501
Linear Algebra
Staff Contact: School Office
U1 S1 or S2 HPW5 or F HPW2.5
Prerequisite: MATH1032 or MATH1042
Notes: Excluded MATH2601.

Vector spaces, linear transformations, change of basis, inner products, orthogonalization, reflections and QR factorizations, Eigenvalues and eigenvectors, diagonalization. Jordan forms and fuctions of matrices. Applications to linear systems of differential equations, quadratics, rotations. Laplace transforms.

MATH2510
Real Analysis
Staff Contact: School Office
U.5 S1 or S2 HPW2.5
Prerequisite: MATH1032 or MATH1042
Notes: Excluded MATH2610.

Multiple integrals, partial differentiation. Analysis of real valued functions of one and several variables.

MATH2520
Complex Analysis
Staff Contact: School Office
U.5 S1 or S2 HPW2.5
Prerequisite: MATH1032 or MATH1042
Notes: Excluded MATH2620.

Analytic functions, Taylor and Laurent series, integrals. Cauchy's theorem, residues, evaluation of certain real integrals.

MATH2601
Higher Linear Algebra
Staff Contact: School Office
U1 S1 HPW5
Prerequisite: MATH1042 or MATH1032 with a mark of at least 70
Notes: Excluded MATH2501.

As for MATH2510, but in greater depth, and with additional material on unitary, self-adjoint and normal transformations.

MATH2610
Higher Real Analysis
Staff Contact: School Office
U.5 S1 HPW2.5
Prerequisite: MATH1042 or MATH1032 with a mark of at least 70
Notes: Excluded MATH2510.

As for MATH2510 Pure Mathematics 2 Real Analysis but in greater depth.

MATH2620
Higher Complex Analysis
Staff Contact: School Office
U.5 S1 or S2 HPW2.5
Prerequisite: MATH1042 or MATH1032 with a mark of at least 70
Notes: Excluded MATH2520.

As for MATH2520 Pure Mathematics 2 Complex Analysis, but in greater depth.

MATH2801
Probability and Random Variables

Staff Contact: School Office
U1 S1 HPW4
Prerequisite: MATH1021(Cr) or MATH1032 or MATH1042
Notes: Excluded MATH2819, MATH2841, MATH2901, BIOS2041. Probability, random variables, standard discrete and continuous distributions, multivariate distributions, transformations, random sampling, sampling distributions, limit theorems.

MATH2810
Statistical Computing and Simulation

Staff Contact: School Office
U.5 S1 HPW2
Prerequisites: MATH1021(Cr) or MATH1032 or MATH1042
Co-requisite: MATH2801
Notes: Excluded MATH2910.

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.

MATH2821
Basic Inference

Staff Contact: School Office
U1 S2 HPW4
Prerequisite: MATH2801
Notes: Excluded MATH2921, MATH2841, MATH2819, BIOS2041.

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.

MATH2829
Statistics SU

Staff Contact: School Office
S1 HPW3
Prerequisite: MATH1032 or MATH1042
Notes: Not available to Science students.

Introduction to probability theory, random variables and distribution functions, sampling distributions, including those of t, chi^2 and F. Estimation procedures, including confidence interval estimation with an emphasis on least squares and surveying problems, and computer based exercises.

MATH2830
Nonparametric Statistical Inference

Staff Contact: School Office
U.5 S2 HPW2
Prerequisite: MATH2801.
Corequisite: MATH2821
Notes: Excluded MATH2930.

Order statistics, exact and approximate distributions, multinomial distributions, goodness of fit, contingency tables, one-sample and two-sample estimation and inference problems.

MATH2839
Statistics SM

Staff Contact: School Office
U1 F HPW2
Prerequisite: MATH1032
Notes: Excluded MATH2841, MATH2801, MATH2821, MATH2901, MATH2921. Restricted to combined degree course **3681**.

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, χ^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.

MATH2841
Statistics SS

Staff Contact: School Office
U1 F HPW2
Prerequisites: MATH1042, MATH1032 or MATH1021(CR)
Notes: Excluded MATH2801, MATH2821, MATH2901, MATH2921, MATH2819, BIOS2041.

An introduction to the theory of probability, with finite, discrete and continuous sample spaces. The standard univariate distributions: binomial, Poisson and normal, an introduction to multivariate distributions. Standard sampling distributions, including those of χ^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 effect models.

MATH2849
Statistics SE1

Staff Contact: School Office
S2 HPW2
Prerequisite: MATH1032 or MATH1042
Notes: Not available to Science students.

Introduction to probability theory, random variables and distribution functions; the binomial, Poisson and normal distributions in particular. Standard sampling distributions including those of χ^2 and t.

MATH2859
Statistics SE2

Staff Contact: School Office
S1 HPW2
Prerequisite: MATH1032 or MATH1042
Notes: Not available to Science students.

Estimation by moments and maximum likelihood; confidence interval estimation. The standard tests of significance 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.

MATH2869
Statistics SC
Staff Contact: School Office
S1 HPW2
Prerequisite: MATH1032 or MATH1042
Notes: Not available to Science students.

Introduction to probability. Random variables. Elementary distribution. Statistical inference. Point estimation. Confidence intervals.

MATH2901
Higher Probability and Random Variables
Staff Contact: School Office
U1 S1 HPW4
Prerequisite: MATH1032 or MATH1042
Notes: Excluded MATH2801, MATH2841, MATH2819, BIOS2041.

As for MATH2801 but in greater depth.

MATH2910
Higher Statistical Computing and Simulation
Staff Contact: School Office
U.5 S1 HPW2
Prerequisite: MATH1032 or MATH1042.
Co-requisites: MATH2901
Notes: Excluded MATH2810.

As for MATH2810 but in greater depth.

MATH2921
Higher Basic Inference
Staff Contact: School Office
U1 S2 HPW4
Prerequisite: MATH2901
Notes: Excluded MATH2821, MATH2841, MATH2819, BIOS2041.

As for MATH2821 but in greater depth.

MATH2930
Higher Nonparametric Statistical Inference
Staff Contact: School Office
U.5 S2 HPW2
Prerequisite: MATH2901.
Corequisite: MATH2921
Notes: Excluded MATH2830.

As for MATH2830 but in greater depth.

MATH3101
Numerical Analysis
Staff Contact: School Office
U1 S1 HPW4
Notes: Excluded MATH3141.

Analysis of some common numerical methods. Iterative methods for solving nonlinear equations; interpolation using polynomials, splines and trigonometric functions; least-squares approximation and orthogonal functions; numerical differentiation and integration: extrapolation; finite difference methods for initial value problems for ordinary differential equations; iterative techniques for large systems of linear equations.

MATH3141
Electrical Engineering Mathematics 3
Numerical and Mathematical Methods
Staff Contact: School Office
S2 HPW3.5
Prerequisites: MATH2100, MATH2501, MATH2510
Notes: Excluded MATH2120, MATH2130, MATH3101. Not available to Science Students.

Numerical and mathematical methods for electrical engineering. *Numerical Methods*: Solution of linear and non-linear algebraic equations, interpolation and extrapolation, numerical quadrature, solution of ordinary differential equations, computational methods for matrix eigenvalues and eigenvectors. *Mathematical Methods for Partial Differential Equations*: Separation of variables methods, generalized Fourier series, Bessel functions, Legendre polynomials.

MATH3150
Transform Methods
Staff Contact: School Office
U.5 S2 HPW2
Prerequisites: MATH2100, MATH2520, MATH3121

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.

MATH3181
Optimal Control
Staff Contact: School Office
U1 S2 HPW4
Prerequisite: MATH2100 or MATH2510

An introduction to the optimal control of dynamical systems. Mathematical descriptions of dynamical systems. Stability, controllability, and observability. Optimal control. Calculus of variations. Dynamic programming. Examples and applications are selected from biological, economical and physical systems.

MATH5045
Advanced Mathematics for Electrical Engineers
Boundary value problems in partial differential equations. Selected topics from complex variable analysis, integral transforms, and orthogonal functions and polynomials.

Materials Science and Engineering

Materials Science and Engineering is a School within the Faculty of Applied Science

MATS1002
Microstructural Analysis
Staff Contact: Dr P. Krauklis
S1 L1 T2

Specimen preparation techniques. Principles of optical micriscopy. Quantitative microscopy and sterology. Electron microscopy. Microchemical analysis.

MATS1042
Crystallography and X-Ray Diffraction
Staff Contact: Dr P. Munroe
S2 L2 T2

Introduction to crystallography, crystal structure, Bravais lattices, Miller indices. Miller-Bravais indices. Production, absorption and diffration of X-rays. Powder and single crystal X-ray methods. Stereographic projections. Applications of diffraction methods to solid solutions and solubility limit. Thermal analysis, stress measurement, X-ray fluorescence spectroscopy.

MATS1062
Mechanical Properties of Materials
Staff Contact: Dr P. Krauklis
S1 L2 T2

Mechanical properties of solids. Nature and significance of mechanical properties. Mechanical testing; the tension test, hardness testing and impact testing. Stress-strain-time relationships. Analysis of stress and strain, stress and strain transformation relationships, Mohr's circle, elastic stress-strain relationships, application to various types of loading and metal working processes. Failure and yeilding criteria. Influence of stress state, temperature, strain rate and environment on mechanical behaviour.

MATS1072
Physics of Materials
Staff Contact: Dr S. Blairs
S2 L2 T1
Prerequisite: PHYS1002

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; instrinsic, extrinstic. Exchange energy; ferromagnetism, antiferromagnetism. Elementary perturbation theory, covalent bond; crystal structures, properties. Ionic bond, crystal structures, force models, properties.

MATS1083
Non-ferrous Alloys
Staff Contact: Dr P. Krauklis
S2 L1 T2

Metallography of non-ferrous alloys. Structure/property relationships in non-ferrous alloys. Hardening mechanisms. Metallography and properties of copper, aluminium, nickel, magnesium, lead, tin and titanium based alloys.

MATS1253
Ferrous Alloys
Staff Contact: Dr P. Krauklis
S1 L1 T2

Ferrous alloys. Iron-carbon Phase equilibrium diagrams. 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.

