
The University of New South Wales

# Engineering

# 1990 Faculty Handbook


**Arms of**

## The University of New South Wales

Granted by the College of Heralds, London
3 March 1952

### Heraldic Description of Arms

Argent on a Cross Gules a Lion passant guardant between four Mullets of eight points Or a Chief Sable charged with an open Book proper thereon the word SCIENTIA in letters also Sable.

The lion and the four stars of the Southern Cross on the Cross of St George have reference to the State of New South Wales which brought the University into being; the open book with SCIENTIA across its page reminds us of its original purpose. Beneath the shield is the motto 'Manu et Mente' ('with Hand and Mind'), which is the motto of the Sydney Technical College, from which the University has developed. The motto is not an integral part of the Grant of Arms and could be changed at will; but it was the opinion of the University Council that the relationship with the parent institution should in some way be recorded.


The University of New South Wales

# Engineering

# 1990 Faculty Handbook

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

**Information in this Handbook has been brought up to date as at 9 October 1989, but may be amended without notice by the University Council.**

# Contents

# Calendar of dates

| | 1990 | 1991 |
|---|---|---|
| **Session 1 (67 teaching days)** | | |
| | 26 February to 12 April | 4 March to 28 March |
| *Recess* | *13 April to to 22 April* | *29 March to 7 April* |
| | 23 April to 7 June | 8 April to 14 June |
| *Study Recess* | *8 June to 13 June* | *15 June to 20 June* |
| Examinations | 14 June to 2 July | 21 June to 9 July |
| *Midyear Recess* | *3 July to 22 July* | *10 July to 28 July* |
| **Session 2 (67 teaching days)** | | |
| | 23 July to 21 September | 29 July to 27 September |
| *Recess* | *22 September to 1 October* | *28 September to 7 October* |
| | 2 October to 31 October | 8 October to 6 November |
| *Study Recess* | *1 November to 6 November* | *7 November to 12 November* |
| Examinations | 7 November to 23 November | 13 November to 29 Novembe |
| Vacation weeks | 16 April to 22 April | 1 April to 7 April |
| common to Australian | 2 July to 8 July | 8 July to 14 July |
| universities | 24 September to 30 September | 30 September to 6 October |

## Important Dates for 1990

### January

| | | |
|---|---|---|
| M | 1 | New Year's Day – Public Holiday |
| F | 5 | Last day for acceptance of applications by office of the Admissions Section for transfer to another undergraduate cou within the University |
| W | 10 | Last day for applications for review of assessment |
| M | 15 | Term 1 begins – Medicine IV and V |
| F | 26 | Australia Day – Public Holiday |

### February

| | | |
|---|---|---|
| M | 5 | Enrolment period begins for new undergraduate students and undergraduate students repeating first year |
| F | 9 | Re-enrolment period begins for second and later year undergraduate and graduate students enrolled in formal cours |
| F | 23 | Last day for acceptance of enrolment by new and re-enrolling students |
| M | 26 | Session 1 begins – all courses except Medicine IV and V and the University College |

### March

| | | |
|---|---|---|
| M | 5 | Session 1 begins – University College, Australian Defence Force Academy |
| F | 9 | Last day applications are accepted from students to enrol in Session 1 or whole year subjects |
| F | 30 | Last day for students to discontinue Session 1 and whole year subjects so as not to incur HECS liability |
| S | 31 | HECS Census Date for Session 1 |

### April

| | | |
|---|---|---|
| Th | 12 | Last day for students to discontinue without failure subjects which extend over Session 1 only |
| F | 13 | Good Friday – Public Holiday<br>Mid-session Recess begins |
| S | 14 | Easter Saturday – Public Holiday |
| M | 16 | Easter Monday – Public Holiday |

**April**

| | | |
|---|---|---|
| S | 14 | Easter Saturday – Public Holiday |
| M | 16 | Easter Monday – Public Holiday |
| Su | 22 | Mid-session Recess ends |
| W | 25 | Anzac Day – Public Holiday |

**May**

| | | |
|---|---|---|
| T | 8 | Publication of provisional timetable for June examinations |
| W | 16 | Last day for students to advise of examination clashes |
| T | 29 | Publication of timetable for June examinations |

**June**

| | | |
|---|---|---|
| Th | 7 | Session 1 ends |
| F | 8 | Study Recess begins |
| M | 11 | Queen's Birthday – Public Holiday |
| W | 13 | Study Recess ends |
| Th | 14 | Examinations begin |

**July**

| | | |
|---|---|---|
| M | 2 | Examinations end |
| Th | 12 | Assessment results mailed to students |
| F | 13 | Assessment results displayed on University noticeboards |
| Su | 22 | Mid-year Recess ends |
| M | 23 | Session 2 begins |

**August**

| | | |
|---|---|---|
| Th | 2 | Last day for applications for review of Session 1 assessment results |
| F | 3 | Last day for students to discontinue without failure subjects which extend over the whole academic year.<br>Last day applications are accepted from students to enrol in Session 2 subjects. |
| F | 31 | HECS Census Day for Session 2.<br>Last day for students to discontinue Session 2 and whole year subjects so as not to incur HECS liability |

**September**

| | | |
|---|---|---|
| F | 7 | Last day for students to discontinue without failure subjects which extend over Session 2 only |
| S | 22 | Mid-session Recess begins |
| F | 28 | Closing date for applications to the Universities and Colleges Admission Centre |

**October**

| | | |
|---|---|---|
| M | 1 | Labour Day – Public Holiday<br>Mid-session Recess ends |
| T | 2 | Publication of provisional timetable for November examinations |
| W | 10 | Last day for students to advise of examination clashes |
| T | 23 | Publication of timetable for November examinations |
| W | 31 | Session 2 ends |

**November**

| | | |
|---|---|---|
| Th | 1 | Study Recess begins |
| T | 6 | Study Recess ends |
| W | 7 | Examinations begin |
| F | 23 | Examinations end |

**December**

| | | |
|---|---|---|
| M | 10 | Assessment results mailed to students |
| T | 11 | Assessment results displayed on University noticeboards |
| T | 25 | Christmas Day – Public Holiday |
| W | 26 | Boxing Day – Public Holiday |
| M | 31 | Public Holiday |

# Staff

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

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Artur Stolz, BSurv PhD *N.S.W.*, RegSurvNSW
John Charles Trinder, BSurv PhD *N.S.W.*, MSc *I.T.C. Delft*, RegSurvNSW, FISAust

Senior Lecturers
Arthur Harry William Kearsley, BSurv MSurvSc PhD *N.S.W.*, MISAust
Anthony John Robinson, BSurv MBA PhD *N.S.W.*, RegSurvNSW, MISAust, MAIC
Jean Marc Rueger, DipIng *E.T.H. Zurich*, PhD *N.S.W.*, SIA, ACSM LSSwitz, MISAust

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

Administrative Assistant
Leon Daras, BA *N.S.W.*

Professional Officers
Brian Edward Donnelly, BSurv *N.S.W.*, RegSurvNSW, GradDipCompStud *C.C.A.E.*
Basil Lai, BSc BE *Syd.*,
Karl David Sippel, BSurv *N.S.W.*

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

## Centre for Biomedical Engineering

Honorary Visiting Professor and Honorary Director
Peter Craig Farrell, BE *Syd.*, SM *M.I.T.*, PhD *Wash.*, DSc *N.S.W.*, MASAIO, MISAO

Associate Professor and Assistant Director
Klaus Schindhelm, BE PhD *N.S.W.*, MIEAust, MASAIO

Senior Lecturers
Alberto Pompeo Avolio, BE PhD *N.S.W.*
Christopher David Bertram, MA DPhil *Oxf.*
Bruce Kenneth Milthorpe, BA *Macq.*, PhD *A.N.U.*

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

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

Administrative Assistant
Rhonwen Mooney, BA DipSocWk *Syd.*

## Centre for Groundwater Management and Hydrogeology

*In association with the Faculty of Applied Science*

Director
Dr M. J. Knight

Deputy Director
Associate Professor C. R. Dudgeon

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

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

Administrative Assistant
Beverley Ann Collin

## Centre for Membrane and Separation Technology

*In association with the Faculty of Applied Science*

Director
Professor C. J. D. Fell

## *Joint Microelectronics Research Centre

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

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

*With the Royal Melbourne Institute of Technology

## Centre for Remote Sensing

*In association with the Faculty of Applied Science*

Director
Associate Professor B. C. Forster

Deputy Director
Dr A. K. Milne

Professional Development Manager
Helen Dawn Williamson, BA *Lond.*, MSc *Cran I.T.*, PhD *Sheff.*

Professional Officers
Leanne Margaret Bischof, BE *Darling Downs I.A.E.*
Arthur Mark Hall, BSc *N.E.*

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

Research Assistant
John Lambert Steer, BApp Sc *N.S.W.I.T.*

## Centre for Safety Science

Monier Chair of Safety Engineering and Director
Jean Cross, BSc *Manc.*, PhD *Lond.*

Associate Professor
Michael Geoffrey Stevenson, BScTech PhD *N.S.W.*, ASTC, CEng, FIEAust, MIProdE

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

Lecturers
Keith Post, BE PhD N.S.W.
Roger Roy Hall, BSc *A.N.U.*, MSc *N.S.W.*, FES, MIES

Senior Research Assistant
David Gavin Lloyd, BScEng *N.S.W.*

Professional Officer
Kamal Yatapanage, BSc MSc *U.N.E.*

*Conjoint appointment with the Faculty of Medicine.

## Centre for Waste Management

*In association with the Faculty of Applied Science*

**Director**
Vacant

**Deputy Director**
Dr M. J. Knight

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

# Foreword

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

The Faculty consists of the Schools of Civil Engineering, Electrical Engineering and Computer Science, Mechanical and Industrial Engineering, Surveying and the Centres for Biomedical Engineering, Manufacturing and Automation, Safety Science and Wastewater Treatment. The Faculty is also closely associated with the Joint Microelectronics Research Centre and the Centres for Groundwater Management and Hydrogeology, Membrane and Separation Technology, Remote Sensing, and Waste Management. The last four Centres are multidisciplinary in nature.

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

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

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

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

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

The Faculty's engineering and surveying courses seek to:

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

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

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

Dean
Faculty of Engineering

# Faculty Information

## Some People Who Can Help You

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

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

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

*School of Mechanical and Industrial Engineering:* Dr C.V. Madhusudhana, Room 105B, or Mr A.D. Bauman, Room 107, Mechanical and Industrial Engineering Building.

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

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

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

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

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

*Centre for Safety Science:* Professor J.A. Cross, Room 445, Geography and Surveying Building.

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

It is University policy to promote equal opportunity in education (refer to EOE Policy Statement, University of New South Wales Calendar and the Guide for Students 1990).

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

## Entrance Requirements

Students are selected for courses offered by the Faculty according to the scaled aggregate mark obtained in the New South Wales 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 | NSW HSC Prerequisites For First-Year Subjects | NSW HSC Score Range Required |
|---|---|---|
| Engineering: | 2U Mathematics *or* | 60-100 |
| Aeronatical | 3U Mathematics *or* | 1-50 |
| Civil | 4U Mathematics | 1-100 |
| Computer | | |
| Electrical | 2U Science (Physics) *or* | 53-100 |
| Industrial | 3U Science or | 90-150 |
| Mechanical | 4U Science (multistrand) | 1-50 |
| *Surveying* | | |
| *Naval Architecture* | 2U English (General) *or* | 53-100 |
| | 2U English *or* | 49-100 |
| | 3U English *or* | 1-50 |
| | 2U Contemporary English | 60-100 |

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 defiencies in subject levels. Further details are available from the Students' Information Guide published annually by the Universities and Colleges Admissions Centre (UCAC).

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

## Faculty of Engineering Enrolment Procedures

All students re-enrolling in 1990 or enrolling in graduate courses should obtain a copy of the free leaflet Re-Enrolling 1990 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.

## 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

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

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

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

Physical Sciences Librarian — Marian Bate

### Undergraduate Services

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

## 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); Students of Safety Science Society (SAFSOC); 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.

## International Association for the Exchange of Students for TechnicalExperience – 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.

## The Institution of Engineers, Australia

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

The Institution functions through a series of divisions, the local one being the Sydney Division. Within each division are branches representing the main interests within the profession, eg civil, mechanical, electrical, engineering managment 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 advising of site tours, conferences, technical meetings of all branches, harbour cruises, film nights, etc. For a small fee they also receive *The Transactions* which contains articles on a particular branch of engineering.

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

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

## 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. The aims of the Institution are to promote scientific, technical and educational aspects of surveying and to maintain high professional standards of practice and conduct. Student members receive the quarterly journal of the Institution of Surveyors, The Australian Surveyor and *Azimuth* which is published by the New South Wales Division of the Institution. Membership also entitles the student to attend all meetings of the Institution and to attend the annual Congress at a special concessional rate. Membership application forms are available at the office of the School of Surveying and from the Institution Office, Third Floor, Guild House, 363 Pitt Street, Sydney.

## 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 **Guide for Students** 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 **Calender.**

# Undergraduate Study

The Faculty of Engineering offers courses leading to the award of the degrees of Bachelor of Engineering (BE) in Aeronautical, Civil, Computer, Electrical, Industrial and Mechanical Engineering and in Naval Architecture. A course is also offered leading to the award of the degree of Bachelor of Surveying (BSurv). The BE courses are available on a full-time or part-time basis or in sandwich form after first year with the (exception of courses offered by the School of Mechanical and Industrial Engineering). The BSurv course is available for full-time study and in a sandwich form. The full-time courses are designed to be taken over a period of four years, whereas part-time study usually involves a combination of day-time and evening attendance over a period of six or seven years. It may not be possible to offer evening classes in the later year subjects. The sandwich pattern provides for alternate periods of full-time study and full-time employment with part-time study. The three major subject areas in engineering and surveying courses are **basic sciences, engineering sciences** and **engineering applications**. The basic sciences area is emphasised in Year 1 since it forms the foundation for the remainder of the course. Engineering sciences form the link between the basic sciences and engineering applications. The engineering applications area provides the opportunity for applying knowledge to the solution of problems and is consequently emphasised later in the course. A feature of the courses at the University of New South Wales is the inclusion of a program of General Education, the requirements for which are set out below.

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

## Combined Courses

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

## General Education Requirement

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

Among its objectives, the General Education program provides the opportunity for students to address some of the

key questions they will face as individuals, citizens and professionals.

The program requires students to undertake studies in three areas:

**A.** An introduction in non-specialist terms to an understanding of the environments in which humans function.

**B.** An introduction to, and a critical reflection upon, the cultural bases of knowledge, belief, language, identity and purpose.

**C.** An introduction to the development, design and responsible management of the systems over which human beings exercise some influence and control.

The exact form of category C is still being decided and should be clearly defined in 1990. This could involve, however, a slight subsequent change to the structure of the later years of degree programs.

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

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

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

**2. Students who commenced their undergraduate program in 1988 or 1989.**

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

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

## Course Transfers

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

## General Rules for Progression

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

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

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

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

**4.** Only in exceptional circumstances will students be permitted to enrol in subjects extending over more than two years of the course or for more than twenty-eight hours of course work per week if a full-time student or fourteen hours per week if a part-time student. Students repeating subjects are required to choose a program which limits their hours of course work to twenty-two per week if a full-time 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.

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

## Prerequisites and Co-requisites

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

## Industrial Experience Requirements

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. Progression to succeeding years of the course and the award of the degree are dependent on the completion of the requisite periods of industrial employment at a standard approved by the University.

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

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

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

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

(1) comply with the requirements for admission;

(2) follow the prescribed course of study in the appropriate school and pass the necessary examinations;

(3) complete an approved program of industrial training over such period as is prescribed concurrently with attendance in the course. In general, this training must be completed before 31 January in the year in which the degree is to be awarded.

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

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

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

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

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

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

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

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;

**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.

Undergraduate Study

# Course Outlines

## School of Civil Engineering

Head of School
Professor R. Fell

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, construction 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).

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

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

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

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

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

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

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

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

## 3620
## Civil Engineering – Full-time Course

### Bachelor of Engineering BE

**Year 1**

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

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

**Year 2**

| | | Hours per week S1 | S2 |
|---|---|---|---|
| 8.210 | Systems Engineering | 2 | 3 |
| 8.220 | Engineering Mechanics 2 | 4 | 4 |
| 8.230 | Engineering Construction | 2 | 2 |
| 8.240 | Materials Engineering 1 | 4 | 4 |
| 8.250 | Hydraulics 1 | 2 | 2 |
| 10.022 | Engineering Mathematics 2 | 4 | 4 |
| 10.381 | Statistics SC | 2 | 0 |
| 29.441 | Surveying for Engineers | 0 | 4.5 |
| 29.491 | Survey Camp* | 0 | 0(3) |
| | 56-hr General Education subject (Cat A) | 4 | 0 |
| | | 24 | 23.5 (+3) |

* Students are required to attend a one week Survey Camp which is equivalent to 3 class contact hours per week in Session 2.

**Year 3**

| | | | |
|---|---|---|---|
| 8.310 | Engineering Computations | 2 | 2 |
| 8.320 | Structural Analysis | 3 | 3 |
| 8.330 | Structural Design | 4 | 4 |
| 8.340 | Geotechnical Engineering 1 | 3 | 3 |
| 8.350 | Hydraulics 2 | 3 | 3 |
| 8.360 | Engineering Management 1 | 2 | 2 |
| 8.370 | Water Resources | 3 | 3 |
| 8.380 | Transport Engineering | 2 | 2 |
| | 56-hr General Education subject (Cat B) | 2 | 2 |
| | | 24 | 24 |

**Year 4**

| | | | |
|---|---|---|---|
| 8.400 | Industrial Training | 0 | 0 |
| 8.410 | Engineering Management 2 | 2 | 0 |
| 8.420 | Structural Engineering | 4 | 0 |
| 8.430 | Engineering and the Environment* | 4 | 0 |
| 8.440 | Materials Engineering 2 | 3 | 0 |
| 8.450 | Geotechnical Engineering2 | 3 | 0 |
| 8.460 | Water Supply and Wastewater Disposal | 3 | 0 |

**Year 4**

| | | Hours per week S1 | S2 |
|---|---|---|---|
| 8.470 | Highway and Pavement Engineering | 3 | 0 |
| 8.490 | Project/Thesis | 1 | 6 |
| *Plus two of the following five elective majors:* | | | |
| 8.481 | Construction Major** | 0 | 9 |
| 8.482 | Geotechnical Major | 0 | 9 |
| 8.483 | Structures Major | 0 | 9 |
| 8.484 | Transport Major | 0 | 9 |
| 8.485 | Water Major | 0 | 9 |
| | | 23 | 24 |

* Category C (General Education)
** Students are required to attend a one week construction camp.

## Combined Course

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

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

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

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

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

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

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

## Geography and Environmental Chemistry

**Year 1**
1.981*
2.991
8.110, 8.120, 8.130
10.001
25.5112

| Year 5†† (1990 only) | | Hours per week S1 | S2 |
|---|---|---|---|
| | 5 Professional Electives* | 15 | 10 |
| 6.911 | Thesis | 3 | 12 |
| 6.903 | Industrial Training | | |
| 10.0331 | Transform Methods | 2 | 0 |
| | One Technical Elective or Industrial Elective*** | | |
| | | 20 | 22 |

†See list of Technical Electives later this section.
††Students are required to complete 168 hours of General Studies electives for the BE degree. If these have not been completed by the end of Year 4, then General Studies must be included in the Year 5 program.
*Three electives are taken in Session 1 and two in Session 2. See list of Professional Electives later this section.
**6.911 Thesis is done in the last two sessions of a student's course. See subject description. Students enrol in 6.911A for the first session of their thesis and in 6.911B for the second.
***See 6.931 Industrial Elective subject description.

**Year 3**
Proposed subjects include:
Parsing and Translation
Microprocessors and Interfacing
Programming Techniques
Systems Theory
Integrated Electronics
Signal Processing
Transform Methods
Numerical Analysis
Management and Economics

**Year 4**
To consist of Electrical Engineering and Computer Engineering Electives.
Students intending to do honours will complete a thesis.

## 3645
## Computer Engineering – Full-time course

### Bachelor of Engineering
### BE

This is a new course, which commenced in 1989. The course is to be phased in over four years and only Years 1 and 2 will be offered in 1990. As a consequence subject description for computing subjects appearing in later years are not given in this handbook.

| Year 1 | | Hours per week S1 | S2 |
|---|---|---|---|
| 1.961 | Physics | 6 | 6 |
| 6.010 | Electrical Engineering 1 | - | 6 |
| 6.710 | Introduction to Computer Engineering | 1.5 | 1.5 |
| 6.711 | Computing 1A | 6 | - |
| 6.712 | Computing 1B | - | 6 |
| 10.001 | Mathematics 1 | 6 | 6 |
| 10.081 | Discrete Mathematics | 6 | - |
| | | 25.5 | 25.5 |

| Year 2 | | | |
|---|---|---|---|
| 6.721 | Data Organization | 5 | - |
| 6.722 | Computer Organization - | 5 | |
| 6.723 | Concurrent Computing - | 5 | |
| 6.729A | Electrical Engineering Laboratory 2A | 1 | - |
| 6.729B | Electrical Engineering Laboratory 2B | - | 2 |
| 6.821 | Circuit Theory 21/1 - | | |
| 6.823 | Analog Electronics - | 2.5 | |
| 6.824 | Digital Circuits 2.5 - | | |
| 10.111A | Linear Algebra - | 4 | |
| 10.1114 | Pure Mathematics 2 -Complex Analysis | 2.5 | - |
| 10.1115 | Pure Mathematics 2 -Finite Mathematics A | 2 | - |
| 10.361 | Statistics SE | | 2 2 |
| | 56-hr General Education 2 subject (Cat A) | 2 | |
| | | 20.5 | 22.5 |

## 3650
## Electrical Engineering

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

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

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

## Technical Electives – all courses

| | | Hours per week S1 | | S2 |
|---|---|---|---|---|
| 1.992 | Mechanics and Thermal Physics | 2 | | 2 |
| 4.964 | Materials Science and Engineering for Electrical Engineers | 0 | | 4 |
| 5.065 | Mechanical Engineering | 4 | | 0 |
| 6.046 | Project Evaluation half elective | 2 | | 0 |
| 6.047 | Reliability Engineering in Design and Development | 0 | | 4 |
| 6.402 | Introductory Physiology for Engineers | 4 | | 0 |
| 6.721 | Data Organisation | 5 | or | 5 |
| 6.722 | Computer Organisation | 5 | or | 5 |
| 6.723 | Concurrent Computing | - | | 5 |
| 8.6120 | Civil Engineering | 4 | | 0 |
| 18.091 | Industrial Management | 5 | | 0 |
| 18.1211 | Production Management A ($^1/_2$ elective)* | 3 | | 0 |
| 47.060G | Electrical Safety | 0 | | 4 |
| 48.302 | Fuels and Energy | 0 | | 4 |

A free choice may not be possible.