MATS1263
Alloy Steels
Staff Contact: Dr P. Krauklis
S2 L1 T1

Alloy steels. Ternary equilibria involving iron and carbon. Metallography and properties of alloy steels. Effects of alloying elements on austenite formation and decomposition under equilibrium and non-equilibrium conditions. Heat treatment of alloy steels. Metallography and properties of alloy cast irons.

MATS4363
Origins of Microstructure - Units 1, 2, 3, 4
Unit 1 Phase equibiria
Staff Contact: Dr A.G. Crosky
S1 L1 T1

Phase rule. Two-component systems: free energy-composition and temperature-composition diagrams, solubility limits, compound formation, invariants. Three-component systems: isothermal sections and liquidus projections. Solidifaction and crystallization; cooling curves, crystallization paths.

Unit 2 Diffusion
S1 L1 T1

Staff Contact: Dr A.K. Hellier
Fick's first and second laws. Solutions for short and long times by analytical and numerical methods. Boundary conditions for solid-fluid and solid-solid interfaces. Diffusion couples. Atomic level diffusion theory.

Unit 3 Metallography and phase equilibrium laboratory
Staff Contact: Dr A.G. Crosky
S1 T3

Determination of equilibrium phase diagrams. Solidification processes in moulds Metallography of non-ferrous alloys.

Unit 4 Phase transformations
Staff Contact: Dr B. Gleeson
S2 L2 T1

Solidification: single phase, eutectic and near-eutectic, pertectic. Diffusional transformations: precipitation, ripening, cooperative transformations, TTT and CCT curves. Diffusionless transformations: crystallography, nucleation and growth modes.

MATS9323
Mechanical Behaviour of Materials - Units 1,2,3
Unit 1 Deformation
S1 L2

Staff Contact: School Office
Atomic and molecular description of deformation. Introduction to dislocation theory and its application to mechanical properties. Chain dynamics under stress.

Unit 2 Fractographic Analysis
Staff Contact: Dr A.G. Crosky
S2 L1 T1

Classification of macroscopic and microscopic fracture mechanisms. Initiation and propagation of ductile, brittle, fatigue, creep, stress corrosion, and corrosion fatigue fractures. Effect of material defects, design deficiencies and incorrect processing on the origin and cause of

fracture. Analysis of various modes of fracture using fractographic techniques involving optical microscopy and scanning and transmission electron microscopy.

Unit 3 Deformation and Strengthening Mechanisms
Staff Contact: Dr B. Gleeson
S2 L1 T1

Strengthening mechanisms, creep, fracture, grain size dependence of strength. Introduction to generation of deformation and recrystallization textures. Measurements of age-hardening, activation energy of strain ageing.

MATS9520
Engineering Materials
Staff Contact: Dr A.G. Crosky
S1 L2 T1

Microstructure and structure-property relationships of the main types of engineering materials (Metals, Ceramics, Polymers and Composites). Micromechanisms of elastic and plastic deformation. Fracture mechanisms for ductile, brittle, creep and fatigue modes of failure in service; corrosion. Metal forming by casting and wrought processes. Phase Equilibria of alloys; microstructural control by thermomechanical processing and application to commerical engineering materials. Laboratory and tutorial work includes experiments on cast and recrystallised structures, ferrous and non-ferrous microstructures and fracture and failure analysis.

MATS9530
Materials Engineering
Staff Contact: Dr A.G. Crosky
S1 or S2 L2 T1
Prerequisite: MATS9520

Materials used in Mechanical Engineering and related fields (Manufacturing Engineering Management, Aerospace Engineering, Naval Architecture) are discussed with emphasis on the dependence of properties and performance on microstructure. Aspcets of materials selection during the design of engineering components which affect the service performance in applications where failure can occur by brittle fracture, corrosion, creep or fatigue, will also be discussed.

MATS9640
Materials Science and Engineering Electrical Engineers
Staff Contact: Dr S. Blairs
S2 L3 T1
Prerequisite: PHYS2989

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, fast ion conductors. The role of materials science in the development of electrical energy systems.

Mines

Mining Engineering is a Department within the School of Mines

MINE1040
Underground Coal Mining
Staff Contact: Dr A.K. Bhattacharyya
F L1 T1
Prerequisites: MINE1130 and MINE1140, MINE1231, MINE1830

Effect of surface improvements and structural geology on mine layout. Influence of coal seam properties on choice of extraction height and working section. Coal properties related to machine extraction. Pillar and coalface layouts to optimise strata control. Face and roadway support systems. Mechanised extraction: cutting machines, their stability and steering, armoured face conveyors and stage loaders, coal clearance systems, coal bunkerage. Mechanisation problems in thin, thick, steep and faulted seams. Multi-seam layouts. Limitations on face advance rate. Logistics of high-speed extraction - supplies, manpower, rapid transfer of face equipment. Packing and stowing. Hydraulic mining. Supervision and performance criteria.

MINE1130
Mining Methods
Staff Contact: A/Prof. E.G. Thomas
F L2
Prerequisite: MINE1420

Technical and environmental considerations for mining by surface or underground methods. Permanent mining facilities and mine development. Metalliferous deposits: underground and surface mining. Sublevel open stoping, sublevel caving, cut and fill stoping, other underground mining methods. Pillar recovery. Coal and lignite deposits: occurrence in Australia. Surface mining methods - considerations of terrain, mining of single, multiple, thin, thick and steeply inclined seams. Underground mining methods - use of panels, pillared, shortwall and longwall mining of thin, thick, multiple and steeply inclined seams. Abandonment of mines.

MINE1140
Geotechnical Engineering
Staff Contact: Dr A.K. Bhattacharyya
F L1 T1
Prerequisites: MINE1231, MINE1232

Stresses around mine openings: magnitude and distribution, determination by analytical methods, analogue and mathematical modelling, in situ measurements. Energy changes caused by excavations. Initiation and propagation of failure in rock structures. Stability of excavations: natural and artificial supports, permanent and temporary supports. Design of support systems. Stability of rock slopes. Ground control measurements. Rockbursts. Outbursts in coal. Mining subsidence, nature effects, prediction and control.

MINE1231
Geomechanics A
Staff Contact: Dr V.S. Vutukuri
S1 L1.5 T1.5
Prerequisite: MATH1032
Corequisite: MINE4330

Rock mass, rock material and discontinuities. Geomechanical properties of discontinuities - orientation, spacing, persistence, roughness, apertures and filling. Rock mass classification. Rock strength and deformability, concepts and definitions, common laboratory strength tests, measurement of deformability by static tests, dynamic measurements, influence of time on rock deformation. Strength criteria for isotropic and anisotropic rock material, shear behaviour of discontinuities, behaviour of rock masses containing discontinuities. Pre-mining state of stress and its measurement.

MINE1320
Fluid Mechanics and Thermodynamics
Staff Contact: Dr A.C. Partridge
F L1 T1
Prerequisites: MINE0110, MECH1300, PHYS1002, MATH1032
Corequisite: MATH2001

Fluid properties, fluid statics, fluid flow - laminar and turbulent. Continuity equation, energy equation, momentum equation. Flow measurement. Pumps and pump characteristics. Energy losses in pipelines and open channels. Boundary layer theory. Dimensional analysis. Thermodynamic systems - states, processes and properties. Energy of a system, first and second laws of thermodynamics. Reversibility, ideal gas laws, cycles for heat engines, heat pumps, compressors and refrigerators, psychrometrics.

MINE1330
Mine Transport
Staff Contact: A/Prof G.S. Sen
S2 L1.5 T.5

Transport requirements for minerals, waste, supplies and people. Mine winding systems for shafts and drifts. The mechanics of hoisting. Mine ropes and chains. Winding cycle diagrams and calculations. Surface and underground haulage arrangements. Secondary transport systems. Rope haulage, aerial ropeways, monorails, belt conveyors, locomotive haulage. Track mounted, crawler and trackless methods. Elements of soil vehicle mechanics applied to mining equipment. Primary systems. Chain, screw and bucket conveyors and elevators. Shaker and vibratory conveyors. Hydraulic and pneumatic transport methods. Chutes and bunkers. Design of transport systems.

MINE1420
Mine Development
Staff Contact: Mr D. Panich
F L1
Prerequisite: MINE0210
Notes: Visits to mines and related undertakings are a requirement of this subject.

Infrastructure requirements for mines and mining communities. Prospecting, exploration, mine feasibility studies, statutory requirements. Surface requirements and layout for winding, ventilation, drainage, mine services, administration, welfare. Mine working drawings. Provision of primary underground access by shaft, drive, drift, decline and incline, adit, raise, winze. Development through water-bearing and unconsolidated ground. Explosives applied in mine development. Development by tunnelling machine. Equipping shafts. Ground support during development. Emergency egress requirements. Development of surface metalliferous and coal mines. Spoil and waste disposal, land restoration and other environmental considerations. Preparation of Environmental Impact Statements.

MINE1440
Surface and Offshore Mining
Staff Contact: Dr A.K. Bhattacharyya
F L1 T1
Prerequisite: MINE1130

Surface mining of tabular and other deposits, general methods, current trends. Planning and design of surface mines; reserves, scale of operations, surface facilities. Stripping ratio, pit limit determination by manual and computer-based methods, phase plans, operating layouts, scheduling. Mining systems: equipment selection, type, capacity and fleet size, operational costs, maintenance. Slope stability: pit walls, spoil piles, ground water control. Surface rehabilitation. Stream and offshore dredging for metals, minerals, gemstones and construction materials. Evaluation of marine deposits. Dredge design and operation. Beach sand mining. Deep sea mining. International agreements and law. Project.

MINE1524
Mining Conservation
Staff Contact: Dr V.S. Vutukuri
C3 S1 or S2 L2 T2

The reclamation of excavated land; integration with operational stages of mining. Mining cycles of alluvial, strip, and open cuts. Land clearing. Stabilising the mined area. Socio-economic aspects of mining. Rehabilitation costs. Government regulations. Examination and evaluation of current operations.

MINE1530
Power Supply in Mines
Staff Contact: Dr C.R. Daly
S1 L1 T1
Prerequisites: MINE0310, MINE1320, PHYS2920, ELEC0802

Electric power distribution, mine cables, switchgear. Flameproofing and intrinsic safety, fault protection. Oil hydraulic power. Fluid characteristics. Components and circuits. Pumps, motors, valves. Speed and torque control. Compressed air: generation, distribution, applications and equipment, compressors. Control theory, automatic control in mining.

MINE1630
Excavation Engineering
Staff Contact: Prof F.F. Roxborough
F HPW2

Rock drilling and boring. Percussive, rotary, hybrid and exotic methods. Drilling patterns for shafts, headings, faces and benches. Classification of chemical explosives and their application. Detonation. Misfire procedures. Alternative explosive agents. Special blasting techniques including presplitting, profiling, trenching, casting and

demolition. Environmental considerations, handling and storage of explosives, vibrations. Nuclear blasting. Rock fragmentation by machine. Principles of rock cutting mechanics. Drag picks and free rolling cutters. Hydraulic mining. Water jet cutting. Thermal, electrical, ballistic and other novel fragmentation techniques. Rock cutting tool materials. Effect of tool metallurgy on wear and fracture resistance. Methods of assessment rock cuttability. The design of cutting arrays for machine mining.

MINE1740
Mining Legislation
Staff Contact: Dr C.R. Daly
S2 L2

An appreciation of the laws relating to mining practice and to safety and health in mines.

MINE1830
Mine Ventilation and Drainage
Staff Contact: Dr V.S. Vutukuri
F L1.5 T.5
Prerequisites: MINE1320, MINE1420
Corequisites: MINE4330

Mine ventilation - practice in mines, forces causing airflow, resistance of workings and distribution of mine air, network analysis, fans and their operation, auxiliary ventilation calculations, economic size of airways. Ventilation surveys. Mine gases - hazards, occurrence, detection, monitoring and control. Airborne dust - physiological effects, sampling, measurement and analysis, sources and control. Mine climate - physiological effects, air cooling power, factors affectring mine climate and control. Ventilation planning - airflow requirements based on gaseous, airborne dust and heat pollutants.

Mine drainage - engineering hydrology, sources of mine water, forecasting water inflows, drainage and dewatering, pumps and pumping.

MINE1840
Underground Metalliferous Mining
Staff Contact: Mr D. Panich
F L1 T1
Prerequistes: MINE1130.

Production, development and resource scheduling. Main development, slope development. Cyclic and continuous production systems - slope, haulage, hoisting; use of stockpiles and multi-face production systems. Optimum ore fragmentation, material flow in passes. Pillar recovery. Optimum fill selection. Preparation and placement of mine fills. Bulkhead design, fill dewatering. Ground support during stoping. Practice in Australasia. Mine design project.

MINE1940
Tunnel Engineering and Shaft Sinking
Staff Contact: A/Prof G.S. Sen
F L1 T1
Notes: Not available to students who have completed MINE1640.

Scope for tunnels. Site investigation. Primary excavation in soft and hard ground. Drilling and blasting. Tunnelling shields, full face boring, partial face machines. Debris disposal. Temporary and permanent support. Ground stability. Sub-aqueous tunnels. Cut and cover tunnels, immersed tubes. Compressed air working. Environmental considerations. Tunnel services, ventilation, drainage and lighting for road and all-rail tunnels. Shaft sinking in different ground conditions. Ground treatment before excavation. Shaft lining.

MINE2140
Mine Economics and Planning
Staff Contact: Mr D. Panich
S1 L2 T2 S2 L1 T1
Prerequisite: MINE1130, MINE2230

Resource sampling, reserve calculations by traditional methods and by geostatistics, feasibility studies including calculation of capital costs and operating costs, company taxation. Feasibility study project. Project financing - equity, debt, leasing, non-recourse financing, joint ventures. Company types and structures, capitalisation, documents of incorporation and of annual reports. Commodity marketing, metal exchanges, producer pricing, price forecasting. Mining law, mineral ownership, federal and state responsibilities, royalties. Projectr control, contracts, insurance. Operating cost systems, discounted cash flow techniques appllied to mine expansion and system modification. Replacement of mine plant.

MINE2230
Mine Feasibility Studies
Staff Contact: Mr D. Panich
S2 L1

Elements of mineral project cash flow. Application of numerical discounted cash flow techniques to economic analysis of mineral projects. Parameter sensitivity calculations.

MINE3040
Mine Safety Engineering
Staff Contact: Dr V.S. Vutukuri
F L1 T1

Safety precautions against outbursts. Methane drainage. Fires and explosions in coal and metalliferous mines, explosible dust. Spontaneous combustion. Water hazards in mines and precautions against inundation. Mine rescue and recovery. Noise measurement, hearing hazards and control. Mine lighting. Poisons and general toxic hazards. Radiation hazards. Loss control, accidents, accident investigations, safety programs. Safety and health legislation.

MINE4330
Mining Laboratory
Staff Contact: Mr D. Panich
F T2
Corequisites: MINE1231, MINE1232

A program of laboratory experiments for Year 3 students requiring the submission of appropriate laboratory reports related to the syllabus areas of the the co-requisite subjects.

MINE5355
Mine Fill Technology
Staff Contact: A/Prof E.G. Thomas
C3 S1 or S2 HPW3

Fill properties and their assessment. Fill preparation, placement and dewatering. Field sampling and *in situ* testing. Mining methods employing fill. Pozzolanic fills. Dry

fills and rock fills. Economic aspects of fill practice. Soil and rock mechanics aspects. Environmental aspects. Specific fill practice in mining coal and uranium.

MINE7342
Minerals Engineering Processes
Staff Contact: Dr A.C. Partridge
F L1 T2

Beneficiation requirements. Scope of mineral processing. Sampling and mineralogical assessment. Comminution, fracture, liberation, size criteria, energy-size relationships. Crushing and grinding. Screening and classifying. Fluid dynamics of suspensions. Attrition. Concentration processes: density, electrical, magnetic and other physical methods. Cyanidation, amalgamation, leaching, solvent extraction and ion exchange. Interfacial phenomena. Surfactants. Flotation. Liquid-solid separation: flocculation, thickening, agglomeration, filtration. Drying. Materials balances.

MINE7440
Mineral Process Technology
Staff Contact: Dr A.C. Partridge
F L1 T1

Physics and chemistry of surfaces. Measurement of surface properties. On-stream and laboratory analysis and measurements. Laboratory and pilot testing. Flowsheet design. Equipment selection. Plant layout. Monitoring and control systems. Process evaluation. Storage and blending. Materials handling. Waste disposal and pollution control. Waste treatment. Process simulation. Marketing.

Physiology and Pharmacology

Physiology and Pharmacology is a School in the Faculty of Medicine

PHPH2112
Physiology 1
Staff Contact: Dr J. Morley
F HPW6
Prerequisites: BIOS1021; CHEM1002 or CHEM1011 and CHEM1201 or a credit level pass in CHEM1302 or CHEM1401 and CHEM1501; MATH1032 or MATH1042 or MATH1011 and MATH1021
Corequisite: BIOC2312
Notes: From 1994, student numbers in Physiology 1 will be limited, and entry to the subject will be allocated on academic merit.

Introduces fundamental physiological principles, dealing first with basic cellular function in terms of chemical and physical principles, and, with the operation of the various specialized systems in the body, for example, the cardiovascular system; the respiratory system; the gastrointestinal system; the endocrine system; the nervous system. Includes a substantial series of practical class experiments on these different areas of physiology. This subject is taken by students enrolled in any of the Physiology program.

Physics

Physics is a School in the Faculty of Science

Level I

PHYS1002
Physics 1
Staff Contact: 1st Year Director
F L3 T3
Prerequisites: HSC Exam Score Range Required - 2 unit Mathematics 67-100, or 3 unit Mathematics 1-50, or 4 unit Mathematics 1-100 or (for PHYS1002 only) MATH1011, and 2 unit Science (Physics) 57-100, or 2 unit Science (Chemistry) 60-100, or 3 unit Science 90-150, or 4 unit Science 1-50, or PHYS1022 (In this instance 2 unit Mathematics refers to the 3 Unit Mathematics subject and does not refer to the subjects Mathematics in Society or Mathematics in Practice.)
Corequisite: MATH1021 or MATH1032

Motion of particles under the influence of mechanical, electrical, magnetic and gravitational forces. Force, inertial mass, energy, momentum, charge, potential, fields. Conservation principles applied to problems involving charge, energy and momentum. 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. Application of wave theories to optical and acoustical phenomena such as interference, diffraction and polarization.

PHYS1919
Physics 1 (Mechanical Engineering)
Staff Contact: 1st Year Director
F L2 T2
Prerequisites: As for PHYS1002 Physics 1
Notes: Excluded PHYS1002. For students in the School of Mechanical and Industrial Engineering.

Mechanics of intermolecular systems. Atomic structure of solids; forces and defects. Plasticity of solids. Fracture of solids. Thermal properties of solids, liquids and gases. Geometrical optics, optical instruments, interference and diffraction, polarization. Magnetic forces and fields, electromagnetic induction, electrostatics, direct-current circuits. Elementary circuit theory. Introduction to electronics and electronic devices. Boolean algebra; instrumentation.

PHYS1929
Physics 1 (Surveying)
Staff Contact: 1st Year Director
F L2 T2
Prerequisites: As for PHYS1002 Physics 1

Motion of particles under influence of mechanical, electrical, magnetic and gravitational forces. Force, mass, energy, momentum, charge, potential fields. Conservation principles applied to problems involving charge, energy and momentum. Applications of Kirchoff's laws to DC and AC circuits. Uniform circular motion, Kepler's laws and rotational mechanics. Geometrical optics, optical instruments. Application of wave theory to interference, diffraction and polarization.

PHYS1969
Physics 1 (Electrical Engineering)
Staff Contact: 1st Year Director
F L3 T3
Prerequisites: As for PHYS1002 Physics 1
Notes: For students in the School of Electrical Engineering.

Electrostatics, steady state currents, magnetostatics in vacuum, ferromagnetism, electromagnetic induction, transient currents. Vectors ,kinematics, particle dynamics, work and energy, the conservation of energy, conservation of linear momentum, rotational kinematics and 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.