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

1. 6.046 Project Evaluation
   18.1211 Production Management A
2. 6.046 Project Evaluation
   6.047 Reliability Engineering in Design and Development (Part A). Enrol in 6.047A.
3. 6.047 Reliability Engineering in Design and Development Parts A&B

## Electrical Engineering Professional Electives – all courses

Each elective is 5 hours per week for one session.

| | |
|---|---|
| 6.042 | Digital and Analogue Signals |
| 6.202 | Power Engineering 1 |
| 6.203 | Power Engineering 2 |
| 6.240 | Power Electronics |
| 6.215 | Industrial Electrical Systems |
| 6.222 | High Voltage Technology |
| 6.303 | Transmission Lines for Microwave and Optical Communication |
| 6.313 | Signal Propagation at Microwave and Optical Frequencies |
| 6.322 | Electronics 4 |
| 6.323 | Communication Systems 2A |
| 6.333 | Communication Systems 2B |
| 6.412 | Systems and Control 2 |
| 6.413 | Digital Control |
| 6.432 | Computer Control and Instrumentation |
| 6.483 | Biomedical Engineering |
| 6.512 | Semiconductor Devices |
| 6.522 | Transistor and Integrated Circuit Design |
| 6.532 | Integrated Digital Systems |
| 6.540 | Applied Photovoltaics |
| 6.612 | Computer Organization and Digital Systems Design |
| 6.622 | Computer Applications |
| 6.651 | Digital Communication and Computer Networks |
| 6.652 | Data Networks |
| 6.672 | Operating Systems and Compilers |

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

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

## Prerequisites and Co-requisites

### Arranged in order of full-time Bachelor of Engineering Degree Course

**Year 1**

| Subject | Prerequisites | Co-requisites |
|---|---|---|
| 1.961 | See Matriculation and Admission Requirements | |
| 2.9111 | | |
| 5.3600 | See Matriculation and Admission Requirements | |
| 5.1600 | | |
| 6.010 | | 1.961 (or equivalent) |
| 6.011 | | |
| 6.711 | | 10.001 |
| 10.001 | See Matriculation and Admission Requirements | |
| 10.001 | | 10.0911 |

**Year 2**

| | | |
|---|---|---|
| 1.982 | 1.961, 10.001 | 10.2111 |
| 10.0331 | 10.1114, | |
| 10.1213 | 10.001(CR) | |
| 10.1214 | 10.1213‡ | |
| 10.2211 | 10.001(CR) | |
| 10.361 | 10.001 | |
| 6.712 | 6.711 | |
| 6.821 | 6.010, 10.001 | 10.1214 or 10.1114 |
| 6.822 | 6.821, 10.1213 or 10.1113 | 10.0331, 10.1214 or 10.1114 |
| 6.823 | 6.821, 1.982 | |
| 6.824 | 6.010 | |
| 6.825, | 6.010, 1.961 | 10.2111, 6.821 |
| 6.827 | 1.961, 6.010 | |
| 6.828 | 6.827 | 6.823, 6.824, 6.825 |
| 6.829 | | 5.0016, 6.011, 6.823, 6.824 |

**Year 3**

| | | |
|---|---|---|
| 1.992 | 1.961,10.001 | 10.2111 |
| 4.964 | 1.982 | |
| 5.065 | 10.211., 10.2112,1.961 | |
| 10.033A | 10.111A, 10.1114, 10.2111 | |
| 10.111A | 10.001 | |
| 10.361 | 10.001 | |
| 6.201 | 6.831 | |
| 6.501 | 6.833, 6.834 | 6.835 |
| 6.721 | 6.712 | |
| 6.722 | 6.712 | |
| 6.732E | 6.824 | |
| 6.831 | 6.823, 6.825 | |
| 6.833 | 6.823 | |
| 6.834 | 6.822, 10.0331 | 10.361 |
| 6.835 | 6.828, 6.829 | 6.732E, 6.831, 6.833, 6.834 |
| 6.836 | 6.834 | |
| 6.837 | 6.834 | |
| 6.047 | 10.36187† | 10.361†† |

**Year 4**

| | |
|---|---|
| 18.091 | 10.2112, 10.361* |
| 6.042 | 10.0331, 10.361, 6.0311 |
| 6.202 | 6.0312, 6.0315 |
| 6.203 | 6.202 |
| 6.240 | 6.0312, 6.0315 |
| 6.215 | 6.0315 |
| 6.222 | 6.0315 |
| 6.723 | 6.712, |
| 6.303 | 6.0317 |
| 6.313 | 6.303 |
| 6.322 | 6.0313, 6.0316 |
| 6.323 | 6.0317, 10.0331, 10.361 |
| 6.333 | 6.0316, 6.0317 |

**Year 4**

| Subject | Prerequisites | Co-requisites |
|---|---|---|
| 6.412 | 6.0311, 6.0314 | |
| 6.413 | 6.0314, 10.0331, 10.0332, 10.361 | |
| 6.432 | 6.0314,6.0316, 6.0318 | |
| 6.483 | 6.0314, 6.0316, 6.402 | |
| 6.512 | 6.0313 | |
| 6.522 | 6.0313, 6.0316 | |
| 6.532 | 6.021E, 6.0316 | |
| 6.612 | 6.0318 or 6.613 | |
| 6.622 | 6.641 | |
| 6.651 | 6.0317, 6.0318 | |
| 6.652 | 6.651 | |
| 6.672 | 6.0318 or 6.613 | |
| 6.911 | (in graduating program only). | |

§Pass Terminated result PT does not satisfy prerequisite requirements.
*Attempted at an acceptable level and to be taken as a co-requisite.
††The first session of 10.361 is a prerequisite and the second session of 10.361 is a co-requisite.
‡10.1213 may be taken as a co-requisite.

## Combined Courses

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

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

Students may transfer into a combined course after partially completing the requirements for either degree provided suitable subjects have been studied. However, the choice of subjects and the time taken to complete the program can be seriously affected by this. Thus, students considering course 3725 or course 3720 should contact the Electrical Engineering School before completing their Year 2 enrolment. Application for transfer to a combined course (for students in year 2 in 1989), must be made in writing to the Head of School by the end of the first week of January in the year following their completion of Year 2 of the BE course.

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

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

## 3725
## BE BSc in Electrical Engineering

Changes may be made to the double degree program in 1990 due to the introduction of revisions to the BE course 3640. Students who commenced course 3640 in 1988 or later, and who wish to do the double degree, should consult with the School of Electrical Engineering and Computer Science.

Having completed Years 1 and 2 of course 3640 prior to 1990 students in their third year complete a specific course of study consisting of four Level III Science units chosen from related disciplines, the appropriate General Education electives and no less than four other Level II or Level III units, and otherwise accord with the rules of course 3970 leading to a major in Computer Science, Mathematics or Physics.

Students may open up a wider choice of subjects in their Science Year by including additional Computer Science (viz 6.721), Physics (viz 1.992) or Mathematics (viz 10.111A) in their Year 2 Electrical Engineering program. Any subject omitted may be required to be taken later in the course. The extra subject in Year 2 may be credited towards either the BE or BSc requirements, but not both. Students who commence their BE in 1989 or later and wish to do the combined degree program, should consult the School Office at enrolment time before year 2 and before year 3 of their BE program.

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

In their fourth and fifth years, for students who commenced the BE prior to 1990, students do Year 3 and Year 4 of course 3640. Depending on the program followed in their year of Science they may have already completed parts of the normal third and fourth year programs of the Electrical Engineering course, and they will be required to omit these from their program and to include an equivalent amount of other courses chosen with the approval of the Head of School.

**Year 1**

1.961
2.9111
5.0011
5.0016
6.010,
6.011
6.711
10.001
10.0911

**Year 2†**
1.982, 6.712
6.821, 6.822, 6.823, 6.824, 6.825, 6.827, 6.828, 6.829
10.1213, 10.1214, 10.2211, 10.0331, 10.361
56-hr General Education subject (Cat A)

**Year 3†*‡**
*Either*
Computer Science
56 hr General Education subject (Cat B)
Choose at least 8 Level II or Level III units including at least 4 Computer Science units at Level III, the balance to be chosen from Level III Computer Science units and other Level II or Level III units in Table 1 or Tables 2 for program 0600**
*or*
Mathematics
56-hr General Education subject (Cat B)
Choose at least 5 Mathematics units, 4 of which are Level III
Choose at least 3 Level II or Level III units from Table 1 or Table 2 for program 1000
*or*
Physics
56-hr General Education subject (Cat B)
Choose 7 Level II or Level III units from Table 1 of which four must be Level III Physics units, chosen to include 1.0133, 1.0143, 1.023 and 1.0333.

**Year 4‡**
Year 3 of Electrical Engineering course, modified as required by Head of School

**Year 5**
Year 4 of Electrical Engineering course

†Students intending to major in Computer Science should include 6.721 in their Year 2 enrolment. Students intending to major in Physics are required to take unit 1.992 in Year 2. Students intending to major in Mathematics are required to take 10.111A in year 2.
*For Year 3 refer to course 3970 and the Science Handbook.
**For this strand only the Level I unit, 14.501 Accounting and Financial Management 1A may be taken in place of one of the other Level II or Level III units. Students should note that this subject is a prerequisite for the level III unit, 6.647 Business Information Systems.
‡For students in year 1 in 1989 or later, years 3 and 4 will most likely be interchanged. Consult the School of Electrical Engineering and Computer Science.

## 3720
## BE BA in Electrical Engineering

The combined course should include

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

| Table A | | Credit Points |
|---|---|---|
| 10.001 | Mathematics 1 | 12 |
| 10.111A | Pure Mathematics 2 | 4 |
| 10.1113 | Pure Mathematics 2 | 2 |
| 10.1114 | Pure Mathematics 2 | 2 |
| 10.2111 | Applied Mathematics 2 | 2 |
| 10.2112 | Applied Mathematics 2 | 2 |
| 10.361 | Statistics SE | 2 |
| 1.961 | Physics 1 | 12 |
| 1.972 | Electromagnetism | 4 |
| 1.982 | Solid-State Physics | 4 |
| 6.712 | Computing 1B | 4 |
| 6.824 | Digital Circuits | 2 |
| | | 52 |

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

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

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

### Minor Study in BA Course 3400 or BSc Course 3970

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

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

### Major Study in BA Course 3400 or BSc Course 3970

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

### Course 3400

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

### Course 3970

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

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

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

### For Computer Science Major:

**Year 1**
6.711, 6.712
10.001, 10.081
3 other Level 1 units

**Year 2**
6.721, 6.722, 6.723
5 other Level II units
56-hr General Education subject (Cat A)

**Year 3**
4 Computer Science Level III units
3 other Level II or Level III units
*56-hr General Education subject (CatB)*
Students intending to proceed to Honours should choose 7 Level III units

**Year 4**
6.606
For further details see the Sciences Handbook.

### Computer Science Electives offered by the School

| No. | Name | Level | Prerequisites | Co-requisites | Excluded |
|---|---|---|---|---|---|
| 6.711 | Computing 1A | I | As for 10.001 | 10.001 *or* 10.011 | 6.611 |
| 6.712 | Computing 1B | I/ II | 6.711 | | 6.620, 6.621, 6.021D |
| 6.721 | Data Organization | II | 6.712 | | 6.641 |
| 6.722 | Computer Organization | II | 6.712 | | 6.631 |
| 6.723 | Concurrent Computing | II | 6.712 | | |
| 6.613 | Computer Organization and Design | III | 6.631 *or* 6.021E, 6.021D *or* 6.620 *or* 6.621 | | 6.0318 |
| 6.632 | Operating Systems | III | 6.631 *or* 6.021E, 6.641 | | 6.672 |
| 6.633 | Data Bases and Networks | III | 6.641 | | 14.607, 14.608, 19.607 |
| 6.642 | Design and Analysis of Algorithms | III | 6.641 | | |
| 6.643 | Compiling Techniques and Programming Languages | III | 6.641 | | 6.672 |
| 6.646 | Computer Applications | III | 6.620 *or* 6.021D *or* 6.621, 10.311 *or both* 10.311A *and* 10.311B *or* equivalent | | 6.622 |
| 6.647 | Business Information Systems | III | 6.641, 14.501 *or* 14.001 | | |

## School of Mechanical and Industrial Engineering*

### **Incorporating Aeronautical Engineering and Naval Architecture*

Head of School
Vacant

Executive Assistant to Head of School
Dr C. V. Madhusudana

Administrative Officer
Mr A.D. Bauman

The School consists of three departments. **Applied Mechanics** (agricultural engineering, automatic control, biomechanics, engineering design, engineering mechanics and mechanics of solids); **Fluid Mechanics and Thermodynamics** (energy utilisation and power generation, refrigeration and air conditioning, gas and liquid handling, aeronautical engineering and naval architecture); **Industrial Engineering** (economic analysis, production planning and control, product and process design, methods engineering and operations research). The **Centre for Manufacturing and Automation** is also located within the School.

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

### Summary of Courses

The courses are planned to provide the appropriate academic training for the professional engineer in the fields of aeronautical, industrial and mechanical engineering, and for the naval architect. They may be taken on a full-time basis,

normally over four years, or on a combined full-time part-time basis. Part-time students will normally take two years for each equivalent full-time year and will be required to attend day classes for the equivalent of at least 1.5 days per week. Students intending to enter part-time study are advised that most subjects in the course are only offered in the day-time.

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

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

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

The first halves of the courses of Mechanical, Industrial and Aeronautical Engineering and of Naval Architecture are identical, and students attend classes together. The latter halves of these four courses contain a number of common core subjects together with specific disciplinary requirements. In the final years, in addition to core subjects and disciplinary requirements, provision is made for a limited degree of specialization in one or more elective subjects. Students with a distinguished academic record may take, subject to the approval of the Head of School, a limited number of graduate subjects offered by the School in lieu of an equivalent quantity of final year undergraduate electives. Each student is required to submit a thesis at the end of the final year and to deliver a short paper on the subject of the thesis.

### General Education Program

The University requires that undergraduate students undertake a structured program in General Education as an integral part of their degree. For further details, please locate General Education in the Contents. In certain instances and with permission from the Head of School and the Director of the Centre for Liberal and General Studies, students may substitute an Arts subject in lieu of two General Education subjects.

### Industrial Experience

Industrial experience is an integral part of the courses. Full-time 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 taking the course on a full-time part-time basis must complete an equivalent amount of industrial training.Students who have had suitable experience in industry may qualify for exemption from certain subjects. The Head of School should be contacted for details.

### Honours

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

### 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 courses by overseas engineering institutions.

The award of the degree BE in Aeronautical Engineering is recognized by the Royal Aeronautical Society as giving exemption from the formal examination requirements for corporate membership. Advancement from graduate membership to associate membership grade is awarded on a case by case basis after a further period of some years of professional experience.

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

### Course Progression Guidelines

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

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

### Revision of Courses

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

The object of the revision has been to modernise the courses, so that a greater emphasis will be placed on electronics, microprocessors, instrumentation, robotics and computing, all of which are now important to Mechanical and Industrial

Engineering. In first year this has resulted in a revised Physics course, emphasising in part the fundamentals of the above areas, and a new, more extensive Computing subject. Subject areas are to be streamed throughout the courses so that discontinuities in the teaching of material will be minimised.

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

## 3680
## Mechanical Engineering – Full-time Course

### Bachelor of Engineering BE

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

| Year 1 | | Hours per week S1 | S2 |
|---|---|---|---|
| 1.911 | Physics 1 (Mechanical Engineering) | 4 | 4 |
| 2.951 | Chemistry 1ME | 6 | 0 |
| 5.0010 | Professional Studies 1 | 1 | 0 |
| 5.0011 | Engineering Mechanics 1 | 4 | 0 |
| 5.0300 | Graphical Analysis and Communication | 0 | 3 |
| 5.0303 | Workshop Technology | 3 | 0 |
| 5.0305 | Manufacturing Technology | 0 | 3 |
| 5.1010 | Mechanical Engineering Design 1 | 1 | 2 |
| 5.421 | Mechanics of Solids | 0 | 3 |
| 5.5010 | Computing 1M | 0 | 3 |
| 10.001 | Mathematics 1 | 6 | 6 |
| | | 25 | 24 |

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

| | | | |
|---|---|---|---|
| 1.001 | Physics 1 | 6 | 6 |
| 2.121 | Chemistry 1A or | 6 | 0 |
| 2.951 | Chemistry 1ME | | |
| 5.0010 | Professional Studies 1 | 1 | 0 |
| 5.0011 | Engineering Mechanics 1 | 4 | 0 |
| 5.0300 | Graphical Analysis and Communication | 0 | 3 |
| 5.0303 | Workshop Technology | 3 | 0 |
| 5.0305 | Manufacturing Technology | 0 | 3 |
| 5.1010 | Mechanical Engineering Design 1 | 1 | 2 |
| 5.421 | Mechanics of Solids | 0 | 3 |
| 10.001 | Mathematics 1 | 6 | 6 |
| | *and either* | | |
| 1 relevant level I unit from the School of Physics, Chemistry, Electrical Engineering and Computer Science, or Mathematics offerings in Table 1 of Sciences Handbook | | 0 | 6 |
| *or* | | | |
| 5.5010 | Computing 1M | 0 | 3 |
| | | 27 | 29 or 26# |

*Students are recommended to choose 2.951 unless they wish to pursue studies requiring 2.121. Computer Science majors must choose 2.951 and subsequently 6.711 Computing 1A in Session 2. Materials Science majors must choose 2.121 and subsequently 2.131 Chemistry 1B in Session 2.
†For BE/BSc students. Computer Science majors must take 6.711. Materials Science majors must take 2.131.
#For BE BA students.

| Year 2 | | Hours per week S1 | S2 |
|---|---|---|---|
| 4.952 | Engineering Materials | 3 | 0 |
| 5.0020 | Professional Studies 2* | 0 | 0 |
| 5.122 | Mechanical Engineering Design 2 | 3 | 3 |
| 5.3021 | Engineering Mechanics 2A | 3 | 0 |
| 5.3022 | Engineering Mechanics 2B | 0 | 2 |
| 5.4221 | Mechanics of Solids 2 | 3.5 | 3.5 |
| 5.620 | Fluid Mechanics 1 | 2 | 2 |
| 5.626 | Thermodynamics 1 | 2 | 2 |
| 6.856 | Electronics for Measurement and Control | 0 | 3 |
| 10.022** | Engineering Mathematics 2 | 4 | 4 |
| 10.351 | Statistics SM | 2 | |
| | 28 hr General Education subject(s) (Cat A) | | |
| | | 24.5 | 23.5 |

*The total contact hours are 4. This subject is preparatory to 5.043 Industrial Training 1.
**Students may substitute 10.111A, 10.1113, 10.2111 and 10.2112 for 10.022. Also, if they satisfy pre-requisites, they may take one or more of these at the higher level.

| Year 3 | | | |
|---|---|---|---|
| 5.034 | Engineering Experimentation | 2 | 1.5 |
| 5.043 | Industrial Training 1 | 0 | 0 |
| 5.070 | Optimal Engineering Strategies | 1.5 | 1.5 |
| 5.079 | Numerical Methods | 1.5 | 1.5 |
| 5.123 | Mechanical Engineering Design 3 | 3 | 3 |
| 5.3030 | Engineering Mechanics 3 | 0 | 2 |
| 5.3130 | Vibration Analysis | 0 | 2 |
| 5.343 | Linear Systems Analysis | 3 | 0 |
| 5.423 | Mechanics of Solids 3 | 2 | 2 |
| 5.630 | Fluid Mechanics 2 | 1.5 | 1.5 |
| 5.636 | Thermodynamics 2 | 1.5 | 1.5 |
| 6.854 | Electrical Power Engineering | 0 | 3 |
| 6.856# | Electronics for Measurement and Control | 3 | 0 |
| 18.603 | Management Economics | 2 | 2 |
| | 28-hr General Education subject(s) (Cat B) | 2 | 2 |
| | | 23 | 23.5 |

Note: Appropriate concessions will be made at enrolment for students who have already completed electives which have material in common with 5.630 and or 5.636.
*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained prior to Year 3. Students may not enrol in 5.043 without submitting the relevant report.
†Combined degree course students who have taken 10.2116 Applied Mathematics 2 – Continuous Time Systems or 10.2216 Higher Applied Mathematics 2 – Continuous Time Systems or 10.212A or 10.222A Numerical Analysis should substitute a Technical Elective or a half Level II or Level III unit from Table 1 of the Sciences Handbook for this subject.
‡Combined degree course students who have taken 10.212M or 10.222M Optimal Control Theory should substitute a Technical Elective or a half Level II or III unit from Table 1 of the Sciences Handbook.
#Combined degree course students who have taken 1.9222 Electronics or 1.032 Laboratory should substitute a Technical Elective or a half Level II or III unit from Table 1 of the Sciences Handbook.

**Year 4**

| | | Hours per week S1 | S2 |
|---|---|---|---|
| 5.044* | Industrial Training 2 | 0 | 0 |
| 5.051 | Thesis | 6 | 6 |
| 5.062 | Communications | 2 | 2 |
| 5.350 | Principles of Control of Mechanical Systems | 3 | 0 |
| | Technical Electives | 9 | 12 |
| | General Studies elective(s) | 2 | 2 |
| | | 22 | 22 |

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

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

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

## Mechanical Engineering Technical Electives

| | | Hours per week S1 | | S2 |
|---|---|---|---|---|
| ***Applied Dynamics*** | | | | |
| 5.3040 | Plane Mechanism Kinematics | 3 | *or* | 3 |
| 5.3140 | Advanced Vibration Analysis | 3 | *or* | 3 |
| 5.3541 | Engineering Noise 1 | 3 | | 0 |
| 5.3542 | Engineering Noise 2 | 0 | | 3 |
| ***Mechanics of Solids*** | | | | |
| 5.424 | General Mechanics of Solids | 3 | or | 3 |
| 5.434 | Plates and Shells | 3 | *or* | 3 |
| 5.444 | Theory of Elasticity | 3 | *or* | 3 |
| 5.454 | Theory of Plasticity | 3 | *or* | 3 |
| 5.464 | Structural Instability | 2 | | 0 |
| Mechanical Design | | | | |
| 5.1240 | Design Project | 3 | | 3 |
| 5.1242 | Design Technology | 3 | | 0 |
| 5.1243 | Machinery Design Project | 0 | | 3 |
| 5.1244 | Project Management | 0 | | 3 |
| 5.1245 | Computer-Aided Engineering Design | 3 | | 3 |
| ***Fluid Mechanics Thermodynamics*** | | | | |
| 5.6040 | Turbomachines and Engines | 3 | *or* | 3 |
| 5.633 | Turbomachines | 3 | *or* | 3 |
| 5.6341 | Viscous Flow Theory | 1.5 | *or* | 1.5 |
| 5.6342 | Lubrication | 0T | 3 | |
| 5.635 | Convection Heat Transfer | 3 | *or* | 3 |
| 5.641 | Thermal Power Plants | 3 | *or* | 3 |
| 5.643 | Energy, Combustion and Engines | 3 | *or* | 3 |
| 5.644 | Solar Energy | 3 | *or* | 3 |
| 5.654 | Hydraulic Transients | 3 | *or* | 3 |
| 5.664 | Multiphase Flow | 3 | *or* | 3 |
| 5.673 | Special Fluid Mechanics Elective | 3 | *or* | 3 |
| 5.674 | Special Thermodynamics Elective | 3 | *or* | 3 |

*Industrial Engineering*

| | | S1 | | S2 |
|---|---|---|---|---|
| 18.004 | Manufacturing Management | 2 | | 2 |
| 18.224 | Numerical Control of Machine Tools | 3 | or | 3 |
| 18.303 | Methods Engineering | 2 | | 2 |
| 18.403 | Production Design and Technology | 4 | | 4 |
| 18.404 | Design for Production | 2 | | 2 |
| 18.503 | Operations Research A | 3 | | 3 |
| 18.551 | Operations Research | 3 | | 3 |
| 18.803 | Optimization | 3 | | 0 |

*Other Technical Electives*

| | | | |
|---|---|---|---|
| 4.913 | Materials Science | 3 | 3 |
| 5.074 | Computing Science for Mechanical Engineers | 3 | 0 |
| 5.235 | Nuclear Power Technology | 3 | 0 |
| 5.811 | Aerodynamics 1† | 3 | 3 |
| 5.831 | Aircraft Propulsion | 2 | 2 |

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

## 3681
## Mechanical Engineering – Combined Course

### Bachelor of Engineering Bachelor of Science BE BSc

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

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

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

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

undertaken and from the Head of the School of Mechanical and Industrial Engineering.