PHYS1989
Physics 1 (Civil Engineering)
Staff Contact: 1st Year Director
S1 L2 T2 and S2 L2 T1
Prerequisites: As for PHYS1002
Notes: For students in the School of Civil Engineering.

In all first year Civil Engineering undergraduate degree courses students are advised to attempt PHYS1989 Physics1CE but if timetabling difficulties arise or other exceptional circumstances prevail permission will be given to attempt PHYS1002 Physics 1. However, students who intend to apply for transfer to the Combined BE BSc degree program involving Level 2/3 Physics subjects must enrol in PHYS1002.

Mechanical concepts, properties of matter, atomic structure, elasticity, plasticity, fracture of solids; surface tension and viscosity of fluids, electrical and magnetic forces, DC and AC circuits, digital electronics. Simple harmonic motion. Acoustic and mechanical waves, attenuation, velocity of propagation. Elastic moduli. Non-destructive testing, instrumentation.

Level II

PHYS2001
Mechanics, and Computational Physics
Staff Contact: Executive Assistant
S1 L3 T1
Prerequisites: MATH1032, PHYS1002
Corequisite MATH2100
Notes: Excluded PHYS2999.

Harmonic motion, systems of particles, central force problems, Lagrange's equations, coupled oscillations, travelling waves, pulses, energy and momentum transfer, computer operating systems, introduction to FORTRAN, libraries and software packages, use of computers to solve problems in physics.

PHYS2011
Electromagnetism and Thermal Physics
Staff Contact: Executive Assistant
S2 L3 T1
Prerequisites: MATH1032, PHYS1002
Corequisite: MATH2100
Notes: Excluded PHYS2999.

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.

PHYS2021
Quantum Physics and Relativity
Staff Contact: Executive Assistant
F L1.5 T.5
Prerequisites: MATH1032, PHYS1002
Notes: Excluded PHYS2989.

Wave-particle duality. Operators, postulates of quantum mechanics. Applications – steps, barriers and tunnelling. H. atom. Orbital, spin angular momentum, magnetic moment. Spin orbit interaction. Molecules. LCAO, rotation and vibration. Introduction to statistical mechanics. The nucleus – properties, forces, models, fission and fusion. Special theory of relativity, simultaneity, time dilation, length contraction, momentum and energy.

PHYS2031
Laboratory
Staff Contact: Executive Assistant
F T3
Prerequisites: MATH1032, PHYS1002
Notes: Excluded PHYS2920.

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

PHYS2959
Introductory Semiconductor Physics (Computer Engineering)
Staff Contact: Executive Assistant
S1 L1 T.5
Prerequisites: MATH1032, PHYS1969 or PHYS1002
Notes: Excluded PHYS2021, PHYS2989.

Structural properties of solids; free electrons in metals; introductory quantum physics; band theory; semiconductors in equilibrium.

PHYS2969
Physics of Measurement (Surveying)
Staff Contact: Executive Assistant
S1 L1 T2
Prerequisite: PHYS1929

Resolution, accuracy and sensitivity of instruments. Errors of observation; transducers; thermometry; electrical noise; mechanical design of apparatus; optical instruments; optical fibres: photometry; analogue-to-digital conversion and digital instruments. Measurements of very large and very small quantities.

PHYS2979
Electromagnetic Theory (Electrical Engineering)
Staff Contact: Executive Assistant
S1 L2 T1.5
Prerequisites: ELEC1011, PHYS1969
Corequisite: MATH2100

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 field concepts. Superconductivity. Maxwell's equation.

PHYS2989
Solid State Physics (Electrical Engineering)
Staff Contact: Executive Assistant
S1 L2.5 T2
Prerequisites: MATH1032, PHYS1969 or PHYS1002
Corequisite: MATH2100

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.

PHYS2999
Mechanics and Thermal Physics (Electrical Engineering)
Staff Contact: Executive Assistant
F L1.5 T.5
Prerequisites: MATH1032, PHYS1969
Corequisite: MATH2100
Notes: Excluded PHYS2001, PHYS2011.

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.

Level III

PHYS3010
Quantum Mechanics
Staff Contact: Executive Assistant
S1 L1.5 T.5
Prerequisites: MATH2120, PHYS2021

Foundation principles, harmonic oscillator systems, spherically symmetric systems, angular momentum, hydrogen atom, perturbation theory, variational methods, identical particles, quantum theory of atoms.

PHYS3021
Statistical Mechanics and Solid State Physics
Staff Contact: Executive Assistant
S1 L3 T1
Prerequisites: MATH2120, PHYS2011, PHYS2021

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.

PHYS3030
Electromagnetism
Staff Contact: Executive Assistant
S1 L1.5 T.5
Prerequisites: MATH2100, MATH2120, PHYS2011

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

PHYS3041
Experimental Physics A
Staff Contact: Executive Assistant
F T4
Prerequisite: PHYS2031

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.

PHYS3050
Nuclear Physics
Staff Contact: Executive Assistant
S2 L1.5 T.5
Corequisite: PHYS3010

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.

PHYS3060
Advanced Optics
Staff Contact: Executive Assistant
S2 L1.5 T.5
Prerequisite: PHYS1002
Corequisite: MATH2120

Review of geometrical optics, including ray tracing, aberrations and optical instruments: physical optics, including Fresnel and Fraunhofer diffraction, transfer functions, coherence and auto and cross correlation: applications of optics, including fibre optics, lasers and holography.

PHYS3110
Experimental Physics B1
Staff Contact: Executive Assistant
S1 T4
Prerequisite: PHYS2031

Selected experiments and projects. Advanced experimental techniques and open ended projects in the areas covered in PHYS3041 Experimental Physics A together with projects involving electron and nuclear magnetic resonances, low temperature physics and super-conductivity. Fourier optics, holography.

PHYS3630
Advanced Electronics
Staff Contact: Executive Assistant
S1 L1 T2
Prerequisite: PHYS2031, PHYS2630

Noise and drift. Instrumentation, amplifiers, precision amplifier techniques. Digital electronics. Active filters. Oscillators. Modulation and demodulation, phase locked loops. RF techinques. Conversion between analogue and digital. Transducers. Bandwidth narrowing techniques, power supplies.

Town Planning

Town Planning is a School within the Faculty of Architecture.

PLAN9111
Town Planning
Staff Contact: Ms S. Thompson
S1 L2

Introduction to the purpose, scope and application of planning. The urban planning process. Objectives and means of planning 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.

Polymer Science

Polymer Science is a Department within the School of Chemical Engineering and Industrial Chemistry.

POLY3010
Polymer Science
Staff Contact: A/Prof R. Burford
S1 L2 S2 Lab.4
Prerequisites: CHEM2011, CHEM2021, MATH2021, MATH2819
Co- or prerequisites: INDC3090

Polymerization chemistry and processes. Step and radical chain polymerization. Ionic (including stereoregular) polymerization. Methods including bulk, suspension, emulsion, solution and gas phase polymerization. Industrially important polymers and their manufacture. Principles of analysis. Molecular weight distribution. Thermodynamics of polymer solutions. Polymer chain conformation. Viscoelasticity. Mechanical behaviour. Polymer morphology. Thermal behaviour and analysis. Chemistry and physics of elastomers. Elements of polymer compounding and fabrication. New polymers.

Safety Science

Safety Science is a Department within the Faculty of Applied Science

SAFE9213
Introduction to Safety Engineering M
Staff Contact: Dr R. Rosen
C3
Prerequisite: Assumed knowledge SAFE9011 or PHYS1022

The treatment of the following topics covers similar material as SAFE9211, but assumes a basic knowledge of differential calculus. The following workplace topics are considered; safety management, ergonomics, equipment design and task consideration, machine guarding, electrical safety, fire and explosion, management of dangerous materials, ventilation, radiation protection, noise and vibration control, environmental safety, transport safety, safety issues in different industries.

SAFE9224
Principles of Ergonomics
Staff Contact: Dr K. Kothiyal
C3
Prerequisite: Assumed knowledge SAFE9011 or PHYS1022
Notes: A project forms a substantial proportion of the assessment for this subject.

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, heat and ventilation, thermal regulation in humans, criteria for comfort. Person-machine interfaces, displays, machine controls, reaction times, vigilance. Applications of ergonomics to occupational safety and health. Ergonomic research methodology.

SAFE9232
Introduction to Occupational Health and Safety Law
Staff Contact: Head of School
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.

SAFE9242
Human Behaviour and Safety Science
Staff Contact: Ms Dianne Gardner
C3

Human behaviour as a major system factor in occupational safety and health. 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. Planning and implementing organizational change.

SAFE9533
Electrical Safety
Staff Contact: Prof Jean Cross
C3

Effects of current flow and magnetic and electric fields; elementary circuit representation, typical supply situations; likely dangerous conditions; static electricity; hazardous locations; standards and codes of practice; treatment of electric shock. Electrical causes of fire and explosion; prevention of electrical accidents.

SAFE9543
Management of Dangerous Materials
Staff Contact: Dr C. Winder
C3
Prerequisite: Assumed knowledge 1st year Chemistry

Chemical legislation, regulatory assessment of chemicals, chemical information (labels/MSDs), workplace management of chemical safety (workplace assessment, exposure control, storage of chemicals, personal protection monitoring), emergency preparedness, pollution, management of hazardous wastes and disposal.

SAFE9553
Radiation Protection
Staff Contact: Dr R. Rosen
C3
Prerequisite: Assumed knowledge SAFE9211 or SAFE9213

Principles and practices of radiation protection for both ionising and non-ionising radiation. Radiation physics, detection and measurement; background radiation; biological effects of radiation; dose limits; technical controls for radioactive sources and irradiating apparatus. Codes of safe practice; radiological monitoring and personal dosimetry; storage, transport aand disposal of sources; environmental impact; administrative controls; emergency procedures; control of non-ionising radiation. Practical work and site visit.

SAFE9583
Ventilation
Staff Contact: Dr K. Post
C3
Prerequisite: Assumed knowledge Maths, Physics and Engineering Mechanics.

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.

Conditions for the Award of Degrees

First Degrees

Rules, regulations and conditions for the award of *first degrees* are set out in the appropriate Faculty Handbooks.