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

Year 1 of the combined course is equivalent to the Year 1 'Science Arts compatible' course in the School of Mechanical and Industrial Engineering, and is as detailed in course **3680** Mechanical Engineering. Having completed Years 2 and 3, as outlined below, students in Years 4 and 5 do Year 3 and Year 4 of their selected Engineering course except that significant repetition of subject material is not allowed. Instead, students are required to substitute either an appropriate Technical Elective or an appropriate Level II or III subject from Table1 or Table 2, or in exceptional circumstances, some other equivalent subject with the permission of the Head of the School of Mechanical and Industrial Engineering.

Note: In order to limit the combined degree courses to five years, the workload in the first three years is higher than in the single degree course. Students who have barely satisfied the minimum entrance requirements are therefore advised against enrolling for the combined degree course. Those who do enrol and whose average mark at the end of Session1 of Year 1 is less than 65% are advised to contact the School to see whether or not they should continue in the combined course in Session 2 of Year 1, as the workload in Session 2 is higher than in Session 1.

| **Year 2**[1,11] | | **Hours per week** S1 | S2 |
|---|---|---|---|
| 5.3021 | Engineering Mechanics 2A | 3 | 0 |
| 5.4221 | Mechanics of Solids 2 | 3.5 | 3.5 |
| 5.5010 | Computing 1M | 0 | 3 |
| 10.111A | Pure Mathematics 2 – Linear Algebra | 2.5 | 2.5 |
| 10.1113 | Pure Mathematics 2 – Multivariable Calculus | 2.5 | 0 |
| 10.1114 | Pure Mathematics 2 – Complex Analysis | 0 | 2.5 |
| 10.2111 | Applied Mathematics 2 – Vector Calculus | 2.5 | 0 |
| 10.2112 | Applied Mathematics 2 – Mathematical Methods for Differential Equations | 0 | 2.5 |
| | 4.5 appropriate Level II units from Table 1* or Table 2* for course **3681**[2] | 9+ | 9+ |
| | | 23+ | 23+ |

| **Year 3** | | | |
|---|---|---|---|
| 5.0020** | Professional Studies 2 | 0 | 0 |
| 5.122 | Mechanical Engineering Design 2 | 3 | 3 |
| 5.3022 | Engineering Mechanics 2B | 0 | 2 |
| 5.620 | Fluid Mechanics 1 | 2 | 2 |
| 5.626 | Thermodynamics 1 | 2 | 2 |
| | At least 5 appropriate Level II or III units from Table 1* or Table 2* for course **3681**[2] of which at least 4 must be Level III | 10+ | 10+ |
| | 28-hr General Education subject (Cat A)[6] | 2 | 2 |
| | | 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.

* Tables refer to the Sciences Handbook.
** The total contact hours are 4. This subject is preparatory to 5.043 Industrial Training 1.

## Computer Science Majors[3]

**Year 2**
4.952
5.3021, 5.4221, 5.5010[4]
6.712, 6.721., 6.722, 6.723
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214),
10.2111 (or 10.2211), 10.2112 (or 10.2212), 10.331 (or 10.351)

**Year 3**
5.0020, 5.122, 5.3022, 5.620, 5.626
6.856
4 Level III units from Table 1* and Table 2* offerings of School of Electrical Engineering and Computer Science for course 3681. 1 General Education subject (Cat A)[6]

## Materials Science Majors

**Year 2**
2.102A[1], 2.102B
4.412A[5], 4.422B, 4.432, 4.742
5.3021, 5.4221, 5.5010[4]
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214), 10.2111 (or 10.2211),
10.2112 (or 10.2212)

**Year 3**
4.413, 4.433C, 4.443, 4.453, 4.634, 4.713
5.0020, 5.122, 5.3022, 5.620, 5.626
6.856
10.331 (or 10.351)
48.403
3 appropriate Level III units from School of Materials Science and Engineering offerings in Table 2* for course **3681**[5]
1 General Education subject (Cat A)[6]

## Mathematics Majors

**Year 2**
Same Year 2 as for Computer Science[7] or Materials Science[7] or Physics or Statistics[8] majors
*or*
4.952
5.3021, 5.4221, 5.5010
6.856[9]
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214),
10.2111 (or 10.2211), 10.2112 (or 10.2212)

3.5 appropriate Level II units from Table 1* or Table 2* for course **3681**, including some from the School of Mathematics[9].

**Year 3**
5.0020, 5.122, 5.3022, 5.620, 5.626
10.331 (or 10.351)
4 Level III units from School of Mathematics offerings in Table 1*
1 General Education subject (Cat A)[6]

## Physics Majors

**Year 2**
1.002, 1.012, 1.022, 1.032
4.952
5.3021, 5.4221, 5.5010
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214),
10.2111 (or 10.2211), 10.2112 (or 10.2212)

**Year 3**
1.013310, 1.023, 1.033310, 1.04310
1 Level III unit from School of Physics offerings in Table 1*
5.0020, 5.122, 5.3022, 5.620, 5.626
10.331 (or 10.351)
1 General Education subject (Cat A)[6]

## Statistics Majors

**Year 2**
4.952
5.3021, 5.4221, 5.5010
6.856[9]
10.111A (or 10.121A), 10.1113 (or 10.1213), 10.1114 (or 10.1214), 10.2111 (or 10.2211), 10.2112 (or 10.2212), 10.311A (or 10.321A), 10.311B (or 10.321B), 10.3111 (or 10.3211), 10.3112 (or 10.3212)
1/2 appropriate Level II unit from Table 1* or Table 2* for course 3681[8]

**Year 3**
5.0020, 5.122, 5.3022, 5.620, 5.626
4 Level III units from Statistics offerings in Table 1*
1 Level II or III unit from School of Mathematics or School of Physics offerings in Table 1*
1 General Education subject (Cat A)[6]
* Tables refer to the Sciences Handbook.

**Notes**
1. Years 2 and 3 are requirements pertaining to students who commenced Year 1 in 1989. Students who commenced in earlier years should consult the Handbook appropriate to their year.
2. The following considerations pertain to the choice of additional units in Years 2 and 3:

   (a) The Level III units satisfy the relevant major requirements.

   (b) They be from the Schools of Chemistry, Electrical Engineering and Computer Science, Mathematics, Materials Science and Engineering and/or Physics.

   (c) The include 10.331 Statistics or 10.311B Basic Inference.

   (d) They include 1.032 Laboratory or 6.856 Electronics for Measurement and Control.

   (e) They include 4.952 Engineering Materials or 4.432 Physical Metallurgy 1C.

   (f) They exclude 10.261A Mathematical Computing.

   (g) All pre and co-requisites are satisfied.
3. Quota restrictions apply to certain Computer Science Level III units and application must be made in writing to the Head of the School of Electrical Engineering and Computer Science before the end of Session 2 in the preceding year. Prospective Computer Science Majors should aim for a creditable academic attainment (65%) over Years 1 and 2.
4. With permission of the School of Mechanical and Industrial Engineering, students may delay this subject till Year 3.
5. Provided 5.4221 is taken concurrently or has been taken, the pre or co-requisite requirement of 4.732 is assumed to be satisfied.
6. Actual General Education requirements correspond to whatever is required in the second year of the normal Mechanical and Industrial Engineering degree course.
7. These Mathematics Majors need to add 6.856 Electronics for Measurement and Control to Year 3.
8. These Mathematics Majors should substitute 1 Level II or III units from the Schools of Physics, Chemistry or Mathematics offerings in Table 1 for 10.331 Statistics in Year 3.
9. Students may substitute 1.032 Laboratory for 6.856 plus a .5 Level II unit.
10. Under special circumstances, with permission of the Head of the School of Physics, a student may substitute alternative Physics Level III offerings of equivalent unit value.
11. The Mathematics units are also offered at higher level.

* Tables refer to the Sciences Handbook.

# 3610
# Aeronautical Engineering

### Bachelor of Engineering
### BE

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

a two-year program leading to the Bachelor of Engineering degree in Aeronautical Engineering.

| Year 3 | | Hours per week S1 | S2 |
|---|---|---|---|
| 5.034 | Engineering Experimentation | 2 | 1.5 |
| 5.043 | Industrial Training 1 | 0 | 0 |
| 5.070 | Optimal Engineering Strategies | 1.5 | 1.5 |
| 5.079 | Numerical Methods | 1.5 | 1.5 |
| 5.3130 | Vibration Analysis | 0 | 2 |
| 5.343 | Linear Systems Analysis‡ | 3 | 0 |
| 5.423 | Mechanics of Solids 3 | 2 | 2 |
| 5.800 | Aircraft Design 1 | 3 | 3 |
| 5.811 | Aerodynamics 1 | 3 | 3 |
| 5.822 | Analysis of Aerospace Structures 1 | 2 | 2 |
| 6.854 | Electrical Power Engineering | 0 | 3 |
| 6.856 | Electronics for Measurement and Control | 3 | 0 |
| 18.603 | Management Economics | 2 | 2 |
| | 28-hr General Education subject(s) (Cat B) | 2 | 2 |
| | | 25 | 23.5 |

*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained prior to Year 3. Students may not enrol in 5.043 without submitting the relevant report.
†Combined degree course students who have taken 10.2116 Applied Mathematics 2 – Continuous Time Systems or 10.2216 Higher Applied Mathematics 2 – Continuous Time Systems or 10.212A or 10.222A Numerical Analysis should substitute a Technical Elective or a half Level II or Level III unit from Table 1 of the Sciences Handbook for this subject.
‡Combined degree course students who have taken 10.212M or 10.222M Optimal Control Theory should substitute a Technical Elective or a half Level II or Level III unit from Table 1 of the Sciences Handbook.
**Combined degree course students who have taken 1.9222 Electronics or 1.032 Laboratory should substitute a Technical Elective or a half Level II or III unit from Table 1 of the Sciences Handbook.

| Year 4 | | Hours per week S1 | S2 |
|---|---|---|---|
| 5.044 | Industrial Training 2 | 0 | 0 |
| 5.051 | Thesis | 6 | 6 |
| 5.062 | Communications | 2 | 2 |
| 5.801 | Aircraft Design 2 | 3 | 3 |
| 5.812 | Aerodynamics 2 | 3 | 3 |
| 5.823 | Analysis of Aerospace Structures 2 | 2 | 2 |
| 25.831 | Aircraft Propulsion | 2 | 2 |
| | Technical Electives | 3 | 3 |
| | General Studies electives | 2 | 2 |
| | | 23 | 23 |

Note 1: The Technical Electives may be taken from the Mechanical Engineering or Industrial engineering Technical Elective List or from Years 3 or 4 of other courses in the School or suitable subjects outside the School 5.350 Principles of Control of Mechanical Systems from Year 4 of the Mechanical Engineering degree course being recommended in this respect. Students with good academic records may include some graduate subjects. A counselling service is provided to assist students to choose electives. The selection of certain subjects or combinations of subjects may require the approval of the Head of School.
Note 2: Only a limited number of Technical Electives is offered each year. The actual Technical Electives offered each year are decided on the basis of staff availability and student demand. Students are advised in September of each year which Technical Electives will be offered in the following year.
*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained between Years 3 and 4. Students may not enrol in 5.044 without submitting the relevant report.

## 3611
## Aeronautical Engineering – Combined Course

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

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

## 3700
## Naval Architecture

### Bachelor of Engineering
### BE

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

| Year 3 | | Hours per week S1 | S2 |
|---|---|---|---|
| 5.034 | Engineering Experimentation | 2 | 1.5 |
| 5.043 | Industrial Training 1 | 0 | 0 |
| 5.070 | Optimal Engineering Strategies | 1.5 | 1.5 |
| 5.079† | Numerical Methods | 1.5 | 1.5 |
| 5.3130 | Vibration Analysis | 0 | 2 |
| 5.423 | Mechanics of Solids 3 | 2 | 2 |
| 5.901 | Introduction to Mathematical Modelling and Decision Making | 3 | 0 |
| 5.902 | Ship Management Economics | 0 | 2 |
| 5.911 | Ship Hydrostatics | 2.5 | 2.5 |
| 5.921 | Ship Structures 1 | 2 | 2 |
| 5.9311 | Principles of Ship Design 1 | 3 | 0 |
| 5.953 | Ship Hydrodynamics | 3 | 2 |
| 6.854 | Electrical Power Engineering | 0 | 3 |
| 6.856 | Electronics for Measurement and Control | 3 | 0 |
| | 28-hr General Education subject(s) (Cat B) | 2 | 2 |
| | | 25.5 | 22 |

*Report to be submitted in Week 1 of Session 1 detailing involvement and experience gained prior to Year 3. Students may not enrol in 5.043 without submitting the relevant report.
†Combined degree course students who have taken 10.2116 Applied Mathematics 2 – Continuous Time Systems or 10.2216 Higher Applied Mathematics 2 – Continuous Time Systems or 10.212A or 10.222A Numerical Analysis, should substitute a Technical Elective or a half Level II or Level III unit from Table 1 of the Sciences Handbook for this subject.
**Combined degree course students who have taken 1.9222 Electronics or 1.032 Laboratory should substitute a Technical Elective or a half Level II or III unit from Table 1 of the Sciences Handbook.

| Year 4 | | | |
|---|---|---|---|
| 5.044* | Industrial Training 2 | 0 | 0 |
| 5.054 | Thesis | 0 | 0 |
| 5.062 | Communications | 6 | 6 |
| 5.922 | Ship Structures 2 | 2 | 2 |

| Year 4 | | Hours per week S1 | S2 |
|---|---|---|---|
| 5.9321 | Principles of Ship Design 2 | 2 | 2 |
| 5.937 | Ship Design Project | 4 | 2 |
| 5.941 | Ship Propulsion and Systems | 3 | 4 |
| | General Studies electives | 2 | 2 |
| | | 23 | 22 |

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

## 3701
## Naval Architecture - Combined Course

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

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

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

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## 3612
## BE BA in Aeronautical Engineering

## 3662
## BE BA in Industrial Engineering

## 3682
## BE BA in Mechanical Engineering

## 3702
## BE BA in Naval Architecture

### Introduction

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

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

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

### Requirements

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

*Engineering*

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

*Arts*

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

- no more than 30 First Level credit points (typically 5 one session subjects)
- at least 24 Upper Level credit points forming a major sequence (typically 4 one-session subjects)
- at least 6 Upper Level credit points in a school other than that in which the major is taken.Computing and mathematics majors are not permitted. The combined BE BSc program would be more appropriate in these cases.

### Honours

In the Engineering component, Honours are awarded for superior performance in the standard program.In the Arts components, the award of Honours requires at least one further year of study devoted exclusively to the Honours subject(s). Consult the Faculty of Arts for further details.

### General

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

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## Department of Industrial Engineering

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

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

The first two years of the degree course, taken full-time, provide the student with a sound foundation in the basic science and engineering subjects, and this knowledge is used and extended in the later years in the study of the industrial subjects in which the problems associated with the practical economics of manufacturing operations are stressed. The aim is to provide the student with the education necessary to carry out an industrial job and to examine it critically in the light of economic efficiency. Traditional engineering courses do not embrace the problems which are characteristic of Industrial Engineering. These problems include the analysis of a product to ensure satisfactory functioning with regard to methods and sequence of manufacturing operations; the disposition of buildings and of equipment within them to permit efficient handling of materials; the avoidance of bottlenecks; the related problems of quality and cost control, testing and inspection; labour and personnel relations; and, finally, the problem of distribution and sales.

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

The Industrial engineer 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.

## 3660
## Industrial Engineering

### Bachelor of Engineering
### BE

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

| Year 3 | | Hours per week S1 | S2 |
|---|---|---|---|
| 5.043 | Industrial Training1 | 0 | 0 |
| 6.854 | Electrical Power Engineering | 0 | 3 |
| 6.856 | Electronics for Measurement and Control | 3 | 0 |
| 14.001 | Introduction to Accounting A | 1.5 | 0 |
| 14.002 | Introduction to Accounting B | 0 | 1.5 |
| 18.003 | Numerical Methods/Industrial Experimentation | 1.5 | 2 |
| 18.303 | Methods Engineering | 2 | 2 |
| 18.403 | Production Design and Theory | 4 | 4 |
| 18.413 | Design for Industrial Engineers | 2 | 3 |
| 18.503 | Operations Research A | 3 | 3 |
| 18.603 | Management/Economics | 2 | 2 |
| 18.803 | Optimization | 3 | 0 |
| | 28-hr General Education subject (Cat B) | 2 | 2 |
| | | 24 | 22 |

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

| Year 4 | | | |
|---|---|---|---|
| 5.044† | Industrial Training 2 | 0 | 0 |
| 5.051 | Thesis | 6 | 6 |
| 5.062 | Communications | 2 | 2 |
| 18.004 | Manufacturing Management | | |
| | Technical Electives | | |
| | General Studies elective(s) | | |
| | | 22 | 22 |

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

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

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

### Industrial Engineering Technical Electives

| *Production Engineering* | | Hours per week S1 | | S2 |
|---|---|---|---|---|
| 5.454 | Theory of Plasticity | 3 | *or* | 3 |
| 18.224 | Numerical Control of Machine Tools | 3 | *or* | 3 |
| 18.404 | Design for Production | 3 | *or* | 2 |
| 18.360G | Ergonomics | 3 | *or* | 3 |
| *Operations Research* | | | | |
| 5.074 | Computing Science for Mechanical Engineers | 3 | | 0 |
| 18.574G | Management Simulation | 1 | | 2 |
| 18.671G | Decision Theory | 2 | *or* | 2 |
| 18.672G | Decision Theory for Industrial Management | 3 | *or* | 3 |
| 18.673G | Energy Modelling, Optimization and Energy Accounting | 3 | *or* | 3 |
| 18.760G | Discrete-Event Simulation Languages | 3 | *or* | 3 |
| 18.764G | Management of Distribution Systems | 2 | or | 2 |
| 18.765G | Optimization of Networks | 2 | *or* | 2 |
| 18.777G | Time Series and Forecasting | 2 | *or* | 2 |

| *Operations Research* | | Hours per week S1 | | S2 |
|---|---|---|---|---|
| 18.864G | Applied Geometric Programming | 2 | *or* | 2 |
| 18.868G | Industrial Applications of Mathematical Programming | 3 | *or* | 3 |
| 18.874G | Dynamic Programming | 2 | *or* | 2 |

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

## 3661
## Industrial Engineering – Combined Course

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

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

## 3662
## Industrial Engineering – Combined Course

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

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

# School of Surveying

Head of School
Professor F.K. Brunner

Administrative Assistant
Mr. L. Daras

The School offers a full-time course of four years duration leading to the award of the degree of Bachelor of Surveying. Alternatively, the course may be taken in a sandwich form in which a student may, after completing the first year of the course on a full-time basis, alternate his or her studies with one or more periods of employment by taking leaves of absence of two consecutive sessions. Specialised areas of study include the following: Geodetic Surveying (determining the mathematical model of the earth, and its gravity field, and the practice of surveying on the Earth's surface); Satellite Surveying (position determination techniques using satellite signals); Hydrographic Surveying (mapping the seabed and waterways for navigation and off-shore resource management); Engineering Surveying (the precise surveying for engineering projects); Cadastral Surveying (knowledge of the laws and practices for survey of property boundaries); Land Management and Development (environmental assessment for resource management and change of land use); Land Information Management (the use of computer-based information systems of spatially related data for planning purposes); Photogrammetry and Remote Sensing (the use of photographs and remotely sensed images for mapping and resource surveys). The course recognises the diversity of roles of graduates in government, private and academic sectors as practitioner, consultant, manager, teacher or researcher.

### Recognition

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

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

### Honours

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

### Professional Practice

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

### Field Excursions

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

### Course Rules

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

### Course Revision

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

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

The BSurv is currently being revised. Years 1 and 2 of the new course have been introduced in 1989, while year 3 will be 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.

### Re-enrolment

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

## 3740 Surveying

### Bachelor of Surveying BSurv

| Year 1 | | Hours per week |
|---|---|---|
| Session 1 | | |
| 1.921 | Physics 1 | 4 |
| 5.0302 | Engineering Drawing and Descriptive Geometry | 4 |
| 10.001 | Mathematics 1 | 6 |
| 29.1111 | Introduction to Computing | 4 |
| 29.1711 | Introduction to Surveying | 2 |
| | | 20 |
| *Session 2* | | |
| 1.921 | Physics 1 | 4 |
| 10.001 | Mathematics 1 | 6 |
| 29.1711 | Introduction to Surveying | 2 |
| 29.2041 | Survey Data Presentation | 3 |
| 29.2111 | Principles of Computer Processing | 4 |
| 29.2221 | Introduction to Geodetic Science | 3 |
| | | 22 |

| Year 2 | | |
|---|---|---|
| *Session 1* | | |
| 1.962 | Physics of Measurements | 3 |
| 10.022 | Engineering Mathematics 2 | 4 |
| 10.341 | Statistics SU | 3 |
| 29.3011 | Surveying Instruments | 4 |
| 29.3111 | Survey Computations | 3 |
| 29.3231 | Geodetic Computations | 3 |
| | 28-hr General Education subject (Cat A) | 2 |
| | | 22 |
| *Session 2* | | |
| 9.4051 | Survey Camp 1 | 3 |
| 10.022 | Engineering Mathematics 2 | 4 |
| 29.4011 | Surveying Techniques | 6 |
| 29.4111 | Data Analysis and Computing 1 | 3 |
| 29.4221 | Geodetic Positioning 1 | 3 |
| 29.4721 | Project Management 1 | 2 |
| | 28-hr General Education subject (Cat A) | 2 |
| | | 23 |

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

| Year 3 | | |
|---|---|---|
| *Session 1* | | |
| 8.6140 | Engineering for Surveyors 1 | 3 |
| 29.5011 | Engineering Surveying | 4 |
| 29.5110 | Data Analysis and Computing 2 | 3 |
| 29.5221 | Geodetic Positioning 2 | 3 |
| 29.5621 | Cadastral Surveying 1 | 3 |
| 29.5721 | Project Management 2 | 2 |
| 36.411 | Town Planning | 2 |
| | 28-hr General Education subject (Cat B) | 2 |
| | | 22 |

| Year 3 | | Hours per week |
|---|---|---|
| *Session 2* | | |
| 8.6150 | Engineering for Surveyors 2 | 3 |
| 29.6051 | Survey Camp 2* | 4 |
| 29.6121 | Computer Graphics | 3 |
| 29.6511 | Photogrammetry and Mapping 1 | 3 |
| 29.6621 | Cadastral Surveying 2 | 3 |
| 29.6721 | Project Management 3 | 2 |
| 29.6811 | Land Economics and Valuation | 3 |
| | 28-hr General Education subject (Cat B) | 2 |
| | | 23 |

*Students are required to attend a one week Survey Camp which is equivalent to 3 class contact hours per week together with one hour per week evaluation on campus for preparation of report.

| Year 4 | | |
|---|---|---|
| *Session 1* | | |
| 29.7010 | Surveying 7 | 4.5 |
| 29.7120 | Computer Graphics | 2 |
| 29.7220 | Geodetic Computations | 3 |
| 29.7510 | Photogrammetry 2 | 4 |
| 29.7810 | Land Management and Development 3* | 2 |
| 29.7050 | Survey Camp† | 9 |
| | Technical Elective†† | 3 |
| | 56-hr General Education subject (Cat C) | 4 |
| | | 31.5 |

*One day field tutorial is an essential part of this subject.
†Senior Survey Camp will be held in Session 1.
††Technical electives each of 3 hours per week are chosen from those listed below.

| *Session 2* | | |
|---|---|---|
| 29.8010 | Surveying 8 | 5 |
| 29.8220 | Global Geodesy | 2.5 |
| 29.8510 | Photogrammetry 3 | 3 |
| 29.8710 | Seminar | 1.5 |
| 29.8720 | Management | 2 |
| 29.8810 | Land Management and Development 4* | 2 |
| | Technical Elective†† | 3 |
| | 56-hr General Education subject (Cat C) | 4 |
| | | 23 |

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

### General Education Program

Students undertaking the new course will be required to study subjects in the General Education Program as specified,

whereas students completing the requirements for the degree under the old course will be required to take 168 hours of General Studies electives. General Education and General Studies electives comprise 56 hours and half electives 28 hours.

**Year 4 Electives**

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

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

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

# Subject Descriptions

## Identification of Subjects by Number

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

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

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

**1.** The authority offering the subject, normally a School of the University, is indicated by the number before the decimal point.

**2.** Each subject number is unique and is not used for more than one subject title.

**3.** Subject numbers which have previously been used are not used for new subject titles.

**4.** Graduate subjects are indicated by a suffix 'G' to a number with three digits after the decimal point. In other subjects three or four digits are used after the decimal point.

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

Appropriate subjects for each school appear at the end of each school section.

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

Servicing Subjects are those taught by a school or department outside its own faculty. Their subject descriptions are published in the handbook of the faculty which originates the subject and are also published in the handbook of the faculty in which the subject is taught. These subjects will be found at the back of this handbook.

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

HSC Exam Prerequisites

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

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

**Information Key**

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

**S1** Session 1, **S2** Session 2
**F** Session 1 *plus* Session 2, ie full year
**S1** or **S2** Session 1 *or* Session 2, ie choice of either session
**SS** single session, but which session taught is not known at the time of publication
**CCH** class contact hours
**L** Lecture, followed by hours per week
**T** Laboratory/tutorial, followed by hours per week
**hpw** hours per week
**C** credit or Credit units
**CR** Credit level
**DN** Distinction
**HD** High Distinction
**X** External

| | School, Department etc *Subject also offered for courses in this handbook | Faculty | Page |
|---|---|---|---|
| 1 | School of Physics* | Science | |
| 2 | School of Chemistry* | Science | |
| 3 | School of Chemical Engineering and Industrial Chemistry (New Course) | Applied Science | |
| 4 | School of Materials Science and Engineering | Applied Science | |
| **5** | **School of Mechanical and Industrial Engineering*** | **Engineering** | **27** |
| **6** | **School of Electrical Engineering and Computer Science*** | **Engineering** | **20** |
| 7 | School of Mines (Mineral Processing and Extractive Metallurgy and Mining Engineering) | Applied Science | |
| **8** | **School of Civil Engineering*** | **Engineering** | **17** |
| 9 | School of Fibre Science and Technology (Wool and Animal Science) | Applied Science | |
| 10 | School of Mathematics* | Science | |
| 11 | School of Architecture | Architecture | |
| 12 | School of Psychology | Biological Sciences | |
| 13 | School of Fibre Science and Technology (Textile Technology) | Applied Science | |
| 14 | School of Accounting* | Commerce and Economics | |
| 15 | School of Economics* | Commerce and Economics | |
| 16 | School of Health Services Management | Professional Studies | |
| 17 | Faculty of Biological and Behavioural Sciences* | Biological and Behavioural Sciences | |
| **18** | **School of Mechanical and Industrial Engineering (Industrial Engineering)** | **Engineering** | **27** |
| 19 | School of Information Systems | Commerce and Economics | |
| 20 | Centre for Petroleum Engineering Studies | Applied Science | |
| 21 | Department of Industrial Arts | Architecture | |
| 22 | Faculty of Professional Studies | Professional Studies | |
| 23 | School of Primary and Computer Education | Professional Studies | |
| 25 | School of Mines (Applied Geology) | Applied Science | |
| 26 | Centre for Liberal and General Studies | Liberal and General Studies | |
| 27 | School of Geography | Applied Science | |
| 28 | School of Marketing* | Commerce and Economics | |
| **29** | **School of Surveying*** | **Engineering** | **36** |
| 30 | School of Industrial Relations and Organizational Behaviour | Commerce and Economics | |

| | School, Department etc *Subject also offered for courses in this handbook | Faculty | Page |
|---|---|---|---|
| 31 | School of Optometry | Science | |
| **32** | **Centre for Biomedical Engineering** | **Engineering** | |
| 33 | School of Sports and Leisure Studies | Professional Studies | |
| 35 | School of Building | Architecture | |
| 36 | School of Town Planning * | Architecture | |
| 37 | School of Landscape Architecture* | Architecture | |
| 39 | Graduate School of the Built Environment | Architecture | |
| 40 | Academic Board | | |
| 41 | School of Biochemistry* | Biological and Behavioural Sciences | |
| 42 | School of Applied Bioscience (Biotechnology) | Applied Science | |
| 44 | School of Microbiology* | Biological and Behavioural Sciences | |
| 45 | School of Biological Science | Biological and Behavioural Science | |
| 46 | Faculty of Applied Science | Applied Science | |
| **47** | **Centre for Safety Science** | **Engineering** | |
| 48 | School of Chemical Engineering and Industrial Chemistry (Old course) | Applied Science | |
| 49 | School of Applied Bioscience (Food Science and Technology) | Applied Science | |
| 50 | School of English | Arts | |
| 51 | School of History | Arts | |
| 52 | School of Philosophy | Arts | |
| 53 | School of Sociology | Arts | |
| 54 | School of Political Science* | Arts | |
| 55 | School of Lbrarianship | Professional Studies | |
| 56 | School of French | Artts | |
| 57 | School of Theatre Strudies | Arts | |
| 58 | School of Education | Professional Studies | |
| 59 | Department of Russian Studies | Arts | |
| 60 | Faculty of Arts | Arts | |
| 61 | Department of Music | Arts | |
| 62 | Scjhool of Science and Technology Studies | Arts | |
| 63 | School of Social Work | Professional Studies | |
| 64 | School of German Studies | Arts | |
| 65 | School of Spanish and Latin Ameriocan Studies | Arts | |
| 66 | Subjects Available from Other Universities | | |
| 67 | Faculty of Science | Science | |
| 68 | Board of Studies in Science and Mathematics | Board of Studies in Science and Mathematics | |
| 69 | School of Arts Education | Professional Studies | |
| 70 | School of Anatomy | Medicine | |
| 71 | School of Medicine | Medicine | |
| 72 | School of Pathology | Medicine | |
| 73 | School of Physiology and Pharmacology | Medicine | |

| School, Department etc *Subject also offered for courses in this handbook | Faculty | Page |
|---|---|---|
| 74 School of Surgery | Medicine | |
| 75 School of Obstetrics and Gynaecology | Medicine | |
| 76 School of Paediatrics | Medicine | |
| 77 School of Psychiatry | Medicine | |
| 78 School of Medical Education | Medicine | |
| 79 School of Community Medicine | Medicine | |
| 80 Faculty of Medicine | Medicine | |
| 81 Medicine/Science/ Biological Sciences | Medicine | |
| 85 Australian Graduate School of Management | AGSM | |
| 90 Faculty of law | Law | |
| 97 Faculty of Engineering | Engineering | |
| 98 School of Banking and Finance | Commerce and Economics | |
| 99 Department of Legal Studies and Taxation | Commerce and Economics | |

# Physics

The School of Physics has introduced the specialised units 1.911, 1.961, 1.921, 1.981, 1.962, 1.972 and 1.982 for students in the Faculty of Engineering. The first-year units 1.911, 1.961, 1.921 196and 1.981 are not available at night. Part-time students will be catered for by the Science Course unit 1.001.

All first year full-time students, including repeat students, should enrol in 1.911, 1.961, 1.921, 1.981 according to their schools.

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

## Physics Level I Units

**1.001 Physics 1** **F L3 T3**

*Prerequisites*

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

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

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

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

**1.911 Physics 1 (Mechanical Engineering)** **F L2 T2**

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

For students in the School of Mechanical and Industrial Engineering.

Rotational mechanics. Mechanics of intermolecular systems. Atomic structure of solids; forces and defects. Plasticity of solids. Fracture of solids. Thermal properties of solids, liquids and gases. Wave motion, including acoustics. Optics: geometrical optics, optical instruments interference and diffraction, polarisation, laser light. Electromagnetism: magnetic forces and fields, electromagnetic induction. Electric fields and currents: electrostatics, direct-current circuits. Elementary circuit theory. Introduction to electronics and electronic devices. Boolen algebra and basic number systems. Introduction to instrumentation.

**1.961 Physics 1 (Electrical Engineering)** **F L3 T3**

*Prerequisite: As for 1.001 Physics 1.*

For students in the School of Electrical Engineering.

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

**1.921 Physics 1 (Surveying)** **F L2 T2**

*Prerequisite: As for 1.001 Physics 1.*

For students in the School of Surveying.

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

**1.981 Physics 1 (Civil Engineering)** **S1 L2 T2 and S2 L2 T1**

*Prerequisite: As for 1.001 Physics 1.*

For students in the School of Civil Engineering.

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

## Physics Level II Units

**1.002 Mechanics, Waves and Optics** **S1 L3 T1**

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

Harmonic motion, systems of particles, central force problems, Lagrange's equations, coupled oscillations, travelling waves, pulses, energy and momentum transfer,

polarisation, birefringence, interference, thin films, gratings, lasers, holography, fibre optics, Faraday effect, photoelasticity.

**1.012 Electromagnetism and Thermal Physics** **S2 L3 T1**

*Prerequisites 1.001, 10.001 or 10.011. Co-requisite: 10.2111. Excluded 6.825, 1.992.*

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

**1.022 Modern Physics** **F L0.5 T0.5**

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

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

**1.032 Laboratory** **F T3**

*Prerequisites 1.001, 10.001. Excluded 1.9222.*

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

**1.9222 Electronics** **S1 L1 T2**

*Prerequisites 1.001 or 1.021. Excluded 1.032.*

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

**1.962 Physics of Measurement (Surveying)** **S1 L1 T2**

*Prerequisite: 1.921.*

For students in the School of Surveying.

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

**1.972 Electromagnetism (Electrical Engineering)** **S1 or S2 L2 T2**

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

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

**1.982 Solid State Physics (Electrical Engineering)** **S1 or S2 L2.5 T2**

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

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

**1.992 Mechanics and Thermal Physics (Electrical Engineering)** **F L1.5 T.5**

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

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

## Physics Level III Units

**1.0143 Nuclear Physics** **S2 L1.5 T.5**

*Co-requisite: 1.0133.*

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

**1.023 Statistical Mechanics and Solid State Physics** **S1 L3 T1**

*Prerequisites 1.012, 1.022, 10.2112.*

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

**1.0333 Electromagnetism** **S1 L1.5 T0.5**

*Prerequisites 1.012, 10.2111, 10.2112. Excluded 10.222C.*

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

**1.043 Experimental Physics A** **F T4**

*Prerequisite: 1.032.*

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

**1.0133 Quantum Mechanics** **S1 L1.5 T.5**

*Prerequisites 1.022, 10.2112. Excluded 2.023A, 10.222F.*

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

**1.0533 Experimental Physics B** **S1 T4**

*Prerequisite: 1.032.*

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

**1.133 Electronics** **S1 L2 T4**

*Prerequisites 1.9222 or 1.032.*

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

# Chemistry

## Level 1 Units

**2.121 Chemistry 1A** **S1 or S2 L2 T4**

| *Prerequisites:* | *HSC Exam Score Range Required* |
|---|---|
| *2 unit Mathematics* or* | *67-100* |
| *3 unit Mathematics or* | *1-50* |
| *4 unit Mathematics* | *1-100* |
| *and* | |
| *2 unit Science (Physics) or* | *53-100* |
| *2 unit Science (Chemistry) or* | *3-100* |
| *4 unit Science or* | *1-50* |
| *3 unit Science or* | *90-150* |
| *2.111* | |

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

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

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

**2.131 Chemistry 1B** **S1 or S2 L2T4**

*Prerequisite: 2.121.*

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

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

**2.141 Chemistry 1M** **F L2 T4**

| *Prerequisites:* | *HSC Exam Score Range Required* |
|---|---|
| *2 unit Mathematics* or* | *67-100* |
| *3 unit Mathematics or* | *1-50* |
| *4 unit Mathematics* | *1-100* |
| *and* | |
| *2 unit Science (Chemistry) or* | *60-100* |
| *4 unit Science or* | *1-50* |
| *3 unit Science or* | *90-150* |
| *or* | |
| *2.111* | |

Note: As for 2.121 Chemistry 1A.

The syllabus is an integrated one of 2.121 and 2.131 (see above). Students majoring in Chemistry may take 2.141 in lieu of 2.121 and 2.131.

**2.9111 Chemistry 1EE** **S1 L2 T1**

| *Prerequisites:* | *HSC Exam Score Range Required* |
|---|---|
| *2 unit Mathematics* or* | *67-100* |
| *3 unit Mathematics or* | *1-50* |
| *4 unit Mathematics* | *1.100* |
| *and* | |
| *2 unit Science (Physics) or* | *53-100* |
| *2 unit Science (Chemistry) or* | *53-100* |
| *4 unit Science or* | *1-50* |
| *3 unit Science or* | *90-150* |
| *2.111* | |

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. Application of chemical priniciples to engineering.

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

**2.951 Chemistry 1ME** **S1 L3 T3**

*Prerequisites As for 2.121.*

A treatment of chemistry which illustrates the application of the principles of chemistry to problems of concern to mechanical engineers. Topics: chemistry of materials, thermochemistry, chemical kinetics and equilibrium, radioactivity and nuclear power, electrochemistry and corrosion of metals. Introduction to organic chemistry, structure and properties of polymers, fuels and lubricants. Surface chemistry.

**2.991 Chemistry 1CE** **S2 L3 T3**

*Prerequisites As for 2.9111.*

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 Units

**2.102A Physical Chemistry** **S1 or S2 L3 T3**

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

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

**2.102B Organic Chemistry** **F orS2 L3 T3**

*Prerequisite: 2.131 or 2.141. Excluded 2.002B*

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

**2.102C Inorganic Chemistry and Structure** **S1 or S2 L3 T3**

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

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

**2.102D Chemical and Spectroscopic Analysis** **S1 or S2 L3 T3**

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

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

## Level III Core

**2.103A Physical Chemistry**

*Prerequisites: 1.001, 2.102A and 2.102C. Excluded: 2.013A*

*States of matter:* gases, liquids, solutions and solids. Equations of state. Intermolecular forces and condensed phases. Gas kinetic theory and distribution of molecular energy. Statistical thermodynamics and prediction of properties of simple gases, liquids and solids. Structure and properties of liquids, solutions and solids. *Molecular energies and spectra.* Quantum properties of radiation and molecules. Molecular vibration (harmonic and anharmonic). Infrared and Raman spectra of gases. Molecular rotation. Rotational structure in molecular spectra. Intensity distributions in molecular spectra. Applications of molecular spectroscopy.

## Level III Units

**2.123E Environmental Chemistry** **S2 L3 T3**

*Prerequisites: 2.102A and 2.102D. Excluded: 2.043A.*

Physico-chemical aspects of the environment. Factors affecting the chemistry of rivers, estuaries, oceans, surface and sub-surface water. Photolysis reactions in the atmosphere, primary and secondary pollutants. Distribution of elements, nutrient elements, carbon and oxygen in ecological systems (chemical models of these cycles). Analysis of naturally occurring species and pollutants. Requirements, validation and performance monitoring of standard analytical procedures.

## Materials Science and Engineering

**4.412A Physical Metallurgy 1A** **S1 L3**
**Unit 1: Phase Equilibria I**

*Co-requisite: 2.102A, 4.732.*

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

**4.413 Physical Metallurgy 2A** **S1 L1 T1.5**

*Prerequisite: 4.412A.*

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 base alloys.

**4.422B Physical Metallurgy 1B** **S2 L1 T1**

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

**4.432 Physical Metallurgy 1C** **S2 L1 T3**

*Prerequisite: 4.412A*

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

mottled, malleable and ductile irons.

**4.433C Physical Metallurgy 2C** **S1 L2.5 T1.5**

*Prerequisite: 4.412A.*

Theory of plasticity of metals. Introduction to dislocation theory and its application to mechanical properties of alloys. Strengthening mechanisms, creep, fracture, grain size dependence of strength. Introduction to generation of deformation and recrystallization textures. Measurements of age-hardening, activation enery of strain ageing.

**4.443 Physical Metallurgy** **2D**

*Prerequisite: 4.432.*

Diffusion in the solid state, Kirkendall effect, mechanisms, Fick's laws, solutions. Grain boundary, surface and dislocation pipe diffusion. Precipitation, nucleation and growth of isolated precipitates. Co-operative precipitation, pearlite, discontinuous precipitation. Proposed laws governing growth rates, maximum velocity, maximum rate of entropy production. Hardenability. Effect of alloying elements on pearlite growth rates. Grossman and Jominy tests, calculation of depth of hardening. Development of stresses during quenching, retained stress, distortion, quench cracking.

**4.453 Physical Metallurgy 2E** **S2 L1 T1.5**

*Prerequisite: 4.432.*

Alloy steels. Ternary equilibria involving iron and carbon. Metallography and properties of alloys steels. Effect 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.

**4.634 Metallurgical Engineering 3C** **S1 L2.5 T.5**

*Prerequisite: 4.453.*

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

**4.642 Metallurgical Engineering 1D** **S2 L1T1**

*Prerequisite: 4.732.*

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

**4.713 X-Ray Diffraction and Electron Microsopy** **S1 L2T2**

*Prerequisite: 4.412A or 4.212*

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

**4.742 Physics of Materials** **S2 L2T1**

*Prerequisite: 1.001 or 1.011.*

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

ferromagnetism, antiferromagnetism. Elementary perturbation theory, covalent bond; crystal structures, properties. Ionic bond, crystal structure, force models, properties.

**4.913 Materials Science** **F L2 T1**

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

**4.952 Engineering Materials** **S1 L2 T1**

*Prerequisite: 1.911, 2.951, Excluded: 5.4222*

Microstructure and structure-property relationships of the main types of engineering materials (metals, polymers, ceramics and composites). Micromechanisms of elastic and plastic deformation. Fracture mechanisms for ductile, brittle, creep, fatigue modes of failure in service; corrosion. Metal forming by casting and wrought processes. Phase equilibria of alloys; microstructural control by thermo-mechanical processing and application to commercial engineering materials. Laboratory and tutorial work includes experiments on cast and recrystallized structures, ferrous and non-ferrous microstructures and fracture and failure analysis.

**4.964 Materials Science and Engineering for Electrical Engineers** **S2 L3 T1**

*Prerequisite: 1.982 Solid State Physics.*

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

# Mechanical and Industrial Engineering

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

| *Prerequisite:* | *HSC Exam Score Range Required* |
|---|---|
| *2 unit English (General) or* | *53-100* |
| *2 unit English* | *49-100* |
| *3 unit English or* | *1-50* |
| *2 unit Contemporary English* | *60-100* |

*Excluded 5.061*

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

**5.0011 Engineering Mechanics 1** **S1 or S2 L2 T2**

| *Prerequisite:* | *HSC Exam Score Range Required* |
|---|---|
| *Either* | |
| *2 unit Science (Physics) or* | *53-100* |
| *3 unit Science or* | *90-150* |
| *4 unit Science multistrand* | *1-50* |
| *or* | |
| *2 unit Industrial Arts (Engineering Science) or* | *53-100* |
| *3 unit Industrial Arts (Engineering Science)* | *1-50* |

*Excluded 5.010, 5.0101, 5.0201.*

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

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

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

*Excluded 5.0012, 5.030, 5.0302, 5.010.*

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

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

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

**5.0020 Professional Studies 2**
**4 contact hours total**

*Prerequisite: 5.0010*

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.

**5.0300 Graphical Analysis and Communication** **S2 L1 T2**

*Excluded 5.0016, 5.030, 5.0302.*

Descriptive geometry as the basis of analysis and synthesis of spatial relationships: points, lines, plans, solids, intersections. Orthographic and other projection systems.

Engineering drawing as a means of definition and communication, selection of views, construction of drawings, conventions, dimensions and tolerancing. Introduction to computer-based drafting systems.

**5.0303 Workshop Technology** **SS L1 T2**

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

**5.0305 Manufacturing Technology** **S2 L/T3**

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

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

**5.034 Engineering Experimentation** **S1 L1 T1 S2 L.5 T1**

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

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

**5.043 Industrial Training 1** **SS**

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

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

**5.044 Industrial Training 2** **SS**

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

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

**5.051 Thesis** **F T6**

*Co-requisite: 5.062.*

To be taken in year of completion of course.

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

**5.062 Communications** **F L2**

*Co-requisite: 5.051.*

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

**5.065 Mechanical Engineering** **SS L3 T1**

*Prerequisites: 1.961, 10.2111, 10.2112 or equivalent.*

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. Turbomachinery velocity diagrams. Incompressible and compressible flow in adiabatic ducts. Conduction, convection and radiation heat transfer with applications.