For the full list of undergraduate courses and degrees offered see *Table of Courses by Faculty* (Undergraduate Study) in the Calendar.

The following is the list of *higher degrees, graduate diplomas and graduate certificates* of UNSW together with the publication in which the conditions for the award appear.

Higher Degrees

For details of graduate degrees by research and course work, arranged in faculty order, see *Table of Courses by Faculty* (Graduate Study) in the Calendar.

Title	Abbreviation	Calendar/Handbook
Higher Degrees		
Doctor of Science	DSc	Calendar
Doctor of Letters	DLitt	Calendar
Doctor of Laws	LLD	Calendar
Doctor of Education	EdD	Professional Studies
Doctor of Medicine	MD	Medicine
Doctor of Philosophy	PhD	Calendar and all handbooks
Master of Applied Science	MAppSc	Applied Science
Master of Architectural Design	MArchDes	Architecture
Master of Architecture	MArch	Architecture
Master of Archives Administration	MArchivAdmin	Professional Studies
Master of Art	MArt	College of Fine Arts
Master of Arts Administration	MArtAdmin	College of Fine Arts
Master of Art Education	MArtEd	College of Fine Arts
Master of Arts	MA	Arts and Social Sciences University College
Master of Art Theory	MArtTh	College of Fine Arts
Master of Biomedical Engineering	MBiomedE	Engineering
Master of Building	MBuild	Architecture
Master of the Built Environment	MBEnv	Architecture
Master of the Built Environment (Building Conservation)	MBEnv	Architecture
Master of Business Administration	MBA	AGSM
Master of Business and Technology	MBT	Engineering
Master of Chemistry	MChem	Science*

Title	Abbreviation	Calendar/Handbook
Master of Clinical Education	MClinEd	Medicine
Master of Cognitive Science	MCogSc	Engineering
Master of Commerce (Honours)	MCom(Hons)	Commerce and Economics
Master of Commerce	MCom	Commerce and Economics
Master of Community Health	MCH	Medicine
Master of Computer Science	MCompSc	Engineering
Master of Construction Management	MConstMgt	Architecture
Master of Education	MEd	Professional Studies
Master of Education in Creative Arts	MEdCA	Professional Studies
Master of Educational Administration	MEdAdmin	Professional Studies
Master of Engineering	ME	Applied Science Engineering University College
Master of Engineering *without supervision*	ME	Applied Science Engineering
Master of Engineering Science	MEngSc	Engineering Applied Science University College
Master of Environmental Studies	MEnvStudies	Applied Science
Master of Fine Arts	MFA	College of Fine Arts
Master of Health Administration	MHA	Professional Studies
Master of Health Personnel Education	MHPEd	Medicine
Master of Health Planning	MHP	Professional Studies
Master of Higher Education	MHEd	Professional Studies
Master of Industrial Design	MID	Architecture
Master of Information Science	MInfSc	Engineering
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 Management Economics	MMgtEc	University College
Master of Mathematics	MMath	Science*
Master of Music	MMus	Arts and Social Sciences
Master of Nursing Administration	MNA	Professional Studies
Master of Optometry	MOptom	Science*
Master of Paediatrics	MPaed	Medicine
Master of Physics	MPhysics	Science*
Master of Policy Studies	MPS	Arts and Social Sciences
Master of Project Management	MPM	Architecture
Master of Public Health	MPH	Medicine Professional Studies
Master of Psychological Medicine	MPM	Medicine
Master of Psychology (Applied)	MPsychol	Science†
Master of Psychology (Clinical)	MPsychol	Science†
Master of Psychotherapy	MPsychotherapy	Medicine
Master of Safety Science	MSafetySc	Applied Science
Master of Science	MSc	Applied Science Architecture Engineering Medicine Science*† University College
Master of Science *without supervision*	MSc	Applied Science Architecture Engineering
Master of Science (Acoustics)	MSc(Acoustics)	Architecture
Master of Science (Industrial Design)	MSc(IndDes)	Architecture
Master of Science and Society	MScSoc	Arts and Social Sciences
Master of Social Work	MSW	Professional Studies
Master of Sports Science	MSpSc	Professional Studies
Master of Statistics	MStats	Science*
Master of Surgery	MS	Medicine
Master of Surveying	MSurv	Engineering

Title	Abbreviation	Calendar/Handbook
Master of Surveying *without supervision*	MSurv	Engineering
Master of Surveying Science	MSurvSc	Engineering
Master of Town Planning	MTP	Architecture
Graduate Diplomas		
Graduate Diploma	GradDip	AGSM Applied Science Architecture Arts and Social Sciences Engineering Science*†
	GradDipHPEd	Medicine
	GradDipClinEd	Medicine
	GradDipPaed	Medicine
	GradDipHEd	Professional Studies
	DipEd	Professional Studies
	DipIM-ArchivAdmin	Professional Studies
	DipIM-Lib	Professional Studies
	DipFDA	Science*
Graduate Certificates		
	GradCertPhilT	Arts and Social Sciences
	GradCertHEd	Professional Studies

**Faculty of Science.*

†Faculty of Biological and Behavioural Sciences.

Doctor of Philosophy (PhD)

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.

Qualifications

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

3.(1) An application to enrol as a candidate for the degree shall be lodged with the Registrar at least one month prior to the date at which enrolment is to begin.

(2) In every case before making the offer of a place the Committee shall be satisfied that initial agreement has been reached between the School* and the applicant on the topic area,

**School' is used here and elsewhere in these conditions to mean any teaching unit authorised to enrol research students and includes a department where that department is not within a school, a centre given approval by the Academic Board to enrol students, and an interdisciplinary unit within a faculty and under the control of the Dean of the Faculty. Enrolment is permitted in more than one such teaching unit.*

supervision arrangements, provision of adequate facilities and any coursework to be prescribed and that these are in accordance with the provisions of the guidelines for promoting postgraduate study within the University.

(3)The candidate shall be enrolled either as a full-time or a part-time student.

(4) A full-time candidate will present the thesis for examination no earlier than three years and no later than five years from the date of enrolment and a part-time candidate will present the thesis for examination no earlier than four years and no later than six years from the date of enrolment, except with the approval of the Committee.

(5) The candidate may undertake the research as an internal student i.e. at a campus, teaching hospital, or other research facility with which the University is associated, or as an external student not in attendance at the University except for periods as may be prescribed by the Committee.

(6) An internal candidate will normally carry out the research on a campus or at a teaching or research facility of the University except that the Committee may permit a candidate to spend a period in the field, within another institution or elsewhere away from the University provided that the work can be supervised in a manner satisfactory to the Committee. In such instances the Committee shall be satisfied that the location and period of time away from the University are necessary to the research program.

(7) The research shall be supervised by a supervisor and where possible a co-supervisor who are members of the academic staff of the School or under other appropriate supervision arrangements approved by the Committee. Normally an external candidate within another organisation or institution will have a co-supervisor at that institution.

Progression

4. The progress of the candidate shall be considered by the Committee following report from the School in accordance with the procedures established within the School and previously noted by the Committee.

(i) The research proposal will be reviewed as soon as feasible after enrolment. For a full-time student this will normally be during the first year of study, or immediately following a period of prescribed coursework. This review will focus on the viability of the research proposal.

(ii) Progress in the course will be reviewed within twelve months of the first review. As a result of either review the Committee may cancel enrolment or take such other action as it considers appropriate. Thereafter, the progress of the candidate will be reviewed annually.

Thesis

5.(1) On completing the program of study a candidate shall submit a thesis embodying the results of the investigation.

(2)The candidate shall give in writing to the 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 and Social Sciences 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

6.(1) There shall be not fewer than three examiners of the thesis, appointed by 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 one of the following:

(a) The thesis merits the award of the degree.

(b) The thesis merits the award of the degree subject to minor corrections as listed being made to the satisfaction of the head of school.

(c) The thesis requires further work on matters detailed in my report. Should performance in this further work be to the satisfaction of the higher degree Committee, the thesis would merit the award of the degree.

(d) The thesis does not merit the award of the degree in its present form and further work as described in my report is required. The revised thesis should be subject to re-examination.

(e) The thesis does not merit the award of the degree and does not demonstrate that resubmission would be likely to achieve that merit.

(3) If the performance at the further work 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 work, 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

7. 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 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).

(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.

Project Report

4.(1) A candidate shall be required to undertake a 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 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.

Examination

5.(1) There shall be not fewer than two examiners of the project report, appointed by 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 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 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.

Fees

6. A candidate shall pay such fees as may be determined from time to time by the Council.

Master of Business and Technology

1. The degree of Master of Business and Technology by formal course work may be awarded by the Council to a candidate who has satisfactorily completed a pro gram 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) A candidate for the Master of Business and Technology shall obtain a grade point average of at least credit in the Graduate Diploma in Industrial Management at the first attempt of each of the subjects. Candidates will then be granted advanced standing in the Master of Business and Technology for the subjects already completed in the Graduate Diploma in Industrial Management.

(3) 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.

(4) 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 Graduate School of Engineering 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.

(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 six academic sessions from the date of enrolment. The maximum period of candidature shall be ten academic sessions from the date of enrolment. In special cases a variation to these times may be granted by the Committee.

Fees

4. A candidate shall pay such fees as may be recommended from time to time by the Graduate School of Engineering.

Master of Cognitive Science (MCogSc) at Honours Level

1. The degree of Master of Cognitive Science at Honours level 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. The degree shall be awarded either with the grade of Honours Class 1 or with the grade of Honours Class 2.

Qualifications

2. (1) A candidate for the degree shall:
(a) 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, and
(b) have completed the requirements for the award of the degree at Pass level.

(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 to carry out such work as it 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 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 Chair of the Master of Cognitive Science Management Committee (hereinafter referred to as the Chair of the Management Committee) 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 assessment 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 academic 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 Chair of the Management Committee 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 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 or external candidate. 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 four academic sessions from the date of enrolment. A part-time or external candidate for the degree shall present for examination not later than eight 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 investigation.

(2) The candidate shall give in writing to the 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 on 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 theses or 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.