**5.070 Optimal Engineering Strategies** **F L1 T0.5**

*Prerequisites: 5.3021, 10.022. Co-requisite: 5.122. Excluded 5.073.*

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

**5.074 Computing Science for Mechanical Engineers** **S1 L2 T1**

*Prerequisite: 5.0721 or 5.5010.*

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

**5.079 Numerical Methods** **F L1 T0.5**

*Prerequisites: 5.0721 or 5.5010, 10.022. Excluded 5.073.*

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

**5.1010 Mechanical Engineering Design 1** **S2 L/T3**

*Co-requisite: 5.0010. Excluded 5.0012, 5.061.*

Introduction to hardware. Studies of a range of engineering components, considering: what they do, how they do it, how they were made, the range of possible forms for each item, why each item has its particular form. Design philosophy. Design as the formulation and implementation of practical ways of fulfilling needs, including: recognising the need, generalising the question, considering a range of solutions, selecting a short-list, analysing the selected range, making a final choice. Commercial philosophy. Impetus for design, market competition, significance of innovation, intellectual property, financing, manufacturing, marketing, etc.

**5.122 Mechanical Engineering Design 2** **F L1 T2**

*Prerequisites: 5.0011, 5.0012, 5.0300, 5.0305, 5.421. Co-requisites: 5.061 or 5.0010, 5.3021, 5.4220, 5.4222, 5.620, 5.626.*

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

**5.123 Mechanical Engineering Design 3** **F L2 T1**

*Prerequisite: 5.122. Co-requisites: 5.3030, 5.423.*

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.

**5.1240 Design Project** **F L1 T2**

*Prerequisite: 5.123.*

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.

**5.1242 Design Technology** **SS L2 T1**

*Prerequisite: 5.122.*

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.

**5.1243 Machinery Design Project** **SS L1 T2**

*Prerequisite: 5.123.*

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

**5.1244 Project Management** **SS L2 T1**

*Prerequisite: 5.122.*

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

**5.1245 Computer-Aided Engineering Design** **SS L2 T1**

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

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

**5.3021 Engineering Mechanics 2A** **S1 or S2 L2 T1**

*Prerequisites: 1.001, 1.911 or 1.951, 5.0011 or 5.0201, 10.001 or 10.011. Excluded 5.300.*

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

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

*Prerequisites: 1.001, 1.911 or 1.951, 5.0011 or 5.0201, 10.001 or 10.011. Excluded 5.303*

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

**5.3030 Engineering Mechanics 3** **S2 L/T2**

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

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

**5.3040 Plane Mechanism Kinematics** **S1 or S2 L2 T1**

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

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

**5.3130 Vibration Analysis** **S2 L/T2**

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

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

**5.3140 Advanced Vibration Analysis** **SS L2 T1**

*Prerequisites: 5.3130, 5.423. Excluded: 5.348, 5.338G, 5.314G*

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.

**5.343 Linear Systems Analysis** **S1 L2 T1**

*Prerequisites: 5.0011 or 5.0201, 10.022.*

Models of physical systems: differential equations for physical systems including mechanical, electrical, hydraulic, thermal and pneumatic systems; 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.

**5.348 Mechanical Vibrations 2** **SS L2 T1**

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

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

**5.350 Principles of Control of Mechanical Systems** **S1 L2 T1**

*Prerequisite: 5.343. Excluded 5.344.*

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

**5.3541 Engineering Noise 1** **SS L2 T1**

*Excluded 5.653G.*

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

**5.3542 Engineering Noise 2** **SS L2 T1**

*Prerequisite: 5.3541. Excluded 5.654G.*

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

**5.419 Engineering Applications of Finite Elements** **SS L2 T1**

*Prerequisite: 5.423. Excluded 5.414G, 5.823.*

Introduction to finite element and associated graphics packages.

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

**5.421 Mechanics of Solids 1** **S1 or S2 L2 T1**

*Co-requisite: 5.0011.*

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

**5.4221 Mechanics of Solids 2** **F L1.5 T2**

*Prerequisites: 5.421, 10.001 or 10.011. Excluded 5.422, 5.4220, 5.4222.*

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

**5.423 Mechanics of Solids 3** **F L1.5 T.5**

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

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

**5.424 General Mechanics of Solids** **SS L2 T1**

*Prerequisite: 5.423. Excluded 5.417G.*

Inelastic behaviour of bars, beams, shafts and columns. Thick cylinders and composite cylinders loaded by internal and external pressures; rotating discs; contact stresses. Elementary concepts of fracture mechanics; stress intensity factor; fracture toughness; crack propagation.

**5.434 Plates and Shells** **SS L2 T1**

*Prerequisite: 5.423. Excluded 5.415G.*

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

**5.444 Theory of Elasticity** **SS L2 T1**

*Prerequisites: 5.3021, 5.423, 5.622.*

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

**5.454 Theory of Plasticity** **SS L2 T1**

*Prerequisite: 5.423 or 18.413.*

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

**5.464 Structural Instability** **S1 L1.5 T0.5**

*Prerequisite: 5.423.*

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

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

*Excluded 5.0721.*

Introduction: history, applications, hardware, software, a model of a computer system, editors, operating systems. Program design and development: programming objectives,

data structures, algorithms, symbolic names, translation of algorithms, steps in programming, programming style, syntax charts, errors and debugging. Data: data types, declarations, input output, file control. Programming constructs: arithmetic expressions, assignment, relational and logical expressions, selection, iteration, intrinsic functions, statement functions, subprograms, common, communication. Applications using existing programs: sorting, word processing, graphics and plotting, simultaneous linear algebraic equations.

**5.6040 Turbomachines and Engines** **SS L/T3**

*Prerequisites: 5.630, 5.636.*

Definition of a turbomachine, classes and characteristic of turbomachines, sizing using dimensional analysis. Thermodynamics of axial machines. 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. Fuel air and computer generated engine cycles for reciprocating engines and gas turbines. Heat transfer calculations in engines. Turbomachinery in engines. Introduction to component matching in turbocharged reciprocating engines and gas turbines. Control of emissions from engines.

**5.620 Fluid Mechanics 1** **F L1 T1**

*Prerequisites: 1.001 or 1.951, 5.0011, 10.001 or 10.011. Co-requisite: 5.3021. Excluded 5.622.*

Units. Fluid properties; fluid statics. Flow fields; unsteady and compressible flow. Bernoulli's equation. Momentum equations. Ideal flow. Flow measurement. Dimensional analysis: similitude; dimensionless numbers; methods of analysis. Steady one dimensional flow in ducts: laminar and turbulent; pressure loss; friction factor; losses in bends and fittings. Elementary boundary layer flow; skin friction and drag. Pumps and turbines.

**5.626 Thermodynamics 1** **F L1 T1**

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

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

**5.630 Fluid Mechanics 2** **F L1 T.5**

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

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

**5.633 Turbomachines** **SS L2 T1**

*Prerequisites: 5.630, 5.663, 10.022.*

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

**5.6341 Viscous Flow Theory** **F L/T1.5**

*Prerequisites: 5.620, 5.626, 10.022.*

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.

**5.6342 Lubrication** **SS L/T3**

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

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

**5.635 Convection Heat Transfer** **SS L2 T1**

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

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

**5.636 Thermodynamics 2** **F L1 T.5**

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

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

**5.641 Thermal Power Plants** **SS L2 T1**

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

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

**5.643 Energy, Combustion and Engines** **SS L2 T1**

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

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

**5.644 Solar Energy** **SS L2 T1**

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

Ambient energy systems. Photovoltaic 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.

**5.654 Hydraulic Transients** **SS L2 T1**

*Prerequisites: 5.630, 10.022.*

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

**5.664 Multiphase Flow** **SS L2 T1**

*Prerequisites: 5.630, 5.636, 10.022.*

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

**5.800 Aircraft Design 1** **F L2 T1**

*Prerequisites: 5.122, 5.300 or 5.3021, 5.422. Co-requisite: 5.423.*

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

**5.801 Aircraft Design 2** **F L2 T1**

*Prerequisites: 5.303, 5.423, 5.800, 5.811, 5.822. Co-requisites: 5.812, 5.823, 5.831.*

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

**5.811 Aerodynamics 1** **F L2 T1**

*Prerequisites: 5.300 or 5.3021, 5.620, 10.022. Excluded 5.653, 5.663.*

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

**5.812 Aerodynamics 2**

*Prerequisites: 5.811, 5.303, 5.343.*

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

**5.822 Analysis of Aerospace Structures 1** **F L1.5 T.5**

*Prerequisites: 5.300 or 5.3021, 5.4220, 10.022. Co-requisite: 5.423.*

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

**5.823 Analysis of Aerospace Structures 2** **F L1.5 T0.5**

*Prerequisites: 5.423, 5.822. Excluded 5.414G, 5.419.*

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

**5.831 Aerospace Propulsion** **F L1.5 T0.5**

*Prerequisites: 5.620, 5.626, 5.653 or 5.811.*

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

**5.901 Introduction to Mathematical Modelling and Decision Making** **S1 L2 T1**

*Prerequisite: 5.122.*

This subject is identical with Session 1 of 5.123.

Models and modelling: types, criteria, parameters, constraints; mathematical formulation and validation of models; fundamentals of solution algorithms; post-solution analysis. Decision making: scales and ratings; subjective decision making; mixed rating comparisons; sensitivity; pitfalls. Introduction to project control.

Applications from the marine field.

**5.902 Ship Management Economics** **S2 L1.5 T0.5**

*Prerequisite: 10.022.*

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.

**5.911 Ship Hydrostatics** **F L2 T0.5**

*Prerequisites: 5.0011, 10.001 or 10.011.*

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

**5.921 Ship Structures 1** **F L1.5 T0.**

*Prerequisites: 5.4220, 5.4222, 10.022.*

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

**5.922 Ship Structures 2** **F L1.5 T0.5**

*Prerequisites: 5.423, 5.921.*

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

**5.9311 Principles of Ship Design 1** **S2 L2 T**

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

**5.9321 Principles of Ship Design 2** **S1 L3 T1 S2 L1.5 T0.5**

*Prerequisite: 5.9311.*

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

**5.937 Ship Design Project** **S1 T3 S2 T4**

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

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

**5.941 Ship Propulsion and Systems**

*Prerequisites: 5.911, 5.953.*

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

**5.953 Ship Hydrodynamics** **S1 L2 T1 S2 L1.5 T0.5**

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

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

## Servicing Subjects

For further information regarding the following subjects see the Faculty of Applied Science Handbook.

**5.0302 Engineering Drawing and Descriptive Geometry** **S1 or S2 L1 T3**

*Excluded: 5.0016, 5.030.*

Graphic communication. First and third angle orthographic projection and isometric projection. Descriptive geometry fundamentals and their application to engineering problems with special emphasis on 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.

**5.3000 Engineering Mechanics** **SS L2 T2**

*Prerequisites: As for 5.0011 Engineering Mechanics 1. Exclusions: 5.010, 5.0101, 5.0011, 5.400.*

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.

**5.4000 Engineering Statics** **S1 or S2 L2 T1**

*Prerequisites: As for 5.0011 Engineering Mechanics. Excluded: 5.010, 5.0101, 5.0011, 5.3000.*

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.

## Electrical Engineering and Computer Science

**6.010 Electrical Engineering 1** **S2 L3 T3**

*Co-requisite: 1.961 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. Sinusoidal steady state operation. Concepts of impedance, resonance, bandwidth and filtering. Power in DC and AC circuits. Circuit models of diodes and transistors. Transistor switching. Combinational logic principles and circuits. Diode and transistor logic implementations. Sequential logic circuit elements: monostable, bistable and astable circuits.

**6.011 Introduction to Electrical Engineering** **F L1 T.5**

*Prerequisite:*

| | *HSC Exam Score Range Required* |
|---|---|
| *2 unit English (General) or* | *53-100* |
| *2 unit English or* | *49-100* |
| *3 unit English or* | *1-50* |
| *2 unit Cointemporary English* | *60-100* |

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

**6.021A Circuit Theory 1** **S1 or S2 L2 T2**

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

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

**6.021B Power** **S1 or S2 L2 T2**

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

Topics in electric power engineering including analysis of AC power circuits (single phase, three phase, steady state and transient), magnetic circuits, transformers, fundamentals of electro-mechanical energy conversion and electrical safety.

**6.021C Electronics 1** **S1 or S2 L2 T2**

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

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

**6.021D Computing** **S1 L3 T1**

*Prerequisite: 6.611. Excluded 6.620, 6.621.*

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

**6.021E Digital Logic and Systems** **S1 or S2 L2 T2**

*Prerequisite: 10.001.*

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

**6.0311 Circuit Theory 2** **S1 or S2 L2 T2**

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

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

**6.0312 Utilisation of Electric Energy** **S1 or S2 L2 T2**

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

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

**6.0313 Electronics 2** **S1 or S2 L2 T2**

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

Linear signal-processing techniques. Short review of basic transistor theory and properties. Design and analysis of small signal amplifiers incorporating bipolar junction transistors.

Applications of negative feedback. Differential amplifiers. Structure, properties and use of operational amplifiers.

**6.0315 Electrical Energy** **S2 L2 T2**

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

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

**6.0316 Electronics 3** **S1 or S2 L2 T2**

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

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

**6.0318 Microprocessor Systems and Applications** **S1 or S2 L2 T2**

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

Basic computer architecture: fetching and executing instructions; Microprocessor registers and instructions; assemblers, addressing modes; bus waveforms; interfacing to a bus; parallel interfacing – the PIA; handshaking; interrupts; critical regions; buffered I/O; stack data frames; recursion; serial interfacing – the ACIA; direct memory access (DMA); dynamic memory; Microprocessor examples.

**6.042 Digital and Analogue Signals** **SS L2 T3**

*Prerequisites: 6.0311, 10.0331, 10.361.*

*Analysis and processing of continuous-time and discrete-time (digital) signals:* Generalised Fourier analysis; convolution, correlation, energy and power density spectra. Signal distortion (linear and nonlinear) Hilbert transforms; analytic signals, signals in systems. Sampling and digital processing of analogue signals; the discrete Fourier transform (DFT), the fast Fourier transform (FFT), algorithm. Design of finite and infinite impulse response (FIR and IIR) digital filters. Analysis of random signals and noise; mean-square estimation of signals from noisy data, adaptive signal processing and spectrum estimation.

**6.046 Project Evaluation** **S1 L2**

*Exclusion: 18.1212.*

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

**6.047 Reliability Engineering for Design and Development** **S2 L2 T2**

*Prerequisite: 10.361 Session 1 attempted.Co-requisite: 10.361 Session 2. Excluded 6.044.*

Part A: Quantified reliability, maintainability, availability achievement in design and development. Prediction of RAM. Redundancy design. Fault tree analysis. FMECA. Life cycle cost. 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.

**6.201 Electrical Energy** **S2 L2/T2**

*Prerequisite: 6.831.*

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.

**6.202 Power Engineering – Systems 1** **SS L2 T3**

*Prerequisites: 6.0312, 6.0315.*

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

**6.203 Power Engineering – Systems 2** **SS L2 T3**

*Prerequisite: 6.202.*

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

**6.215 Industrial Electrical Systems** **S2 L2 T3**

*Prerequisite: 6.0315.*

The design, operation, maintenance and efficiency of large industrial electric power systems. Protection and detailed fault calculations. Choice and use of protective equipment, including circuit interrupters, surge diverters and personnel protection. Testing of equipment and relevance of Standards (including loading specifications, safety and general wiring procedures). 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.

**6.222 High Voltage Technology** **SS L2 T3**

*Prerequisite: 6.0315.*

An elective concerned with the high voltage design and testing of electrical equipment used in the power industry. The practical applications of relevant materials, with emphasis on properties of insulation systems (gases, liquids and solids) and the interaction of the materials in non-uniform fields. Methods of testing under steady state – AC and DC – and surge conditions are incorporated in the laboratory work. Design

examples are taken from insulator, bushing, cable, power capacitor, transformer, rotating machine and switchgear technologies.

**6.240 Power Electronics** **SS L2 T3**

*Prerequisites: 6.0311, 6.0312. 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.

**6.303 Transmission Lines for Microwave and Optical Communication** **SS L2 T3**

*Prerequisite: 6.0317.*

Transmission line equations. Smith chart and matching. Multimode optical fibre. Step-index and graded-index fibres, bandwidth of fibre, fibre connections, measurements and fabrication.

**6.313 Signal Propagation at Microwave and Optical Frequencies** **SS L2 T3**

*Prerequisite (or co-requisite): 6.303.*

Maxwell's equations, waveguide theory, single mode optical fibres, free space propagation, antennas. Microwave sources. Light emitting diodes, lasers and optical detectors.

**6.322 Electronics 4** **S1 or S2 L2 T3**

*Prerequisites: 6.0313, 6.0316.*

Theory and applications of electronic devices, circuits and systems employing microelectronics technology. Active filters, voltage-controlled oscillators, phase-locked loops, multipliers. Modulation and demodulation techniques. Additional topics chosen from: ICs using MOS devices, controlled-gain amplifiers, charge-coupled devices, voltage references, switching regulators. Laboratory: a series of projects to design, construct and study circuits based on the above topics.

**6.323 Communication Systems 2A** **SS L2 T3**

*Prerequisites: 6.0317, 10.0331, 10.361.*

Theory and practice of modern analogue and digital communication techniques. Topics selected from: digital communications: bandlimited signalling, Nyquist and partial response shaping, non-binary transmission, receiver optimisation and matched filters, line coding, spectrum with line coding, adaptive equalisation, error control coding information theory (entropy, discrete and continuous channel capacity); linear and nonlinear analogue modulation (AM, SSB, FM etc, signal to noise ratios, characterisation and effect of nonlinearities on transmitters and receivers, comparison); aspects of transmission media relevant to telecommunication systems.

**6.333 Communication System 2B** **SS L2 T3**

*Prerequisites: 6.0316, 6.0317.*

Modern digital and analogue communications systems from a systems point of view. Topics selected from: television, teletext and viewdata; acoustic systems; broadcast systems covering AM, FM, stereo; radar, sonar, electronic navigation aids; satellite communication systems; point-to-point and mobile terrestrial communication systems.

**6.402 Introductory Physiology for Engineers** **S1 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.

**6.412 Systems and Control 2** **SS L2 T3**

*Prerequisites: 6.0311, 6.0314.*

The design of feedback controllers for single and multivariable systems typically encountered in electrical engineering. Emphasis on satisfying steady-state, transient and sensitivity specifications by both frequency domain and time domain techniques. Treatment of identification methods and nonlinearities via the describing function. Extensive use of interactive computer-aided design programs..

**6.413 Digital Control** **SS L2 T3**

*Prerequisites: 6.0314, 10.0331, 10.0332, 10.361.*

The design and analysis of digital control systems. Sampling, aliasing, pulse transfer function, discrete state-space, z-trans-form, transform methods of control design, digital PID, analog redesign. On-line digital identification and adaptive control techniques as illustrated by the self-tuning regulator, minimum variance and dead beat control structures. Linear quadratic regulator and observers.

**6.432 Computer Control and Instrumentation** **SS L2 T3**

*Prerequisites: 6.0314, 6.0316, 6.0318.*

Current practice in hardware and introduction to software techniques as applied to the implementation of control and instrumentation systems. Analog computers and associated circuit techniques. Transducers, actuators, controllers and special electro-mechanical devices as used in industrial instrumentation. Digital instrumentation. Hybrid devices and analog conversion. Sampling. Computer control organisation and interfacing concepts. Microprocessor peripherals, including display systems, and magnetic data storage devices. Bus communication system for instrumentation. Programmable logic controllers. Standard process control configurations. Introduction to software systems for digital control applications. Computer control of processes via on-line languages. Includes a significant laboratory program aimed both at illustrating the lecture material and introducing new concepts.

**6.483 Biomedical Engineering** **SS L2 T3**

*Prerequisites: 6.0314, 6.0316, 6.402.*

Allocation 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.

**6.501 Electronic Signal Processing** **S2 L2/T2**

*Prerequisites: 6.833, 6.834. Co-requisite: 6.835.*

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.

**6.512 Semiconductor Devices** **SS L2 T3**

*Prerequisite: 6.0313.*

Principles of operation and circuit characteristics of a range of semiconductor devices including bipolar diodes and transistors, MOS devices and circuits, charge-coupled devices, solar cells, light-emitting diodes, and semiconductor lasers. The lectures are supplemented by experimental work with a selection of these devices.

**6.522 Transistor and Integrated Circuit Design SS L2 T3**

*Prerequisites: 6.0313, 6.0316.*

Review of technology for bipolar and MOS integrated circuits. Device models, layout rules, the relationship of parameters to processes. Analog circuit modules: current mirrors, compound transistors, differential pairs and multipliers. Operational amplifiers and voltage regulators. Bipolar logic: S&TTL and compound functions. MOS and CMOS logic. Analog MOS circuits, switchedcapacitor filters and other selected topics. The use of SPICE in circuit simulation. The laboratory program is aimed at understanding the internal design of some standard IC functions.

**6.532 Integrated Digital Systems** **SS L2 T3**

*Prerequisites: 6.021E, 6.0316.*

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.

**6.540 Applied Photovoltaics** **SS I2 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.

**6.606 Computing Science Honours**

**6.612 Computer Organisation and Digital Systems Design** **SS L3 T2**

*Prerequisite: 6.0318 or 6.613. Excluded 6.654G.*

The structural organisation and hardware design of digital computer systems, basic computer organisation, control and microprogramming, arithmetic algorithms and processor design, memory management and organisation, input-output systems, parallel processing and multiprocessor systems. Use of algorithmic state machines for digital system description, specification and design.

**6.613 Computer Organisation and Design** **SS L3 T2**

*Prerequisites: 6.631 or 6.021E, 6.021E, 6.021D or 6.620 or 6.621 (Pass Conceded (PC) awarded prior to Session 2, 1983, is not acceptable for these subjects). Excluded 6.0318.*

Bussing structures (asynchronous and synchronous); input/output organisation; polling, interrupt and DMA control; parallel and serial device and processor communication and interfacing. Memory organisation; CPU and control unit design. Microprocessor case studies.

**6.621 Computing 2A** **S1 L3 T2**

*Prerequisites: 6.611, 10.001 or 10.011. Excluded 6.620, 6.021D.*

For those students who intend to take further subjects in computer science.

Expansion and development of material introduced in 6.611 Computing 1. Systematic program development: introduction to programming language semantics, reasoning about programs, program derivation, abstract programs, realisation of abstract programs (conversion from abstract to concrete). Practice in programming in a high-level programming language. Data-structures arrays, lists, sets, trees; recursive programming. Introduction to computer organisation: a simple machine architecture. Introduction to operating systems.

**6.622 Computer Applications** **SS L3 T2**

*Prerequisite: 6.641. Excluded 6.646, 6.63.*

Simulation: discrete even simulation, pseudo-random number generation, simple queuing theory. Non-numeric programming: artificial intelligence, symbolic computing. Database systems: data base models: relational, hierarchical and network structures; query languages; case study of ingress; data base security.

**6.631 Computing 2B** **S1 or S2 L3 T2**

*Prerequisite: 6.620 or 6.621 or 6.021D, Excluded 6.021E.*

Assembler programming: programming in a low level machine oriented language in order to illustrate the mapping of higher level language constructs onto a typical machine and the inter action between operating systems and devices. *Digital Logic Design:* Boolean algebra and logic gates, simplication of Boolean functions, combinational logic, medium scale integration building blocks, clocked sequential circuits, registers and memory, computer arithmetic.

**6.632 Operating Systems** **SS L2 T3**

*Prerequisites: 6.631 or 6.021E, 6.641. Excluded 6.672.*

Introduction to operating systems via a case study of a particular system, namely the UNIX Time-sharing system. Includes system initialisation, memory management, process management, handling of interrupts, basic input output and

file systems. A comparison of UNIX with other operating systems. General principles for operating systems design.

**6.633 Data Bases and Networks** **SS L3 T2**

*Prerequisite: 6.641. Excluded 14.608, 14.607, 19.607.*

*Data base management systems:* data models; relational and network structures; data description languages; data manipulation languages; multi-schema structures. Data distribution integrity and security; recovery; privacy. *Computer networks:* economic and technological considerations; digital data transmission; error detection and recovery; network configurations; circuit switching, packet switching; communication protocols, current international standards; data compression; encryption and decryption.

**6.641 Computing 2C** **S1 or S2 L3 T2**

*Prerequisites: 6.620 or 6.021D or 6.621.*

*Design of data structures:* abstraction, representation, manipulation and axiomatisation. Key transformations (hashing), balanced and multiway tress, introduction to graphs. *Files:* sequential access, random access, merging, sorting and updating. File organisations and introduction to data base systems. *Programming in logic:* descriptive programming languages, symbolic manipulation, pattern matching and associative programming. Software engineering: a survey of some current techniques in problem specification and program design.

**6.642 Design and Analysis of Algorithms** **SS L3 T2**

*Prerequisite: 6.641.*

The course consists of 2 strands: Algorithms and Software Engineering. The first strand covers techniques for the design and performance analysis of algorithms for a number of classes of problems. Analysis: order notation, recurrence equations, worst case and average case statistics. Design: recursion, divide and conquer, balancing, backtracking dynamic programming, approximate algorithms, Np-complete problems. Software engineering covers the specification, analysis, design and testing of software systems. The methodology used produces a naturally concurrent, hierarchical network of intercommunicating processes as a model of the system being specified. A significant group project is undertaken.

**6.643 Compiling Techniques and Programming Languages** **SS L3 T2**

*Prerequisite: 6.641. Excluded 6.672.*

**1.** Language description: phrase structure grammars, Chromsky classification, context-free grammars, finite state grammars, Backus Naur Form, syntax graphs LL(k), LR(k), LAL(k). **2.** Lexical analysis: translation of an input (source) string into a (machine independent) quasi-terminal symbol string. Finite state recognisors. **3.** Syntax analysis: top-down compilation for LL(1) grammars using syntax graph driven analysers or recursive descent. Bottom-up compilation for simple and weak-precedence and LR(k) grammars. **4.** Semantic analysis: program translation and code generation; attributed grammars. **5.** Compliers generators: automatic generation of compliers for LALR(1) grammars. **6.** Code optimisation by systematic program transformation. **7.** Run-time organisation: activation record stacks, heap management.

**6.646 Computer Applications** **SS L3 T2**

*Prerequisites: 6.021D or 6.621, 10.311 or both of 10.311A and 10.311B, 10.331, or equivalent. Excluded. 6.622.*

The use of computers for solving problems with a substantial mathematical and operational research content: includes use of some standard software packages. Topic selected from: discrete event simulation; a simulation language; pseudo random number generation; simple queuing theory, applications of mathematical programming; dynamic programming; statistical calculations; critical path methods; computer graphics, artificial intelligence.

**6.647 Business Information Systems** **SS L3 T2**

*Prerequisites: 6.641, 14.001 or 14.501.*

Introduction to accounting systems: general ledger, debtors and creditors; models of business information systems; integrated business systems. System specification, system analysis, system design and implementation; testing and debugging. Managing a project team, project control. The COBOL programming language. File organisation and design; sequential, indexed sequential, random, inverted, B-tree file organisations; data dictionaries, program generators, automatic system generators. A major project, written in COBOL, is undertaken as a team exercise.

**6.651 Data Communication and Computer Networks** **SS L3 T2**

*Prerequisites: 6.0317, 6.0318.*

Data communications. Error detection coding and synchronisation. Physical layer standards and modems. IEEE-488 instrument bus. Principles of data networks and queuing theory. Local area networks. Contention and token passing systems. Laboratory work covers experiments on physical, data link and network layer protocols in a practical network.

**6.652 Data Networks 2** **SS L3 T2**

*Prerequisite: 6.651.*

Data transmission on telephone networks. Data in mixed traffic environment. 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. Case studies: ARPAnet and ACSnet. Laboratory work covers experiments on network layer to application layer protocols in a practical network.

**6.672 Operating Systems and Compilers** **SS L3 T2**

*Prerequisites: 6.0318 or 6.613. Excluded 6.643, 6.632.*

Operating systems: principles of operating systems; multiprocessing; resource sharing and deadlock; interprocess communication; CPU scheduling; memory management including segmentation and virtual memory; file systems. Laboratory component covers C programming, polled input output, interrupt driven input output, multiprocessing, and real-time control of a simple system. Compilers: language description; Backus-Naur form, lexical analysis, semantic analysis, code generation. There is a project which involves modification of a simple complier.

**6.710 Introduction to Computer Engineering** **F L1 T.5**

| *Prerequisite:* | *HSC Exam Score Range Required* |
|---|---|
| *2 unit English (General) or* | *53-100* |
| *2 unit English or* | *49-100* |
| *3 unit English or* | *1-50* |
| 2 unit Contemporary English | 60-100 |

Introduction to the nature, history and scope of computer engineering (including computer architecture, digital systems, software engineering, information processing, electronics, and communications). The roles of computer engineering in industry, government and public utilities. Development of organisation, communication and research skills in engineering.

**6.711 Computing 1A** **S1 or S2 L3 T3**

*Prerequisite: as for 10.001. Co-requisite: 10.001 Excluded 6.611.*

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

**6.712 Computing 1B** **S1 or S2 L3 T3**

*Prerequisite: 6.711. Excluded 6.620, 6.621, 6.021D.*

Expansion of the functional approach to computing in 6.711. Introduction to procedural and logic programming styles. Data structure implementation. Control structures: recursion and interaction. The software development process. Program efficiency and complexity – time and space analysis. Practical experience in using a procedural language. The basic structure of a computer, the layered model of a computer, instruction execution, assembly language, computer building blocks, the function of the operation system.

**6.718 Computing 1 (Procedural)** **S2 L3 T3**

*Prerequisites: as for 10.001. Co-requisite: 10.001. Excluded: 6.600, 6.611, 6.711, 6.620, 6.021D.*

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

**6.721 Data Organisation** **S1 or S2 L3 T2**

*Prerequisite: 6.712. Excluded: 6.641.*

Data types and data structures: abstractions and implementations. Data representation: logical and physical. Files and file organisation, database structures Knowledge representation. Concepts of state, scope and binding within programs. Storage policies (VM, caching), addressing and accessing methods. Analysis of performance.

**6.722 Computer Organisation** **S2 L3 T2**

*Prerequisite: 6.712. Excluded: 6.631.*

The multilevel approach to the structure of computers. The machine Code Level: data representation; registers; instruction sets; the fetch/execute cycle; the programmer's model of the computer, 68000 assembly-language programming. The Component Level: the classification of digital logic components; processing, storage and communication devices; the concept of hierarchical logic description; the separation of control and data paths; Register Transfer Language; other description tools for digital systems. Programmable Controllers: the design of controllers using state machines and microcode. The System Level: the main characteristics of storage and I/O devices; communication between processors, memory, and I/O devices; networking. Virtual machines. Tradeoffs and constraints in computer systems and techniques for performance enhancement. The history and technology of computer systems. An introduction to advanced architectures.

**6.723 Concurrent Computing** **S2 L3 T2**

*Prerequisite: 6.712.*

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, lifelock, scheduling. Distributed algorithms: detection of deadlock, detection of termination. Protocols for data transfer.

**6.729A Electrical Engineering – LAB2A** **S1 T1**

*Prerequisites: 6.010, 1.961. Co-requisite: 6.821. Excluded: 6.827.*

Experiments in electric circuits. The use of the computer aided circuit analysis package SPICE. Laboratory Technique.

**6.729B Electrical Engineering – LAB2B** **S2 T2**

*Prerequisites: 6.729A, 6.821, 6.824. Co-requisite: 6.823. Excluded: 6.828.*

Experimental work on digital and analogue circuits, devices and systems. Computer aided experimental work.

**6.732E Microprocessors and Interfacing** **S1 L2 T0.5**

Prerequisite: 6.824. Excluded: 6.732.

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.

**6.821 Circuit Theory** **S1 L2 T.5**

*Prerequisites: 6.010, 10.001. Co-requisite: 10.1214 or 10.1114:*

Dynamic response of linear circuits: 1st and 2nd order circuits with DC sources, introduction to higher order circuits. Sinusoidal steady state operation: phasers, impedance and admittance; dynamic response of circuits driven by sinusoidal sources, concepts of power electronics; linearity, network theorems; resonance, bandwidth, and quality factor. Two-port networks: parameters, circuits as filters. Power in steady-state

circuits; average and reactive power, power factor, power factor correction. Three-phase circuits: balanced and unbalanced steady-state operation; real and reactive power in balanced circuits, transient analysis.

**6.822 Systems Theory** **S2 L2 T.5**

*Prerequisites: 6.821, 10.1213 or 10.1113. Co-requisites: 10.0331, 10.1214 or 10.1114.*

Continuous and discrete signals and their transformations. Properties of continuous and discrete systems. Linear time invariant systems. Low order differential and difference equations. Diagrammatic representations of systems. Fourier analysis, filtering, Laplace transforms, z-transforms. Examples of systems will be taken from areas of circuits, analog and digital electronics, power and mechanical engineering.

**6.823 Analog Electronics** **S2 L2 T.5**

*Prerequisites: 6.821, 1.982.*

Operating principles and terminal characteristics of PN diodes, bipolar and field effect transistors, and thyristors. Small signal models of devices, including h-parameter model. Analysis and design of low-frequency Class-A amplifiers, including choice of biasing method.

**6.824 Digital Circuits** **S2 L2 T.5**

*Prerequisite: 6.010.*

Logic functions: truth tables, Boolean expressions. Boolean algebra: laws, standard forms, algebraic simplification. Logic Gates: symbols, timing diagrams, interconnections. Gate circuits: realisations of Boolean expressions. Gate-level design: prime implicants and covers, Karnaugh maps. MSI-level design: decoders, multiplexers, ROMs, PLAs. Introduction to sequential circuits: stop-watch, traffic light sequencer examples. Astable Bistable elements: clock circuits, RS, JK, D-type flip-flops. State machines: Moore/Mealy models, state diagram from circuit analysis. Synchronous sequential circuit design: state diagram, state transition table, excitation output specification, gate flip-flop design. Registers and memories: parallel and shift registers, multifunction registers, addressable register arrays. High-level design: register transfer language, control data paths, design examples.

**6.825 Electromagnetic Theory and Applications** **F L2 T.5**

*Prerequisites: 6.010, 1.961. Co-requisites: 10.2111, 6.821.*

Electrostatics in vacuum and in dielectric materials. Electric current. Magnetostatics in vacuum and magnetic media, magnetic materials and magnetic circuits. Time-varying fields. Capacitance and inductance calculations. General field concepts. Rotating magnetic fields, and electromagnetic principles of machines. Transformers. Superconductivity. Maxwell's equations. Transmission lines from circuit and electromagnetic viewpoints. Electromagnetic radiation and electromagnetic interference. This subject is taught jointly by staff from the schools of Physics and Electrical Engineering and Computer Science.

**6.827 Electrical Engineering Laboratory 2A** **S1 T1.5**

*Prerequisite: 1.961, 6.010. Co-requisite: 6.821, 6.825.*

Experiments in electric circuits and electromagnetic fields and applications. Laboratory technique.

**6.828 Electrical Engineering Laboratory 2B** **S2 T3**

*Prerequisites: 6.827. Co-requisites: 6.823, 6.824, 6.825.*

Experimental work on digital and analog devices and circuits, electromagnetic fields and electrical systems.

**6.829 Electrical Design** **S2 L1 T2**

*Co-requisites: 5.0016, 6.011, 6.823, 6.824.*

Concepts of product design: specification, design methodology, project management, costing for prototype production, testing. Electronic circuit design – device specifications, thermal dissipation, passive component choices, tolerances. Electronic circuit analysis and design using computer aids. Electronic circuit prototyping techniques: wire-wrapping, PCB layouts using computer aids, interconnection technologies, earthing. Group Project Work: including initial design, PCB production and testing, and preparation of a report on an electrical project.

**6.831 Introduction to Electrical Energy** **S1 L2 T.5**

*Prerequisites: 6.823, 6.825.*

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.

**6.833 Integrated Electronics** **S1 L2 T.5**

*Prerequisite: 6.823.*

Analysis and design of small signal bipolar and field effect transistor amplifiers. Applications of negative feedback. Differential amplifiers Properties and applications of operational amplifiers. Analysis and design of sinewave oscillators. Basic logic families: TTL, ECL, nMOS, CMOS.

**6.834 Signals, Filters, and Spectra** **S1 L2 T.5**

*Prerequisites: 6.822, 10.0331. Co-requisite: 10.361.*

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.

**6.835 Electrical Engineering Laboratory 3** **S1 T6**

*Prerequisites: 6.828, 6.829. Co-requisites: 6.732E, 6.831, 6.833, 6.834.*

A programme of experiments and laboratory-based design exercises in electrical energy, electronic devices and circuits, signal processing and microprocessors.

**6.836 Communication Systems 1** **S2 L2 T2**

*Prerequisite: 6.834.*

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: analogue to digital conversion (sampling, quantising, aliasing, pulse code modulation, delta modulation, time and frequency division multi-plexing). Modulation and demodulation (amplitude, frequency and phase modulation, signal to noise ratio, noise figure, error probability, bandwidth, spectrum, intersymbol interference). Communication systems (radio wave propagation, antennas and arrays, modems, repeaters, equalisers, line and error coding).

**6.837 Systems and Control 1** **S2 L2 T2**

*Prerequisite: 6.834.*

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

**6.854 Electrical Power Engineering** **S2 L/T3**

*Prerequisite: 1.001 or equivalent (1.9222 or 6.851 for students in Course 3140).*

Extensive introduction to the theory and application of heavy current electrical engineering. Commences with the requisite circuit theory and then proceeds to consideration of the distribution of electrical power and the characteristics and selection of electrical machinery. DC power supplies, three-phase AC supply, voltage regulation, transformers, AC and DC machines and their rating; a project illustrating the application of electrical engineering to various aspects of industry. Consists of one 2-hour tutorial or laboratory sessions per week each commencing with a structured mini-lecture. Detailed lecture notes are provided.

**6.856 Electronics for Measurement and Control** **SS L2 T1**

The use of electronics in mechanical systems and the processing of signals by analog and digital techniques. Revision of basic circuit theory, operational amplifier circuits and filtering. Digital logic using integrated circuits. Microcomputers and Microprocessors. Techniques for A/D and D/A conversion, measurement system interfacing to microprocessors.

**6.902 Industrial Experience**

A minimum of three years of appropriate industrial experience must be obtained concurrently with attendance in Course 3650. Students are required to submit to the School evidence from their employers confirming completion of the prescribed period of industrial training.

**6.903 Industrial Training**

Students enrolled in courses 3640, 3725 and 3720 must complete a minimum of 60 days' industrial training. At least some of this must be obtained in Australia. Overseas employment must have prior approval. Students are required to submit to the School evidence from their employers confirming completion of the prescribed training and a report, typically 500 words long, summarising the work done and training received. Experience claimed as an industrial elective covers requirements for this subject.

**6.911 Thesis**

This is done in the last two sessions of the BE degree course. For full-time students, three hours per week in the first session, and twenty one hours per week in the second session are devoted to directed laboratory and research work on an approved subject under guidance of members of the lecturing staff. Part-time students may need to attend the University full-time in their final session or attend for one further part-time session, if facilities are not available for the thesis to be done at work. Generally, the thesis involves the design and construction of experimental apparatus together with laboratory tests. Each student is required to present a seminar, and a written thesis must be submitted on each project by the Tuesday of the fourteenth week of Session 1 or Session 2.

**6.921 Project**

The project is done in the final stages of the BSc(Eng) course. It involves the design and construction of experimental apparatus together with laboratory tests. Each student is required to present a seminar and submit a written report. The project should represent the equivalent of a minimum 100 hours of directed laboratory work. If facilities are not available for this to be done largely at work, students may need to attend the University full-time in final session, or attend for one further part time session.

**6.931 Industrial Elective**

**6.932 Industrial Elective**

**6.933 Industrial Elective**

*Prerequisites for 6.931, 6.932, 6.933: Students must be in at least the third stage of part-time BE degree course and be in full-time approved employment or be pursuing an approved sandwich course.*

Each Industrial Elective represents one year of appropriate quality concurrent industrial experience for students in approved full-time employment. Students must submit evidence and a written report to the satisfaction of the Head of School. Some attendance at the University for verbal reporting may also be required.

A maximum of three such electives can be taken and they may be substituted for certain subjects in course 3640 requirements. The substitution is not available for work done during the first year of employment if this coincides with the first year of part-time enrolment. The period of employment claimed must precede the completion of the thesis 6.911. An Industrial Elective cannot be claimed for work submitted for credit as 6.911 Thesis. Details of the procedure for registering and the requirements to be met can be obtained from the School of Electrical Engineering and Computer Science.

# Civil Engineering

**8.110 Computing and Graphics** **S1 L2 T1 S2 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.

**8.120 Engineering Mechanics** **F L2 T2**

*Co-requisite: 10.001.*

Two-dimensional concurrent and non-concurrent force systems. Equilibrium of particles and rigid bodies. Distributed forces: centre of gravity and centroid. Internal forces in structural members: shear and bending moment diagrams. Analysis of structures: trusses, frames and machines. Determinacy and constraints. Compatibility. Forces in cables. Properties of cross-sections. Concepts of stress and strain.

Dynamics of particles. Laws governing conservation of energy and momentum. Curvilinear motion and angular momentum. 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.

**8.130 Civil Engineering Practice** **S1 L2 T1 S2 L1.5 T0.5**

| *Prerequisite:* | *HSC Exam Score Range Required* |
|---|---|
| *2 unit English (General) or* | *53-100* |
| *2 unit English* | *49-100* |
| *3 unit English or* | *1-50* |
| 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.

**8.210 Systems Engineering** **S1 L1 T1 S2 L2 T1**

*Prerequisites: 10.001, 8.110. Co-requisite: 10.381.*

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.

**8.220 Engineering Mechanics 2** **F L2.5 T1.5**

*Prerequisite: 8.120*

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.

**8.230 Engineering Construction** **F L1.5 T0.5**

*Prerequisite: 8.130.*

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.

**8.240 Materials Engineering 1** **F L2.5 T1.5**

*Prerequisites: 8.120, 25.5112, 2.991. Co-requisite: 8.220.*

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.

**8.250 Hydraulics 1** **F L1 T1**

*Prerequisites: 10.001, 8.120.*

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.

**8.310 Engineering Computations** **F L1 T1**

*Prerequisites: 8.110, 10.022.*

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.

**8.320 Structural Analysis** **F L2 T1**

*Prerequisite: 8.220.*

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.

**8.330 Structural Design** **F L3 T1**

*Prerequisite: 8.220.*

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.

**8.340 Geotechnical Engineering 1** **F L2 T1**

*Prerequisites: 25.5112, 8.220.*

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. Theoretical and presumptive bearing capacity of shallow foundations. Allowable settlement and foundations on sand and rock. Laboratory work to compliment the lectures.

**8.350 Hydraulics 2** **F L2 T1**

*Prerequisite: 8.250.*

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.

**8.360 Engineering Management 1** **F L1.5 T.5**

*Prerequisites: 8.130, 8.210.*

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.

**8.370 Water Resources** **F L2 T1**

*Prerequisite: 10.381.*

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.

**8.380 Transport Engineering** **F L1 T1**

*Prerequisites: 8.210, 10.381.*

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.

**8.400 Industrial Training**

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.

**8.410 Engineering Management 2** **S1 L1.5 T0.5**

*Prerequisite: 8.360.*

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.

**8.420 Structural Engineering** **S1 L3 T1**

*Prerequisites: 8.320, 8.330.*

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.

**8.430 Engineering and the Environment** **S1 L2 T2**

*Prerequisite: 8.360.*

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.

**8.440 Materials Engineering 2** **S1 L3**

*Prerequisites: 8.240, 8.330.*

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.

**8.450 Geotechnical Engineering 2** **S1 L2 T1**

*Prerequisite: 8.340.*

Site investigation and selection of design parameters. Slope stability including simple models and methods of slices. Lateral earth pressures and retaining wall design. Single axially and laterally loaded piles, pile groups. Reactive soils, residential slabs and footings.

**8.460 Water Supply and Wastewater Disposal** **S1 L2 T1**

*Prerequisite: 8.250.*

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.

**8.470 Highway and Pavement Engineering** **S1 L2 T1**

*Prerequisites: 8.340, 8.380.*

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.

**8.481 Construction Major** **S2 L/T9**

Construction camp: a one week field camp involving several construction procedures and associated performance measurements. Construction planning and design: organisation, management and control to support the conduct of the construction camp. Advanced construction technology and construction management topics. Construction and/or management project.

**8.482 Geotechnical Major** **S2 L/T9**

Six topics selected from: Soil engineering. Rock engineering. Foundation engineering. Geotechnical engineering.

Advanced pavement design. Theoretical soil mechanics. Concrete technology.

**8.483 Structures Major** **S2 L/T9**

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

**8.484 Transport Major** **S2 L/T9**

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.

**8.485 Water Major** **S2 L/T9**

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.

**8.490 Project/Thesis** **S1 1S2 6**

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.

**8.6120 Civil Engineering for Electrical Engineers** **SS L2 T2**

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

**8.6140 Engineering for Surveyors 1** **SS L1.5 T1.5**

*Aspects of hydraulics:* Fluid properties, hydrostatics, motion of fluids, continuity, energy and momentum aspects, closed conduit flow and open channel flow. *Aspects of hydrology:* Scope and applications. Hydrologic measurements, rainfall analysis, storm rainfall-runoff relations, flood estimation. Urban drainage design.

**8.6150 Engineering for Surveyors 2** **SS L3**

Municipal engineering. Soil mechanics: Soil forming processes; pedological classification; engineering classification of soils; pavement design based on engineering classification; effective stress concept for saturated and unsaturated soils, shear strength, flow of water through soils, consolidation; slope stability and earth pressures. *Public utilities:* Relationship between urban development and each of water supply, wastewater and stormwater drainage, transport.

## Servicing Subjects

These are subjects taught within courses offered by other faculties.