Examination

5. (1) There shall be not fewer than two examiners of the thesis, appointed by 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 thesis and shall recommend to the Committee that:

(a) the candidate be awarded the degree either with Honours Class 1 or with Honours Class 2 without further examination; or

(b) the candidate be awarded the degree either with Honours Class 1 or with Honours Class 2 without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school*; or

**Or department where a department is not within a school, or schools or departments where the research is being undetaken in more than one school or department.*

(c) the candidate be awarded the degree either with Honours Class 1 or with Honours Class 2 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 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 Cognitive Science (MCogSc) at Pass Level

1. The degree of Master of Cognitive Science at Pass level 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 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 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 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.

(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 four academic sessions from the date of enrolment. The maximum period of candidature shall be eight academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

Fees

4. A candidate shall pay such fees as may be determined from time to time by the Council.

Master of Computer Science (MCompSc)

1. The degree of Master of Computer 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 ben 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 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) undertake an approved combination of the above and demonstrate ability to undertake research by the submission of a project report embodying the results of an original investigation of an approved topic.

(3) The program of advanced study shall total a minimum of 48 credits. The number of credits allocated for each subject shall be determined by the Committee on the recommendation of the appropriate head of school.

(4) A candidate's proposed program shall be approved by the head of the Department of Computer Science prior to enrolment.

(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 three 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 six 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) A candidate who undertakes an 18 credit project 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.

(2) The candidate shall give in writing to the Registrar two months notice of intention to submit a project report.

(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.

Examination of 18 Credit Project Report

5.(1) There shall be not fewer than two examiners of the project report, appointed by 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 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 in unsatisfactory the Committee shall determine whether or not the candidate may resubmit it 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 (ME) and Master of Science (MSc)

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.

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 Committee.

(2) An applicant who submits evidence of such other academic or professional attainment 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 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.

**Or department where a department is not within a school, or schools or departments where the research is being undetaken in more than one school or department.*

(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 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 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

(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

**'School' is used here and elsewhere in these conditions to mean any teaching unit authorised to enrol research students and includes a department where that department is not within a school, a centre given approval by the Academic Board to enrol students, and an interdisciplinary unit within a faculty and under the control of the Dean of the Faculty. Enrolment is permitted in more than one such teaching unit.*

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 Engineering (ME), Master of Science (MSc) and Master of Surveying (MSurv) *without supervision*

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.

Qualification

2. A candidate for the degree shall have been awarded an appropriate degree of Bachelor of 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.

Enrolment and Progression

3. An application to enrol as candidate for the degree without supervision shall be made n the prescribed form which shall be lodged with the 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 (or department) with regard to the adequacy of the subject matter and its presentation for the degree. A sypnosis of the work should be available

Thesis

4.(1) A candidate shall submit a thesis embodying the results of the investigation.

(2) The candidate shall give in writing to the 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 an 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.

Examination

5.(1) There shall be not fewer than two examiners of the thesis, appointed by the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

(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 tot he 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 department); 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)

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.

Qualifications

2.(1) A candidate for the degree shall have ben 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 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) Undertake an approved combination of the above and demonstrate ability to undertake research by the submission of a project report embodying the results of an original investigation of an approved topic.

(3) The program of advanced study shall total a minimum of 30 credits. The number of credits allocated for each subject shall be determined by the Committee on the recommendation of the appropriate head of school.

(4) A candidate's proposed program shall be approved by the appropriate head of school* prior to an enrolment. For the purposes of this requirement the appropriate head of school shall normally be the head of the school providing the major field of study.

(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

18 Credit Project Report

4.(1) A candidate who undertakes an 18 credit project shall carry out the work on an approved topic supervised by a supervisor or supervisors or under other appropriate supervision arrangements approved by the Committee.

(2) The candidate shall give in writing to the Registrar two months notice of intention to submit a project report.

(3) The project report 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) 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 and theses 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 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.

Examination of 18 Credit Project Report

5.(1) There shall be not fewer than two examiners of the project report, appointed by the Committee.

(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 in unsatisfactory the Committee shall determine whether or not the candidate may resubmit it 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 Information Science (MInfSc)

1. The degree of Master of Information 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 ben 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 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) undertake an approved combination of the above and demonstrate ability to undertake research by the submission of a project report embodying the results of an original investigation of an approved topic.

(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.

(4) A candidate's proposed program shall be approved by the head of the Department of Computer Science prior to enrolment.

(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 three 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 six 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) A candidate who undertakes an 18 credit project 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.

(2) The candidate shall give in writing to the Registrar two months notice of intention to submit a project report.

(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.

Examination of 18 Credit Project Report

5.(1) There shall be not fewer than two examiners of the project report, appointed by 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 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 in unsatisfactory the Committee shall determine whether or not the candidate may resubmit it 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 (MSurv)

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.

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 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) 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.

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 Registrar at least one calendar month before the commencement of the session in which enrolments is to begin.

(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 regulars attendance at the University and using research facilities external to the University.

**Or department where a department is not within a school, or schools or departments where the research is being undetaken in more than one school or department.*

(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 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 (GradDip)

1. A Graduate Diploma 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 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 attainment 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.

Enrolment and Progression

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 Registrar at least two calendar months before the commencement of the session in which enrolment is to begin.

(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.

Fees

4. A candidate shall pay such fees as may be determined from time to time by the Council.

**For the Graduate Diploma in Computer Science no candidate shall be awarded the diploma until a lapse of three academic sessions from the date of enrolment.*

Graduate Diploma in Industrial Management (GradDip)

1. The Graduate Diploma in Industrial Management 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 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) A candidate for the Graduate Diploma in Industrial Management shall obtain a grade point average of at least credit in the Industrial Management Qualification at the first attempt of each of the subjects. Candidates will then be granted advanced standing in the Graduate Diploma in Industrial Management for the subjects already completed in the Industrial Management Qualification

(3) An applicant who submits evidence of such other academic or professional attainment as may be approved by the Committee may be permitted to enrol for the diploma

(4) 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 diploma shall be made on the prescribed form which shall be lodged with the Registrar at least two calendar months before the commencement of the session in which enrolment is to begin.

(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 four sessions from the date of enrolment. The maximum period of candidature shall be six sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

Fees

4. A candidate shall pay such fees as may be recommended from time to time by the Graduate School of Engineering.

Scholarships and Prizes

The scholarships and prizes listed below are available to students whose courses are listed in this book. 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. Applicants should note that the awards and conditions are subject to review.

Key: **V** Value **T** Year/s of Tenure **C** Conditions

Scholarships

Undergraduate Scholarships

Listed below is an outline in summary form of undergraduate scholarships available to students. Full information may be obtained from the Student Centre located on the Lower Ground Floor of the Chancellery.

Unless otherwise indicated in footnotes, applications for the following scholarships should be made to the Registrar and Deputy Principal by 14 January each year. Please note that not all of these awards are available every year.

General

John Crawford Scholarship Scheme

V Tuition fees. Some students maybe eligible for airfares and a stipend.

T Determined by normal course duration

C Information should be obtained from Australian Diplomatic Posts. Conditions and entitlements vary depending on the home country. The closing date is normally early in the year before the year of study.

Sam Cracknell Memorial

V Up to $1500 pa payable in fortnightly instalments

T 1 year

C 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.

Girls Realm Guild

V Up to $1500 pa

T 1 year with the prospect of renewal subject to satisfactory progress and continued demonstration of need

C 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

V Up to $6500 pa

T 1 year renewable for the duration of the course subject to satisfactory progress

C 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. Applications close 30 September each year. Apply directly to PO Box 460 Broken Hill NSW 2880

Alumni Association

V Up to $1500 pa

T 1 year with the possibility of renewal

C Available to students enrolled in any year of a full-time course. Candidates must be the children of Alumni of the University of NSW and may be either permanent residents of Australia or international students.

Sporting Scholarships

V $2000 pa

T 1 year with possibility of renewal

C Available to students who are accepted into a course of at least two years duration. Prospective applicants should have an outstanding ability in a particular sport and are expected to be an active member of a UNSW Sports Club. Apply directly to Sport and Recreation Section, PO Box 1, Kensington 2033.

Electrical Engineering

The Tyree Westinghouse Electrical Company Pty Ltd

V Up to $6720 over

T 1 year renewable for 4 years the duration of the course, subject to satisfactory progress

C Eligibility for admission to the full-time degree course in Electrical Engineering

OTC Ltd-Women in Electrical Engineering

V Up to $1000 pa

T 1 year

C Available to female students enrolled in Year 1 of the electrical Engineering degree course. Candidates must be residents of Australia.

Environmental Engineering

Rankine and Hill

V $1500

T 1 year only

C Available to students enrolled in Year 1 of the degree course in Environmental Engineering

Mechanical and Manufacturing Engineering

Rheem Australia Ltd

V Up to $2500 pa

T 1 year renewable for the duration of the course, subject to satisfactory progress

C Permanent residence in Australia for a second or later year student enrolled in degree course in Mechanical or Manufacturing Engineering

Surveying

The Institution of Surveyors

V Up to $500 pa

T 1 year renewable for the duration of the course, subject to satisfactory progress

C 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.

NSW Department of Lands – Women in Surveying

V Up to $2000 pa

T 1 year

C Available to female students entering Year 1 of the degree course in Surveying course, Candidates must be residents of Australia.

The UNSW Co-op Program

The University of New South Wales has industry-linked education scholarships to the value of $9600 per annum in the following areas: Accounting (and Economics, Finance, Information Systems or Japanese Studies); Business Information Technology, Aeronautical, Bioprocess, Ceramic, Chemical, Civil, Electrical, Environmental, Materials, Mechanical, Metallurgical, Mineral, Mining and Petroleum Engineering; Food Science and Technology, Industrial Chemistry, Manufacturing Management, Textile Management, Textile Technology, and Wool and Pastoral Science.

Graduate Scholarships

Listed below is an outline in summary form of Graduate Scholarships available to students. Application forms and further information are available from the Scholarships Unit and Student Centre, located on the Ground Floor of the Chancellery, unless an alternative contact address is provided. Normally applications become available four to six weeks before the closing date. 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;*

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. Applicants should note that the awards and conditions are subject to review.