**For further information regarding the following subjects see the Faculty of Applied Science Handbook.**

**8.6110 Structures** **S1 L1T2**

Theory of structures: Moduli of elasticity, simple stress and strain. Compound bars, temperature stresses. Thin shells. Stress at a point. Strain at a point. Principal stresses and strains. Relationship between load, shear force and bending moment. Moments of inertia, principal moments of inertia. Stresses due to axial force, bending moment, shear force, and torsion. Differential equations of simple beam theory. Deflection of beams. Statically indeterminate beams. Strain energy. Deflections at a single load. Shock loads. Theory of centrally loaded column and eccentrically loaded columns.

**8.6130 Properties of Materials** **F L1 T1**

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.

# Mathematics

**10.001 Mathematics 1** **F L4 T2**

| *Prerequisite:* | *HSC Exam Score Range Required* |
|---|---|
| *2 unit Mathematics* or* | *67-100* |
| *3 unit Mathematics or* | *1-50* |
| *4 unit Mathematics* | *1-100* |
| *or* | |
| *10.021B.* | |

*Excluded 10.011, 10.021B, 10.021C.*

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

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

**10.011 Higher Mathematics 1** **F L4 T2**

| *Prerequisite:* | *SC Exam Score Range Required* |
|---|---|
| *3 unit Mathematics* | *47-50* |
| *or* | |
| *4 unit Mathematics* | 1-100 |

*Excluded 10.001, 10.021B, 10.021C.*

As for 10.001 Mathematics 1 but in greater depth.

**10.021B General Mathematics 1B** **S1 L4 T2**

*Prerequisite:*

| | *HSC Exam Score Range Required* |
|---|---|
| *2 unit Mathematics* or* | *60-100* |
| *3 unit Mathematics or* | *1-5* |
| *4 unit Mathematics* | *1-100* |
| *or* | |
| *10.021A* | |

*Excluded 10.011, 10.001.*

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

Functions (and their inverses), limits, asymptotes, continuity; differentiation and applications; integration, the definite integral and applications; inverse trigonometric functions; the logarithmic and exponential functions and applications; sequences and series; mathematical induction; the binomial theorem and applications; introduction to probability theory; introduction to 3-dimensional geometry; introduction to linear algebra.

**10.021C General Mathematics 1C** **S2 L4 T2**

*Prerequisite: 10.021B. Excluded 10.001, 10.011.*

Techniques for integration, improper integrals; Taylor's theorem; first order differential equations and applications; introduction to multivariable calculus; conics; finite sets; probability; vectors, matrices and linear equations.

**10.0911 Discrete Mathematics for Electrical Engineers** **S1 L2 T1**

*Co-requisites: 10.001 or 10.011. Excluded: 10.081*

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.

**10.022 Engineering Mathematics 2** **F L2 T2**

*Prerequisite: 10.001.*

Differential equations, use of Laplace transforms, solutions by series; partial differential equations and their solution for selected physical problems, use of Fourier series; introduction to numerical methods; matrices and their application to theory of linear equations, eigenvalues and their numerical evaluation; vector algebra and solid geometry; multiple integrals; introduction to vector field theory.

**10.031 Mathematics** **F L1 T1**

*Prerequisite: 10.001 or 10.011 or 10.021C(CR).*

Note A: A unit, together with 10.032, which is available to Faculty of Science students as one of a sequence of two units constituting a terminating service course in mathematics. As such it is mutually exclusive to any other Level II or Level III unit in Pure and or Applied Mathematics except that 10.292A may be taken with 10.031 and 10.032.

Note B: Mathematics 10.031 is included for students desiring to attempt only one Level II Mathematics unit. If other Level II units in pure Mathematics or Applied Mathematics are taken, 10.031 Mathematics will not be counted. Differential equations, use of Laplace transforms, solutions by series, partial differential equations and their solution for selected physical problems, use of Fourier series; multiple integrals, matrices and their application to theory of linear equations, eigen-values; introduction to numerical methods.

**10.081 Discrete Mathematics** **S1 or S2 L4 T2**

*Co-requisite: 10.001 or 10.011.*

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.

**10.0331 Electrical Engineering Mathematics 3 Transform Methods** **S1 L1.5 T.5**

*Prerequisites: 10.111A, 10.1113, 10.1114, 10.2122. Exclusions: 10.412D. 10.422D and 10.4331.*

The mathematics of signals and linear systems. General Fourier series. Fourier, Laplace and related transforms Delta-distributions and others and their transforms. Discrete Fourier and Z-transforms. Applications to spectral analysis, autocorrelation, uncertainty and sampling, linear analog and digital filters, partial differential equations.

**10.033A Numerical and Mathematical Methods** **S2 L2.5 T1**

*Prerequisites: 10.111A, 10.1114, 10.2111. Excluded: 10.2112, 10.2212, 10.212A, 10.222A*

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 eigen values and eigenvectors. Mathematical Methods for Partial Differential Equations: Separation of variables methods, generalized Fourier series, Bessel functions, Legendre polynomials.

**10.111A Pure Mathematics 2 – Linear Algebra** **F L1.5 T1**

*Prerequisite: 10.001 or 10.011. Excluded 10.121A.*

Vector spaces, linear transformations and matrices, change of basis. Eigenvalues and eigenvectors, generalised eigenvectors. Functions of matrices. Linear systems of differential equations including the use of Laplace transform. Inner products, orthogonalisation, projections. Unitary and self-adjoint transformations. Quadratic and Hermitian forms.

**10.1113 Pure Mathematics 2 – Real Analysis** **S1 or S2 L1.5 T1**

*Prerequisite: 10.001 or 10.011. Excluded 10.1213.*

Multiple integrals, partial differentiation. Analysis of real valued functions of one and several variables.

**10.1114 Pure Mathematics 2 – Complex Analysis** **S1 or S2 L1.5 T1**

*Prerequisite: 10.001 or 10.011. Excluded 10.1214.*

Analytic functions, Taylor and Laurent series, integrals. Cauchy's theorem, residues, evaluation of certain real integrals.

**10.1115 Pure Mathematics 2 – Finite Mathematics** **S1 L1.5 T0.5**

*Prerequisite: 10.001 or 10.011*

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, factorisation, interpolation, finite field. Codes, error-correcting codes, public-key cryptography.

**10.1116 Pure Mathematics 2 – Automata and Algorithms** **S2 L1.5 T0.5**

*Prerequisite: 10.001 or 10.011.*

Finite automata, regular languages and Kleene's theorem. Analysis of fast algorithms for matrix, integer and polynimial manipulation, sorting, etc. Discrete and Fast Fourier Transform and applications.

**10.121A Higher Pure Mathematics 2 – Algebra** **F L2 T0.5**

*Prerequisite: 10.011 or 10.001 (CR) Excluded 10.111A, 10.1111.*

Linear algebra: vector spaces, commutative rings, polynomials, modules, linear transformations, eigenvectors, invariant subspaces, canonical forms, linear functions, bilinear and multi-linear algebra. Group theory; subgroups, quotient groups, isomorphisms. Lagrange's theorem, Sylow's theorem.

**10.1213 Higher Pure Mathematics 2 – Real Analysis** **S1 L2 T0.5**

*Prerequisite: 10.011 or 10.001 (CR). Excluded 10.1113.*

As for 10.1113 Pure Mathematics 2 – Multivariable Calculus but in greater depth.

**10.1214 Higher Pure Mathematics 2 – Complex Analysis** **S1 or S2 L2 T.5**

*Co-requisite: 10.1213. Excluded 10.1114.*

As for 10.1114 Pure Mathematics 2 – Complex Analysis, but in greater depth.

**10.2111 Applied Mathematics 2 – Vector Calculus** **S1 or S2 L1.5 T.5**

*Prerequisite: 10.001. Excluded 10.2211.*

*Properties of vectors and vector fields;* divergence, gradient, curl of a vector; line, surface, and volume integrals. Gauss' and Stokes' theorems. Curvilinear co-ordinates.

**10.2112 Applied Mathematics 2 – Mathematical Methods for Differential Equations** **S1 or S2 L1.5 T.5**

*Prerequisite: 10.001. Excluded 10.2212.*

Mathematical methods for ordinary and partial differential equations. Series solutions, numerical methods, separation of variables. Fourier series. Besser functions.

**10.2113 Applied Mathematics 2 – Linear Programming** **S1 L1.5 T.5**

*Prerequisite: 10.001. Co-requisite: 10.111A Excluded 10.2213.*

Mathematical modelling and solution techniques for linear optimization problems. Feasible regions, graphical methods, the standard problem, basic solutions, fundamental theorem, simplex and revised simplex methods, duality and the dual simplex method, sensitivity analysis, the transportation problem.

**10.2115 Applied Mathematics 2 – Discrete-Time Systems** **S2 L1.5 T.5**

*Prerequisite: 10.001. Co-requisite: 10.111A. Excluded 10.2215.*

The study of dynamical systems whose states change at discrete points in time. Difference equations: existence and uniqueness of solutions, general solution of linear equations. Linear systems: dynamics, stability, and oscillations, z-transforms, state-space methods. Nonlinear systems; equilibrium points, limit cycles.Applications selected from problems of importance in engineering, biological, social, management, and economic systems.

**10.2116 Applied Mathematics 2 – Continuous-Time Systems** **S2 L1.5 T.5**

*Prerequisite: 10.001. Excluded: 10.2216*

*The study of continuous dynamical systems.* One-dimensional systems, kinematic waves, applications to traffic flow and waves in fluids. Momentum equation for one-dimensional fluid flow, sound waves. Dynamics of a system of particles, oscillations. An introduction to the modelling of biological and ecological systems.

**10.2211 Higher Applied Mathematics 2 – Vector Analysis** **S1 L2 T.5**

*Prerequisite: 10.011 or 10.001 (CR). Excluded 10.2111.*

As for 10.2111 but in greater depth.

**10.2212 Higher Applied Mathematics 2 – Mathematical Methods for Differential Equations** **S2 L2 T.5**

*Prerequisite: 10.011 or 10.001 (CR) Excluded 10.2112.*

As for 10.2112 but in greater depth.

**10.2213 Higher Applied Mathematics 2 – Linear Programmimg** **S1 L1.5 T.5**

*Prerequisite: 10.011 or 10.001 (CR) Co-requisite: 10.111A. Excluded 10.2113.*

Not offered in 1990.

**10.2215 Higher Applied Mathematics 2 – Discrete-Time Systems** **S2 L1.5 T.5**

*Prerequisite: 10.011 or 10.001 (DN). Co-requisite: 10.111A Excluded 10.2215.*

Not offered in 1990.

**10.2216 Higher Applied Mathematics 2 – Continuous-Time Systems** **S2 L1.5 T.5**

*Prerequisite: 10.011 or 10.001 (CR). Excluded: 10.2116*

As for 10.2116 but in greater depth.

**10.311A Theory of Statistics 2 – Probability and Random Variables** **S1 L3 T1**

*Prerequisite: 10.001 or 10.011 or 10.021C (CR). Excluded 10.321A, 10.301, 10.331, 45.101.*

Probability, random variables, standard discrete and continuous distributions, multivariate distributions, transformations, random sampling, sampling distributions, limit theorems.

**10.311B Theory of Statistics 2 – Basic Inference** **S2 L3 T1**

*Prerequisite: 10.311A. Excluded 10.321B, 10.301, 10.331, 45.101.*

Point estimation: general theory, estimation by moments, maximum likelihood, interval estimation with general theory and application, hypothesis testing using Neyman Pearson theory, linear regression and prediction, analysis of variance.

**10.3111 Theory of Statistics 2 – Statistical Computing and Simulation** **S1 L1.5 T.5**

*Prerequisite: 10.001 or 10.011 or 10.021C(CR). Co-requisite: 10.311A.*

Introduction to APL, random variables, univariate transformation, simulation of random variables, APL programming, integer value random variables, random walks - theory and simulation, introduction to Markov chains.

**10.3112 Theory of Statistics 2 Nonparametric Statistical Inference** **S2 L1.5 T.5**

*Prerequisite: 10.311. Co-requisite: 10.311B.*

Order statistics, exact and approximate distributions, multinomial distributions, goodness of fit, contingency tables, one-sample and two-sample estimation and inference problems.

**10.3211 Higher Theory of Statistics 2 – Statistical Computing and Simulation** **S1 L1.5 T.5**

*Prerequisite: 10.001 or 10.011. Co-requisite: 10.321A.*

As for 10.3111 but in greater depth.

**10.3212 Higher Theory of Statistics 2 – Nonparametric Statistical Inference** **S2 L1.5 T.5**

*Prerequisite: 10.321A. Co-requisite: 10.321B.*

As for 10.3112 but in greater depth.

**10.321A Higher Theory of Statistics 2 – Probability and Random Variables** **S1 L3 T1**

*Prerequisite: 10.001 or 10.011. Excluded 10.311A, 10.301, 10.331, 45.101.*

As for 10.311A but in greater depth.

**10.321B Higher Theory of Statistics 2 – Basic Inference** **S2 L3 T1**

*Prerequisite: 10.321A. Excluded 10.311B, 10.301, 10.331, 45.101.*

As for 10.311B but in greater depth.

**10.331 Statistics** **SS F L1.5 T.5**

*Prerequisite: 10.001 or 10.021C (CR). Excluded 10.311A, 10.311B, 10.321A, 10.321B, 10.301, 45.101.*

An introduction to the theory of probability, with finite, discrete and continuous sample spaces. The standard elementary univariate distributions; binomial, Poisson and normal, an introduction to multivariate distributions. Standard sampling distributions, including those of ($^2$, t and F. Estimation by moments and maximum likelihood (including sampling variance formulae, and regression); confidence interval estimation. The standard tests of significance based on the above distributions, with a discussion of power where appropriate. An introduction to experimental design; fixed, random and mixed models, involving multiple comparisons and estimation of variance components.

**10.341 Statistics SU** **S1**

*Prerequisite: 10.001 or 10.011.*

For students in the School of Surveying.

Introduction to probability theory, random variables and distribution functions, sampling distributions, including those of t, chi$^2$ and F. Estimation with an emphasis on least squares and surveying problems, and computer based exercises.

**10.351 Statistics SM** **F L1.5 T.5**

*Prerequisite: 10.001 or 10.011.*

For students in Aeronautical, Industrial and Mechanical Engineering and Naval Architecture.

Introduction to probability theory, with finite, discrete and continuous sample spaces. Random variables: the standard elementary distributions including the binomial, Poisson and normal distributions. Sampling distributions: with emphasis on those derived from the normal distribution: t, (chi$^2$ and F. Estimation of parameters: the methods of moments and maximum likelihood and confidence interval estimation. The standard test of statistical hypotheses, and, where appropriate, the powers of such tests. An introduction to regression and the bivariate normal distribution.

**10.361 Statistics SE** **F L1.5 T.5**

*Prerequisite: 10.001 or 10.011.*

For students in the School of Electrical Engineering.

Introduction to probability theory, random variables and distribution functions; the binomial, Poisson and normal distributions in particular. Standard sampling distributions, including those of (chi2 and t. Estimation by moments and maximum likelihood; confidence interval estimation. The standard tests of significance based on the above distribution with a discussion of power where appropriate.

An introduction to linear regression, auto-regression. Probability limit, law of large numbers and central limit theorem. Multivariate normal distribution. Stochastic processes in discrete and continuous time: Poisson and Gaussian processes.

**10.381 Statistics SC** **S1 or S2 L1.5 T.5**

For students in the School of Civil Engineering.

Introduction to probability. Random variables. Elementary distribution. Statistical inference. Point estimation. Confidence intervals.

## Accounting

**14.001 Introduction to Accounting A** **S1 L1.5**

*Architecture: 2 credit points compulsory for BBuild degree course students.*

*Prerequisite: Nil.*

An introduction for non-commerce students to the nature, purpose and conceptual foundation of accounting. Information systems including accounting applications. Analysis and use of accounting reports.

**14.002 Introduction to Accounting B** **S2 L1.5**

*Architecture: 2 credit points; compulsory for BBuild degree course students.*

*Prerequisite: 14.001.*

An introduction for non-commerce students to managerial accounting. Long-range planning, budgeting and responsibility accounting: cost determination, cost control and relevant cost analyses.

**14.501 Accounting and Financial Management 1A** **S1 or S2 L2 T2.5**

*Prerequisite: Nil.*

The basic concepts of financial model building and information systems, including the double-entry recording system, the accounting cycle, income measurement and financial reporting, and an introduction to basic elements of auditing.

## Industrial Engineering

Industrial Engineering is a Department within the School of Mechanical and Industrial Engineering.

**18.003 Numerical Methods 1 Industrial Experimentation** **S1 L1 T.5 S2 L1.5 T.5**

*Prerequisites: 5.0721 or 5.5010, 10.022, 10.351.*

*Numerical methods:* numerical solution of systems of linear and non-linear equations. Numerical interpolation, differentiation and integration. *Industrial experimentation:* planning experiments. Common probability distribution. Experiments of comparison. Accelerated life testing. Analysis of variance. Correlation and regression.

**18.004 Manufacturing Management** **S1 L2 T2**

*Prerequisites: 14.001, 14.002, 18.503, 18.603.*

Production control: modes of manufacture; information flow in multi-stage production systems; classical production and inventory models and control techniques; material requirements planning; just-in-time production; flexible manufacturing systems and their control. *Quality control:* sampling inspection, economic aspects, control charts, management of QC. Project control: critical path scheduling, PERT. Computers in manufacturing management: systems design.

**18.091 Industrial Management** **S1 L/T5**

*Prerequisites: 10.2112, 10.361.*

This subject is intended primarily for Electrical Engineering students.

Engineering economy: economic objectives of the firm. *Economic measures of performance:* net present value, annual equivalent value and the DCF rate of return (including the incremental rate of return) and their application in the selection and replacement of processes and equipment. *Introduction to operational research:* The formation and optimisation of mathematical models of industrial processes. The development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queuing theory, inventory models, simulation, critical path networks. *The use of human and physical resources:* Methods engineering, ergonomics, motion and time study, financial incentives, applications to machine controlled processes, work sampling and data collection. Plant location, factory layout. *Production and quality control:* Control of jobbing, repetitive batch and continuous production. Manufacturing organisations, functions, inter-relationships and information flow. Sampling techniques in quality control, control charts. *Introduction to inventory control:* Analysis of some engineering planning decisions.

**18.224 Numerical Control of Machine Tools** **S1 L2 T1**

*Prerequisite: 5.0721 or 5.5010. Excluded 18.260G.*

Overview of numerical control systems; machine specification and selection; manual part programming; process planning and sequencing; selection of operating conditions; work holding devices and tooling; introduction to computer assisted part programming.

**18.303 Methods Engineering** **F L1 T1**

*Prerequisite: 10.351.*

Aims: Historical development, measurement of productivity. *Methods study:* motion economy, ergonomics, man-machine relationships. *Factory environment:* layout, conditions, safety. *Work measurement:* purposes, time study, fatigue, human work capacity, predetermined motion time systems, regression methods, work sampling. *Human factors:* motivation to work, job satisfaction, socio-technical systems, incentive plans. *Laboratory:* exercises in work measurement, workplace design, ergonomics.

**18.403 Production Design and Technology** **F L2 T2**

*Prerequisites: 5.4220, 5.4222, 10.351.*

Basic metrology and tolerancing, introduction to plasticity theory and its application to theories for machining and forming, economics of production processes; interaction of machines and tools; principles of process selection; review of major processes, interaction of design, production quantity, materials and processes; value analysis.

**18.404 Design for Production** **F L1 T1**

*Prerequisite: 5.123 or 18.413.*

Product design, development and manufacture important in the manufacturing industry. Includes industrial design, patents

law, product liability, product reliability, safety standards and regulations, process and operation planning, advanced production aids and jig and fixture design, advanced measuring inspection and gauging methods, quality control methods and systems.

**18.413 Design for Industrial Engineers** **S1 L1 T1 S2 L1 T2**

*Prerequisites: 5.122, 5.4220, 5.4222.*

Tooling design. Production aids. Fluid power systems. Introduction to fatigue in design. Design analysis for manufacture; component design and drawing with individual and group projects of an interdisciplinary nature. (Some material taken with 5.123 Mechanical Engineering Design 3).

**18.503 Operations Research A** **F L2 T1**

*Prerequisites: 5.0721 or 5.5010, 10.022, 10.351. Co-requisite: 18.803. Excluded 6.646.*

History and overview of operations research. Decision theory. Methodology; identification and formulation of the problem; construction of a model, obtaining solutions; testing the model and implementing the solution. Case study.

**18.551 Operations Research** **F L2 T1**

*Prerequisites: 5.0721 or 5.5010, 10.022, 10.351. Excluded 6.646.*

The formulating and optimisation of mathematical models. The development of decision rules. Some techniques of operations research such as mathematical programming, queuing theory, inventory models, replacement and reliability models; simulation. These techniques applied to situations drawn from industrial fields, eg production planning and inventory control. Practical problems of data collection, problem formulation and analysis.

**18.603 Management/Economics** **F L/T2**

*Prerequisite: 5.0721 or 5.5010.*

Introduction: objectives of a company, measures of performance, need for economic decisions. *Cost information:* sources of costs, fixed and variable, overheads, break-even analysis. *Engineering economics:* time value of money. Derivation and use of interest formulae. Evaluation of alternatives, annual and present equivalents. D.C.F. rate of return. The minimum acceptable rate of return. Capital budgeting. Replacement studies. Risk and uncertainty. *Management:* objectives of an organisation; definition and functions of management. Development of management thought; interactions between organisations and their environment. The management functions of planning, organising, leading and controlling; management and computers.

**18.803 Optimisation** **S1 L2 T1**

*Prerequisite: 10.022. Excluded 5.1245.*

Optimisation in one dimension. Conditions for optimality in n dimensions. Linear programming: problem formulation, solution by the simplex method, duality and post optimality analysis. The transportation algorithm. Dynamic programming. Unconstrained and linearly constrained non-linear programming. Geometric programming.

## Servicing Subjects

These are subjects taught within courses offered by other faculties.

For further information regarding the following subjects see the Faculty of Applied Science Handbook.

**18.121 Production Management** **F L2 T1**

*Prerequisites: 10.031, 10.331.*

Engineering economy: Economic objectives of the firm. Economic measure of performance: net present value, annual equivalent value and the DCF rate of return (including the incremental rate of return) and their application in the selection and replacement of processes and equipment. *The use of human and physical resources:* Methods engineering, ergonomics, motion and time study, financial incentives, applications to machine controlled processes, work sampling and data collection. Plant location, factory layout. *Production and quality control:* Control of jobbing, repetitive batch and continuous production. Manufacturing organisations, functions, inter-relationships and information flow. Sampling techniques in quality control, control charts. *Introduction to inventory control:* Analysis of some engineering planning decisions. *Introduction to operational research:* The formation and optimisation of mathematical models of industrial processes. The development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queuing theory, inventory models, simulation.