**Available for reference in the University Library.*

General

University Postgraduate Research Scholarships

T 1-2 years for a Masters and 3-4 years for a PhD degree

V Living allowance of $14,260 pa. Other allowances may also be paid. Tax free.

C Applicants must be honours graduates or equivalent in the Medicine or Commerce faculties, or the University College, Australian Defence Force Academy. A limited number of scholarships are offered subject to the availbility of funds. Information should be obtained from the Faculty office.

Australian Postgraduate Research Awards

T 1-2 years for a Masters and 3-4 years for a PhD degree

V $14,260 to $18,403

C 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 Registrar by 31 October.

Australian Postgraduate Course Awards

V Living allowance of $11,214 pa. Other allowances may also be paid. Tax free.

T 1-2 years; minimum duration of course

C Applicants must be graduates or scholars who will graduate in current academic year, and who have not previously held a Commonwealth Postgraduate Award. Applicants must be domiciled in Australia. Preference is given to applicants with employment experience. Applications to the Registrar by 30 September.

John Crawford Scholarship Scheme

V Tuition fees. Some students may be eligible for air fares and a stipend.

T Determined by normal course duration

C Information should be obtained from Australian Diplomatic Posts. Conditions and entitlements vary depending on the home country.

Overseas Postgraduate Research Scholarships

V Tuition fees only

T 2 years for a Masters and 3 years for a PhD degree

C Eligibility is confined to postgraduate research students who are citizens of countries other than Australia or New Zealand. Applications to the Registrar by 30 September.

Australian American Educational Foundation Fulbright Award

V Travel expenses and $A2000 as establishment allowance

T 1 year, renewable

C 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. Application forms are available from the Associate Registrar, University of Sydney, NSW 2006, telephone (02) 692 2222.

Australian Federation of University Women

V Amount varies, depending on award

T Up to 1 year

C Applicants must be female graduates who are members of the Australian Federation of University Women. Further enquiries may be directed to the Secretary of the Federation, (telephone (02) 232 5629).

Commonwealth Scholarship and Fellowship Plan

V Varies for each country. Generally covers travel, living, tuition fees, books and equipment, approved medical expenses. Marriage allowance may be payable.

T Usually 2 years, sometimes 3

C Applicants must be graduates who are Australian citizens and who are not older than 35 years of age. Tenable in Commonwealth countries other than Australia. Applications close with the Registrar in early October.

The English-Speaking Union (NSW Branch)

V $7000

T 1 year

C 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 Stipend of Fellowships

V $US7000 pa plus tuition fees

T 1, sometimes 2 years tenable at Harvard University

C 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

V Up to $US 15,000

T 1 year

C 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

V $6000 pa. Under special circumstances this may be increased.

T 2 years

C 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

V Living and travel allowances, tuition and research expenses, health insurance, book and equipment and other allowances for travel and study in the USA

T 12 to 21 months

C Candidates must be Australian citizens and 1. Either members of the Commonwealth or a State Public Service or semi-government Authority. 2. Either staff or graduate students at an Australian university. 3. 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 University

V Living and travel allowances, tuition expenses

T 1-3 years

C Applicants must be Australian citizens who are honours graduates or equivalent, and under 26 years of age. Applications are available from The Secretary, Cambridge Commonwealth Trust, PO Box 252, Cambridge CB2 ITZ, England. The scholarship closes on 15 October.

The Rhodes Scholarship to Oxford University

V Approximately £4862 stg pa

T 2 years, may be extended for a third year.

C 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.

Engineering

Australian Institute of Nuclear Science and Engineering Studentships

V Basic stipend $11,103 pa plus allowances and some University expenses

T 1-3 years

C 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 Registrar.

Harold G. Conde Memorial Fellowship

V $5000 pa

T Maximum of 3 years

C 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 Registrar by 10 April. The scholarship is offered subject to funds.

Medical Engineering Research Association

V Variable

T 1-3 years

C Awarded for graduate study or research in the field of Biomedical Engineering. Applications to The Secretary, MERA, PO Box 218, Lindfield, NSW 2070.

Water Industry Research Award

V $21,000 pa

T 2-4 years

C Application close with the Registrar on 31 July.

Australian Telecommunications Shell Scholarship in Science or Engineering

V $9000 intended as a supplement to other awards

T 1 year for a Masters and up to 3 years for a PhD degree

C Applicants must be first class honours graduates or equivalent or scholars who will graduate with honours in the current academic year, who are Australian citizens or permanent residents and who are aged under 25 years at 1 January. Applications close November 2 with ATERB, PO Box 76, Epping, NSW 2121.

Prizes

Undergraduate University Prizes

The following information summarizes 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.

General

The Sydney Technical College Union Award

V $400.00 and Bronze Medal

C Leadership in student affairs combined with marked academic proficiency by a graduand

The University of New South Wales Alumni

V Statuette Association Prize

C Achievement for community benefit by a student in the final or graduating year

Faculty of Engineering

The Institution of Engineers Australia Award

V $200.00 and medal.

C The best performance by a student in the final or equivalent year leading to the award of the BE or BSc(Eng) degrees offered by the Schools of Civil Engineering, Electrical Engineering and Computer Science, Mechanical and Industrial Engineering, Chemical Engineering and Industrial Chemistry, and the Departments of Mining Engineering and Textile Technology (Engineering option only)

The John Fraser Memorial Award

V $130.00

C The best performance by a student in Year 1 or part-time equivalent of a Bachelor degree offered by the Faculty of Engineering

School of Civil Engineering

The Association of Consulting Structural

V $225.00 Engineers of New South Wales Prize

C Best performance in CIVL4203 Structural Engineering in the Bachelor of Engineering degree course in Civil Engineering

The Association of Consulting Structural Engineers of New South Wales Prize

V $175.00

C The best performance in CIVL3303 Structural Design in the Bachelor of Engineering degree course in Civil Engineering

The Australian Conservation Foundation Prize

V $50.00

C The best performance in the subjects which develop environmental management concepts for the Civil Engineer

The Australian Institute of Traffic Planning and Management Prize

V $150.00

C The best performance in CIVL4844 Transport major in the Bachelor of Engineering degree course in Civil Engineering

The Baulderstone Hornibrook Prize

V $500.00

C The best performance in Engineering Construction and Management in the Bachelor of Engineering degree course in Civil Engineering

The Computing and Graphics Prize (Donor P W Kneen)

V $400.00

C The best performance in CIVL1106 Computing and Graphics by a student in the Bachelor of Engineering in Civil Engineering or Bachelor of Engineering in Environmental Engineering

The Crawford Munro Memorial Prize

V $300.00

C The best performance in CIVL3705 Water Resources in the Bachelor of Engineering degree course in Civil Engineering

The GAA Engineering Award

V $500.00

C The best performance in CIVL3303 Structural Design in the Bachelor of Engineering degree course in Civil Engineering

The GAA Engineering Award

V $500.00

C The best essay on a topic relating to galvanising by a student proceeding to the award of the degree of Bachelor of Engineering in Civil Engineering

The Hardie's Pipeline Award

V $250.00 and plaque

C The best performance in CIVL4605 Water Supply and Wastewater Disposal in the Bachelor of Engineering degree course in Civil Engineering

The Institution of Engineers Environmental Engineering Prize

V $200.00

C The best performance in CIVL1007 Engineering Practice in the Bachelor of Engineering in Enviromental Engineering course

The James Hardie Co Pty Ltd Prize

V $225.00

C The best performance in CIVL2505 Hydraulics 1 in the Bachelor of Engineering degree course in Civil Engineering

The Jeffery and Katauskas Prize

V $500.00

C The best performance in CIVL4822 Geotechnical Major in the Bachelor of Engineering degree course

The Welding Technology Institute of Australia Prize

V Books to the value of $100.00, 1 year membership of the Institute

C The best design which incorporates a welding process for students in Years 2 to 4 of the Bachelor of Engineering degree course in Civil Engineering

School of Computer Science and Engineering

The Logica Pty Limited Prize

V $1000.00

C The best performance by a graduand in a Computer Science degree course at honours level

School of Electrical Engineering

The Electricity Supply Engineers' Association of New South Wales Prize

V $100.00

C The best overall performance including proficiency in electric power distribution in Year 3 full-time or equivalent part-time stages of the Bachelor of Engineering degree course in Electrical Engineering

The Institution of Electrical Engineers Prize

V $100.00

C The best performance in Year 3 studies of the Bachelor of Engineering degree course in Electrical Engineeering

The Institution of Electrical Engineers Prize

V £75.00 and Certificate

C The best performance in the final year thesis/project by a student proceeding to the award of the degree of Bachelor of Engineering in Electrical Engineering

The J. Douglas Maclurcan Prize

V $60.00 book order

C Outstanding performance in the field of Control Systems in the final year of the Bachelor of Engineering degree course in Electrical Engineering

The Telecom Australia Prize

V $300.00

C The best telecommunications related thesis by a final year student proceeding to the award of the degree of Bachelor of Engineering in Electrical Engineering or Computer Engineering

Photovoltaic Devices and Systems

The Photovoltaics Prize (Applied Photovoltaics)

V $500.00

C The best performance in ELEC4540 Applied Photovoltaics in the Bachelor of Engineering degree course

The Photovoltaics Thesis Prize

V $500.00

C The best performance for an undergraduate thesis in the area of photovoltaics in the Bachelor of Engineering degree course

The Photovoltaics Prize (Advanced Photovoltaics)

V $500.00

C The best performance in ELEC9505 Solar Cells leading to the award of the Bachelor of Engineering or Master of Engineering Science or Doctor of Philosophy degrees

School of Mechanical and Manufacturing Engineering

The Ansett Australia Prize

V $200.00 and bronze medal

C The best overall performance in the Bachelor of Engineering degree course in Aeronautical Engineering

The Atlas Copco Prize

V $125.00

C The best overall performance in the Bachelor of Engineering degree course in Mechanical Engineering

The Babcock Engineering Australia Limited Prize

V Books to the value of $100.00

C The best performance in a subject selected by the Head of School at the beginning of each academic year

The Carrier Air Conditioning Pty Limited Prize

V $250.00

C The best performance in a subject selected by the Head of School

The Computer-based Engineering Design Prize

V $100.00

C The best undergraduate or postgraduate thesis making a contribution to computer-based Engineering design in the School of Mechanical and Industrial Engineering

The David Carment Memorial Prize

V $500.00 and Bronze Medal

C The best overall performance in the final year of the Bachelor of Engineering degree course in Naval Architecture

The The Pacific Power Award

V $250.00

C The best performance in MECH4740 Thermal Power Plants

The Hawker de Havilland Ltd Prize

V $500.00

C The best thesis in the Bachelor of Engineering degree course in Aeronautical Engineering

The Hawker de Havilland Victoria Limited Prize

V $300.00 and Silver Medal

C The best overall performance in the final year of the Bachelor of Engineering degree course in Aeronautical Engineering

The Jeremy Hirschhorn Prize in Mechanical Engineering

V $100.00

C The best performance by a final year student in Mechanics of Machines

The John Harrison Prize

V $100.00

C The best performance in Mechanics of Machines in Year 3 of the Bachelor of Engineering degree course in Mechanical Engineering

The R.A.A. Bryant Prize

V $1,000.00 (indexed per year since 1989)

C A student graduating with first class honours and the University Medal in Mechanical Engineering

The R.E. Jeffries Memorial Prize

V $500.00

C The best overall performance in the final year of the Bachelor of Engineering degree course in Industrial Engineering

The Royal Institution of Naval Architects (Australian Division) Prize

V $250.00

C The best ship design by a student in the final year of the Bachelor of Engineering degree course in Naval Architecture

The Shell Refining (Australia) Pty Ltd Prize

V $100.00

C The best performance in a first year mechanical engineering subject to be selected by the Head of School at the beginning of each academic year

The Shell Refining (Australia) Pty Ltd Prize

V $100.00

C The best undergraduate thesis by a student in the final year of the Bachelor of Engineering degree course in Mechanical Engineering

The Shell Refining (Australia) Pty Ltd Prize

V $100.00

C The best performance in the subject MANF3619 Management/Economics by a student in the Bachelor of Engineering degree course

The Shell Refining (Australia) Pty Ltd Prize

V $100.00

C The best performance in a subject selected by the Head of School

The Spruson and Ferguson Prize

V $250.00

C The best performance in MECH3100 Mechanical Engineering Design 3 by a student in the Bachelor of Engineering degree course in Mechanical Engineering

The Staedtler (Pacific) Pty Ltd Prize

V Products to the value of $350.00

C The best overall performance by a student in Year 2 of the Bachelor of Engineering degree course in Mechanical Engineering

The TRW Products Limited Prize

V $1000.00

C The best overall performance inthe Bachelor of Engineering degree course in Manufacturing Engineering

Graduate University Prizes

The following information summarizes graduate prizes awarded by the University.

School of Chemical Engineering and Industrial Chemistry

The Clean Air Society of Australia and New Zealand Prize in Atmospheric Pollution Control

V $100.00

C The highest aggregate in FUEL5910 Atmospheric Pollution and Control and FUEL5920 Practical Aspects of Air Pollution Measurement and Control in a graduate course in the School of Chemical Engineering and Industrial Chemistry

School of Civil Engineering

The Institute of Advanced Motorists Prize

V $50.00

C The best performance in Traffic Planning and Control

The Maunsells Project Report Prize

V $500.00

C The best performance in CIVL8909 or CIVL9909 Project Report (9 credits) or GEOL9504 or GEOL9604 Project Report (9 credits) by a student in the Master of Engineering Science or Master of Applied Science degree courses

The Maunsells Waste Management Prize

V $500.00

C The best aggregate performance by a Stage 1 student in
- CIVL8872/9872 Solid Waste Management
- CIVL8873/9873 Waste and Wastewater Analysis and Environmental Requirements,
- CIVL8874/9874 Waste Management Science by a student in the Master of Engineering Science or Master of Applied Science course

School of Mechanical and Manufacturing Engineering

The Computer-based Engineering Design Prize

V $100.00

C The best undergraduate or graduate thesis making a contribution to computer-based Engineering design in the School of Mechanical and Industrial Engineering

NOTES

NOTES

The University of New South Wales, Kensington Campus

Theatres

Biomedical Theatres **E27**
Central Lecture Block **E19**
Chemistry Theatres *(Dwyer, Mellor, Murphy, Nyholm, Smith)* **E12**
Classroom Block *(Western Grounds)* **H3**
Fig Tree Theatre **B14**
Io Myers Studio **D9**
Keith Burrows Theatre **J14**
Mathews Theatres **D23**
Parade Theatre **E3**
Physics Theatre *(Main Building)* **K14**
Rex Vowels Theatre **F17**
Science Theatre **F13**
Sir John Clancy Auditorium **C24**

Buildings

Applied Science **F10**
Barker Street Gatehouse **N11**
Basser College *(Kensington)* **C18**
Central Store **B13**
Chancellery **C22**
Dalton *(Chemistry)* **F12**
Goldstein College *(Kensington)* **D16**
Golf House **A27**
Gymnasium **B5**
International House **C6**
John Goodsell *(Commerce and Economics)* **F20**
Kensington Colleges *(Office)* **C17**
Library *(University)* **E21**
Link **B6**
Maintenance Workshop **B13**
Mathews **F23**
Menzies Library **E21**
Morven Brown *(Arts)* **C20**
New College **L6**
Newton **J12**
NIDA **D2**
Parking Station **H25**
Philip Baxter College *(Kensington)* **D14**
Robert Heffron *(Chemistry)* **E12**
Sam Cracknell Pavilion **H8**
Samuels Building **F26**
Shalom College **N9**
Sir Robert Webster **G14**
Unisearch House **L5**
University Regiment **J2**
University Union *(Roundhouse)* **E6**
University Union *(Blockhouse)* **G6**
University Union *(Squarehouse)* **E4**
Wallace Wurth School of Medicine **C27**
Warrane College **M7**

General

Aboriginal Student Centre:
47 Botany St, Randwick
Accommodation *(off-campus)* **F15**
Accounting **F20**
Admissions **C22**
Adviser for Prospective Students **C22**
Anatomy **C27**
Applied Bioscience **D26**
Applied Economic Research **G14**
Applied Geology **F10**
Applied Science *(Faculty Office)* **F10**
Architecture *(Faculty Office)* **H14**
Archives, University **E21**
Arts and Social Sciences *(Faculty Office)* **C20**
Asia-Australia Institute:
34 Botany St, Randwick
Audio Visual Unit **F20**
Australian Graduate School of Management **G27**
Banking and Finance **F20**
Biochemistry and Molecular Genetics **D26**
Biological and Behavioural Sciences *(Faculty Office)* **D26**
Biomedical Engineering **F26**
Biomedical Library **F23**
Biotechnology **F26**
Cashier's Office **C22**
Chaplains **L12 & L13**
Chemical Engineering and Industrial Chemistry **F10**
Chemistry **E12**
Civil Engineering **H20**
Co-op Bookshop **G17**
Commerce and Economics *(Faculty Office)* **F20**
Communications Law Centre **C15**
Community Medicine **D26**
Computer Science and Engineering **G17**
Computing Services Department **F26**
Cornea and Contact Lens Research Unit:
22-32 King St, Randwick
Economics **F20**
Education Studies **G2**
Educational Testing Centre **K14**
Electrical Engineering **G17**
Energy Research, Development & Information Centre **F10**
Engineering *(Faculty Office)* **K17**
English **C20**
Examinations **C22**
Fees Office **C22**
Fibre Science and Technology **G14**
Food Science and Technology **B8**
French **C20**
Geography **K17**
German and Russian Studies **C20**
Graduate Office and Alumni Centre **E4**
Graduate School of the Built Environment **H14**
Groundwater Management and Hydrogeology **F10**
Health Service, University **L14b**
Health Services Management **C22**
History **C20**
House at Pooh Corner *(Child Care)* **N8**
Industrial Design **G15**
Industrial Relations and Organizational Behaviour **F20**
Information Systems **F20**
Institute of Languages:
14 Francis St, Randwick
International Student Centre **F16**
IPACE Institute **F23**
Japanese Economic and Management Studies **F20**
Kanga's House *(Child Care)* **O14**
Landscape Architecture **K15**
Law *(Faculty Office)* **F21**
Law Library **F21**
Legal Studies & Taxation **F20**
Liberal and General Studies **C20**
Librarianship **F23**
Lost Property **C22**
Marine Science **D26**
Marketing **F20**
Materials Science and Engineering **E8**
Mathematics **F23**
Mechanical and Manufacturing Engineering **J17**
Medical Education **C27**
Medicine *(Faculty Office)* **B27**
Membrane and Separation Technology **F1**
Microbiology and Immunology **D26**
Mines **K15**
Minor Works and Maintenance **B14A**
Music **B11**
News Service **C22**
New South Wales University Press:
22-32 King St, Randwick
Optometry **J12**
Pathology **C27**
Patrol and Cleaning Services **C22**
Performing Arts **B10**
Petroleum Engineering **D12**
Philosophy **C20**
Physics **K15**
Physiology and Pharmacology **C27**
Political Science **C20**
Printing Section **C22**
Professional Development Centre **K13**
Professional Studies *(Faculty Office)* **G2**
Property and Works **C22**
Psychology **F23**
Publications Section **C22**
Remote Sensing **K17**
Safety Science:
32 Botany Street, Randwick
Science *(Faculty Office)* **F23**
Science and Technology Studies **C20**
Social Science and Policy **C20**
Social Policy Research Centre **F26**
Social Work **G2**
Sociology **C20**
Spanish and Latin American Studies **C20**
Sport and Recreation Centre **B6**
Squash Courts **B7**
Staff Office **C22**
Student Centre *(off Library Lawn)* **C22**
Students' Union **E4, C21**
Student Services:
Careers, Loans, Accommodation etc **L14**
Counselling **L13**
Students' Union **E4, C21**
Surveying **K17**
Swimming Pool **B4**
Textile Technology **G14**
Theatre and Film Studies **B10**
Town Planning **K15**
WHO Regional Training Centre **C27**
Wool and Animal Sciences **G14**