**18.1211 Production Management A** **S1 L3**

*Prerequisites: 10.031, 10.331 or 10.021B, 10.021 C, 13.200.*

Use of human and physical resources: Methods engineering, ergonomics, motion and time study, financial incentives, applications to machine controlled processes, work sampling and data collection. Plant location, factory layout. *Production and quality control:* Control of jobbing, repetitive batch and continuous production. Manufacturing organisations, functions, inter-relationships and information flow. Sampling techniques in quality control, control charts. *Introduction to inventory control:* Analysis of some engineering planning decisions.

**18.1212 Production Management B** **S2 L3**

*Prerequisites: 18.1211.*

Engineering economy: Economic objectives of the firm. Economic measure of performance: net present value, annual equivalent value and the DCF rate of return (including the incremental rate of return) and their application in the selection and replacement of processes and equipment. *Introduction to operational research:* Formation and optimisation of mathematical models of industrial processes. Development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queuing theory, inventory models, simulation.

**18.131 Operations Research**

Introduction to operational research: The formation and optimisation of mathematical models of industrial processes.

The development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queuing theory, inventory models, simulation.

## Information Systems

**19.605 Information Systems Implementation S2 L2 T1**

*Prerequisite: 19.603.*

Supervised implementation of an information systems project in a commercial programming language. Advanced program design and structured techniques, interface with systems software at application implementation level, comparison of a range of programming languages, test data specification, implementation procedures.

## Applied Geology

**25.5112 Geology for Civil Engineers 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 engineering

## Geography

**27.010 Land Studies S1 L2 T2**

*Excluded: 26.424, 27.818.*

Concepts, significance and problems of land. Land as territory and land as resource in Australia. Constraints imposed by the physical environment on human occupancy and settlement patterns, the variety of conflicts that result and management strategies. Practical work involves study of the ways in which the attributes and characteristics of land are displayed on maps, air photos and satellite imagery, and introduces these as basic information sources and research tools in applied geography.

**27.030 Environmental Processes S2 L2 T2**

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, alterations to and movement of materials.

**27.133 Pedology S2 L2 T3**

*Prerequisites: 27.030 or 27.818 and one of 2.121, 2.131 or 2.141 or both 25.110 and 25.120 or both 17.031 and 17.041.*

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, emphasising clay-mineral structure and behaviour, soil solution chemistry, soil water movement and the application of these properties to elements of soil mechanics. Soil properties in natural, rural and urban landscapes, including assessment of soil fertility, swelling characteristics, dispersibility, erodibility and aggregate stability. Laboratory analysis of soil physical and chemical characteristics with emphasis on properties associated with land capability assessment. Statistical analysis of soil data and its application to mapping. The use of soil micromorphological and mineralogical studies in pedology.

**27.143 Biogeography S1 L2 T3**

*Prerequisites: 27.030 or 27.818 or both 17.031 and 17.041.*

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.

**27.175 Introduction to Remote Sensing S1 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.

**27.176 Remote Sensing Applications S2 L2 T2**

*Prerequisite: 27.175 or 29.8710.*

Spectral characteristics of natural phenomena and image formation. Ground truthing, collection and calibration. Introduction to computer classification procedures. Multitemporal sampling procedures, image to image registration and map to image registration. Major applications of remote sensing in the investigation of renewable and non-renewable resources to include: soils, geology, hydrology, vegetation, agriculture, rangelands, urban analysis, regional planning, transportation and route location and hazard monitoring.

**27.183 Geomorphology S2 L2 T3**

*Prerequisites: 27.030 or 27.818 or 25.120.*

Hillslope materials, processes and form; models of slope and landscape evolution. Fluvial geomorphology including water

movement and sediment transport in river channels, hydraulic geometry, channel patterns, river types, flood plain formation, alluvial fans, river channel changes. Erosional and depositional landforms in coastal, arid, humid and glacial environments. Field work in fluvial and hillslope geomorphology, and laboratories on field measurements of geomorphic processes, sediment analyses and airphotograph interpretation.

**27.193 Environmental Impact Assessment** **S1 L2 T2**

*Prerequisites: 27.030 or 27.818 or by permission of Head of School.*

Rationale and basic objectives; standardised types of environmental impact assessment (EIA), including matrix approach, adopted methods of EIA in Australia. Frequently used assessment and predictive techniques for meteorological, hydrological, biological, socio-economic impacts. Techniques of impact evaluation in terms of socio-economic criteria. Environmental decision making and planning under conditions of uncertainty. Case studies exemplifying procedures, techniques and issues. Trends, changes and possible future developments in EIA. Practical exercises representing components of typical EIAs.

**27.213 Soils and Landforms** **S1 L2 T2**

*Prerequisite: 27.133 or 27.183 or 27.828.*

Organisation of soil material: stratigraphic layers versus profiles. Models of soil formation zonal, leaching and landscape approaches. Australian and international soil classification systems. Soil development on hillslopes: texture contrast soils. Floodplain landforms: river terraces and chrono-sequences. Litho-and chrono-stratigraphic use of soils in residual aeolian, fluviatile and coastal deposits.

**27.223 Environmental Change** **S1 L2 T2**

*Prerequisite: Successful completion of 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.

**27.862 Australian Environment and Natural Resources** **S1 L2 T2**

*Prerequisite: 27.183 or 27.828.*

Continental and regional patterns of land, water and energy resources in Australia and its territorial waters, and natural factors affecting their development, including climate, soils and terrain; problems of limited surface and underground water resources and of conflicting demands, exemplified through particular basin studies; comparable reviews of energy, minerals and forest resources, human resources and development.

## Surveying

Note: Electronic Calculators.
Students enrolled in the surveying courses are required to equip themselves with an electronic calculator. Advice on the purchase of this equipment is given to students at the commencement of their course.

**29.1111 Introduction to Computing** **S1 L2 T2**

Revision of plane trigonometry and co-ordinate systems. Join, polar, area calculations using hand calculators. Spherical trigonometry. Principles of calculation; representation of numbers, round-off errors, significant figures, orders of magnitude. Introduction to computers; computer hardware, computer software, operating systems, programs. Program design and documentation. Introduction to FORTRAN; constant types, data elements, selection control, loop control, input and output, program modules.

**29.1711 Introduction to Surveying** **F L1.5 T.5**

Historical development of surveying. Principles of survey observations and the control of observation errors. Introduction to geodetic positioning, photogrammetry and remote sensing; cadastral surveying and land information management; engineering, mining, geophysical and hydrographic surveying; mapping. Discussion of the purpose, methods and products of these surveying disciplines. Survey data; structures, collection, storage, processing and presentation. The key values of the surveying profession. The profile and role of a surveyor in practice; knowledge, skill management and professional ethics. Current and future challenges of the changing surveying profession.

**29.2041 Survey Data Presentation** **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.

**29.2111 Principles of Computer Processing** **S2 L2 T2**

*Co-requisite: 29.1111.*

Operating systems; VAX/VMS, MS-DOS, command languages. Third party software; word processing, spreadsheets, compilers. Program structure; subroutines, functions, control structures. Program libraries; creation, system libraries. Data structures; organisation types, structures, arrays, stacks, lists, queues, trees. Data files; types and organisations. Sorting, searching, merging. Data bases; concepts, types, information access.

**29.2221 Introduction to Geodetic Science** **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.

**29.3011 Surveying Instruments** **S1 L2.5 T1.5**

*Prerequisite: 29.1111.*

Survey tapes and bands; measurement, calibration, reductions. Levelling instruments; principles, construction, testing and adjustment, ancillary equipment. Optical and electronic theodolites; principles, construction, testing and adjustment.

**29.3111 Survey Computations** **S1 L2 T1**

*Prerequisite: 29.2111.*

Intersection, resection, trilateration, with and without redundant data, semigraphic solutions. Missing data problems, road intersections. Subdivision calculations. Transformations. Traverse computations, algorithm development of Bowditch's traverse adjustment. Computer communications, hardware and software standards, file transfer, protocols.

**29.3231 Geodetic Computations** **S1 L2 T1**

*Prerequisite: 29.2221. Co-requisite: 10.022.*

Principles of map projections. Surveying and mapping projections; transverse Mercator projection. Geometry of the ellipsoid; ellipsoidal computations. Corrections to field observations; arc-to-chord, scale factor and grid convergence.

**29.4011 Surveying Techniques** **S2 L4.5 T1.5**

*Prerequisite: 29.2041. Co-requisite: 29.3011, 29.3111.*

Principles, reduction of observations and errors in survey techniques of levelling, horizontal and zenith angle measurement, trigonometric heighting, traversing, vertical staff tacheometry. Electronic distance measurement; principles, corrections, reductions, calibration, electro-optical distance meters.

**29.4051 Survey Camp 1** **S2 T3**

*Co-requisite: 29.3011, 29.4011.*

Theodolite and steel band traverse between control points. Contour survey by stadia. Line levelling. Setting out with theodolite and steel band. Calibration of electronic distance meter.

**29.4111 Data Analysis and Computing 1** **S2 L2 T1**

*Prerequisite: 29.2111. Co-requisite: 29.3111.*

Least squares theory; modelling of observations; general, parametric and condition methods. Solution of equations and inverses. Treatment of singular equations and datum problems. Law of propagation of variances. Statistical testing; confidence intervals, error ellipses. Applications in surveying, geodesy, photogrammetry and other sciences. Software design and coding for least squares analysis. Use of personal computers.

**29.4221 Geodetic Positioning 1** **S2 L2 T1**

*Prerequisite: 29.2221. Co-requisite: 29.3231.*

Review of reference systems in classical positioning. Introduction to positional astronomy; determination of azimuth from sun and close circumpolar stars. Design, establishment and measurement of geodetic control networks. Latitude, longitude, azimuth, geoid determinations. Geodetic levelling; datum and methods. Geodetic data bases.

**29.441 Surveying for Engineers** **S2 L2 T2.5**

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.

**29.4721 Project Management 1** **S2 L1.5 T.5**

Types of business. Organisational and management principles. Goals, strategies and actions. Phases of a project: feasibility study, pilot project, contract work, final report, and control. Principles of project management: organisation, management, planning responsibilities, information, control. Communication: meeting, negotiation, conflict, dialectic for managers.

**29.491 Survey Camp**

A one-week field camp for students studying 29.441 Surveying for Engineers.

**29.5011 Engineering Surveying** **S1 L3.5 T.5**

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.

**29.5111 Data Analysis and Computing 2** **S1 L2 T1**

*Prerequisites: 10.022, 10.341. Co-requisite: 29.3111.*

Applications of least squares analysis in surveying, geodesy and photogrammetry. Statistical testing. Detection of outliers. Use of software packages. Software design and optimisation.

**29.5221 Geodetic Positioning 2** **S1 L2 T1**

*Co-requisite: 29.4111.*

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.

**29.5621 Cadastral Surveying 1** **S2 L2 T1**

The legal system in Australia and NSW; the nature of land law including land tenure, estates in land, interests inland. Land title systems. Land administration in Australia and NSW. Boundary surveying principles. Cadastral mapping in NSW.

**29.5721 Project Management 2** **S1 L1.5 T.5**

*Co-requisite: 29.4721.*

Aims and forms of project organisation. Preparation of contracts and specifications: contract law, subcontracting, contract work, bidding. Project scheduling, control and documentation. Management of the project resources. Budgeting (financial, personnel, equipment), personnel

planning. Financial management reporting, accounting systems, cash flow, cash flow analysis.

**29.6051 Survey Camp 2** **T4**

*Prerequisite: 29.4051. Co-requisite: 29.5011.*

One week survey project of substantial extent, followed by one hour per week computations, plan and report preparation at the School of Surveying.

**29.6121 Computer Graphics** **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.

**29.6511 Photogrammetry and Mapping I** **S1 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.

**29.6621 Cadastral Surveying 2** **S2 L2 T1**

*Co-requisite: 29.5621.*

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.

**29.6721 Project Management 3** **S2 L1.5 T.5**

*Co-requisite: 29.5721.*

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.

**29.6811 Land Economics and Valuation** **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.

**29.7010 Surveying 7** **S1 L3.5 T1**

*Co-requisite: 29.6010.*

Introduction to hydrographic surveys. Echo sounding; theory and practice. Visual fixing by transits, theodolite and sextant. Electronic position fixing; hyperbolic, range-range and satellite systems. Theory of tides. Tidal streams and currents. Tidal datums. Sweeping and searching. Statistical testing of observations. Multi-sample variance analysis. Correlated observations. Linear regression and prediction.

**29.7050 Survey Camp** **S1**

*Prerequisites: 29.5010, 29.6010, 29.5110, 29.5220, 29.5230 29.6220, 29.6610.*

Cadastral surveying including astronomic observations for azimuth, land use survey including air photo and Landsat imagery interpretations. Photo control survey by traverse and resection, precise traverse and heighting with EDM. Preparation of reports based on filed tasks completed.

**29.7120 Computer Graphics** **S1 L1 T1**

*Prerequisite: 29.3110.*

Computer graphics, especially in relation to computer assisted mapping and draughting. Acquisition, processing and presentation of data; graphics programming using a high level language and a graphics language; use of interactive graphics display terminals and plotters.

**29.7220 Geodetic Computations** **S1 L2 T1**

*Prerequisites: 29.5110, 29.5230.*

Elements of geodetic methodology; classes of mathematical models. Least squares solution of overdetermined models; assessment of results. Adjustment of control surveys. Solution of direct and inverse geodetic problems.

**29.7510 Photogrammetry 2** **S1 L2.5 T1.5**

*Prerequisite: 29.6510.*

Analytical methods of relative and absolute orientation. Principles of analytical plotters. Map compilation by photogrammetric techniques. Map production. Differential rectification, orthophotos and mosaics. Map revision. Principles of aerial triangulation. Project planning; costs, scheduling, specifications, capabilities of photogrammetric production.

**29.7810 Land Management and Development 3** **S1 L1 T1**

*Prerequisite: 36.411.*

Design and studio project for a residential neighbourhood development. Constraint and site analysis; preparation of maps of land use, vegetation, surface and soils, drainage and terrain, slopes, climate and aspect; composite overlay maps. Structure plan design: residential precincts, schools commercial areas, industrial areas, active and passive recreation, pedestrian ways and road hierarchy.

**29.8010 Surveying 8** **S2 L3 T2**

*Prerequisite: 29.5010.*

Calibration of linear scales. Principles and practice of autocollimation. Theodolite attachments. Setting out of large structures. Gyro-theodolite. Underground surveys. Plumbing of shafts and high structures. Azimuth and height transfer.

**29.8220 Global Geodesy** **S2 L2 T.5**

*Co-requisite: 29.7220.*

Astro-geodetic methods. Gravimetric geodesy. Space geodetic methods. Combined methods. Variations of geodetic positions with time. Geophysical applications.

**29.8510 Photogrammetry 3** **S2 L2 T1**

*Co-requisite: 29.7510.*

Analytical methods in photogrammetry. Aerial triangulation block adjustment by models and bundles. Control requirements, accuracies of aerial triangulation. Camera calibration. Application in non-topographic methods using metric and non-metric systems. Digital elevation models. Computer assisted mapping techniques in photogrammetry.

**29.8710 Seminar** **S2 L1 T.5**

*Prerequisite: 29.4710.*

Introduction to characteristics of effective speaking. Oral presentation by individual students on topics in selected areas of surveying. Participation in colloquia by invited speakers on current topics in surveying. Student assessment of degree course.

**29.8720 Management** **S2 L2**

Introduction to business management. Types of business. Financial accounting methods and interpretation of financial statements; finance and financial planning for small business. Principles of management and organisation. Professional responsibilities. Management records. Managing people in small business.

**29.8810 Land Management and Development 4** **S2 L1 T1**

*Prerequisites: 8.6140, 8.6150. Co-requisite: 29.7810.*

Continuation of design and studio project for a residential neighbourhood development. Plan of detailed lot layout: consideration of access, grades, drainage reserves, parks and pedestrian ways. Engineering design and plans: catchment details, road longitudinal and cross-sections, drainage layout, flow schedule, hydraulic grade line calculations, longitudinal sections of kerb profiles.

**29.9010 Advanced Surveying Instruments** **S1 or S2 L2 T1**

*Prerequisites: 29.5010, 29.6010.*

Electronic tacheometers: types, construction, circle reading devices, on-line correction of instrument errors. Data storage mediums, data transfer between tacheometer and recorder and between recorder and computer. Electronic field books. High performance gyroscopic theodolites: construction, measuring process and accuracy. Two-colour and high precision electronic distance meters: principle, operation, calibration, accuracy. Microwave distance meters: new developments, ground-swing problem, measuring techniques, calibration. Long range EDM: measurement techniques, calibration of instruments.

**29.9020 Hydrographic Surveying** **S1 or S2 L1 T2**

*Prerequisite: 29.7010.*

Practical training: a hydrographic survey requiring establishment of horizontal and vertical shore control, preparation of plotting sheets, control marking, bathymetry, equipment calibration, tidal observations and reduction, inking in. Other navigational equipment. Nature of seabed, wind waves, the survey report. Discussion on practical surveying tasks or topics of current interest. Harmonic analysis of tidal data.

**29.9030 Precise Engineering Surveying S1 or S2 L2 T1**

*Prerequisites: 29.5010, 29.6010.*

Review of survey problems in industry and engineering. Surveys for large structures – location, setting out and control during construction, monitoring of deformation and settlement: high precision mechanical, optical and electronic equipment for distance measurement, levelling, horizontal and vertical alignment, local deformation. Network design, station marking, observation techniques, data presentation, deformation and settlement analysis including free network solutions. Close-range surveys: optical tooling, laser interferometry. Positioning and alignment of machine components, optical positional constraints, scale and azimuth control.

**29.9090 Project** **S1 or S2 T3**

*Prerequisite: High standard in the chosen topic area normally required; permission of project supervisor.*

Theoretical or practical investigation of a selected topic under the guidance of a supervisor, with a report of a high academic standard required. Topic may be one suggested by the School or by the individual student based on his or her experiences.

**29.9210 Adjustments of Control Networks** **S1 or S2 L1.5 T1.5**

*Prerequisite: 29.7220.*

Adjustment of control surveys on the ellipsoid. Statistical evaluation of the adjustment. Detection of outliers. Design and optimisation of networks. Requires use of School computer program library.

**29.9220 Advanced Geodetic Positioning S1 or S2 L2 T1**

*Prerequisite: 29.5220.*

Precise aspects of terrestrial and extraterrestrial reference frames; units, constants, coordinate systems and transformations used in satellite positioning; modelling of measurements. Orbit determination. Positioning with GPS; field procedures. Inertial surveying systems: inertial frame; sensors; mathematical and error models; filtering and smoothing processes; post-mission adjustment techniques; inertial positioning methods and applications.

**29.9510 Computer Assisted Mapping** **S2 L2 T1**

*Co-requisite: 29.7510.*

Introduction to principles of Computer Assisted Mapping. Collection and editing of feature coded digital terrain data in vector and raster form. Digital elevation models. Automation of mapping procedures. Mapping systems based on computers.

**29.9520 Remote Sensing Principles S1 or S2 L1.5 T1.5**

*Prerequisite: 29.4520.*

Definition and physics of basic electromagnetic quantities, atmospheric effects, photographic film images and sensors, thermal infra-red sensing, radar, radar sensing, electro-optical sensors. Choice of sensor and data processing. Remote sensing project.

**29.9530 Land Information Systems** **S1 or S2 L2 T1**

Land information systems and computer-assisted mapping; land information as maps and records; computerisation of land information; data acquisition from ground surveys, aircraft and satellite mounted sensors; data acquisition from maps and air photographs; data storage methods; data structures; data proc- essing, transformations, searching, sorting; data base management systems; interactive graphical editing; data output including computer plotters and software packages; cartographic presentation; an examination of existing systems in Australia and overseas.

**29.9610 Modern Cadastral Concepts** **S1 or S2 L2 T1**

*Prerequisite: 29.6610.*

An analysis of the operation and components of a modern cadastral survey system, especially the relationship between title, conveyancing, surveying and mapping. Components of land tenure and cadastral systems; statewide parcel based land information systems; cadastral models. Horizontal and vertical subdivision, trends in group housing in Australia and overseas, ownership alternatives including strata titles, management of strata schemes, the development process related to strata subdivision.

**29.9910 Special Topic in Surveying A** **S1 or S2 L2 T1**

A special subject to be lectured on by visiting professors or other visiting staff. Details of syllabus and lecturer to be communicated to Faculty on each occasion when the subject runs.

**29.9920 Special Topic in Surveying B** **S1 or S2 T3**

A special subject taken by a group of students by private study in conjunction with tutorial sessions with the members of staff in charge of the subject.

## Servicing Subjects

These are subjects taught within courses offered by other faculties.

**For further information regarding the following subjects see the Faculty of Architecture Handbook.**

**29.411 Surveying for Builders** **S1 L1 T1.5 C2**

A compulsory subject. Prerequisites: nil.

Introduction. Chaining, methods of measurement, corrections, chain surveys. Level, differential levelling, booking. Contours, volumes of earthworks. Theodolite, methods of reading angles, applications in building. Traversing, setting out.

**29.441 Surveying for Engineers** **S2 L2 T2.5**

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.

**29.491 Survey Camp**

A one-week field camp for students studying 29.441 Surveying for Engineers.

**29.901 Introduction to Mapping** **S1 L1 T.5**

Mapping: map types, map reading, scale, relief, depiction of features, cartography and photogrammetry. *Remote Sensing:* cameras and other sensors. Landsat images and applications. *Cadastral surveying:* land titles, surveys, easements and covenants.

# Town Planning

**36.411 Town Planning** **S1 L2**

*Architecture prerequisite: 11.4308 and 100 credit points.*

Introduction to the purpose, scope and application of planning. The urban planning process. Objectives and means of planning cities. Levels of planning and types of plans: state environmental policies, regional environmental plans, local environmental plans. Problems in planning: equitable distribution of resources. Environment and environmental impact statements. Planning law and administration. Future of cities.

# Chemical Engineering and Industrial Chemistry

**48.302 Fuels and Energy** **S2 L2 T2**

A servicing subject for students in Electrical Engineering which deals with sources and properties of fuels (with particular emphasis on coal, crude oil and natural gas), principles of combustion including combustion calculation and the technology of boilers and other fuel plant. Other energy sources including solar energy and nuclear energy are discussed. The national and global situation is reviewed

**48.403 Polymer Science** **F L2 T1**

*Prerequisites: 2.102A, 2.102B, 10.031, 10.301. Co- or prerequisites: 48.001, 48.113.*

Polymerisation processes; step growth and chain growth (free radical and ionic), stereospecific catalysts. Methods of polymerisation: bulk suspension, emulsion, solution, high pressure. Industrial examples. Principles of analysis of polymers using chemical and instrumental methods. Molecular weight applied to macromolecules: number-, weight-, viscosity and z-average weights. Molecular weight distribution. Thermodynamics of polymer solutions, theta solvent. Measurement of molecular weight. Fractionation methods. Conformation of a polymer chain. The crystalline state. The amorphous state. Stress strain behaviour. Creep. Impact. Rubber elasticity. Dynamic mechanical properties. Principles of operation of polymer processing equipment; safety procedures. Polymer compound design.

## Anatomy

**70.011C Introductory Anatomy** **S1 L2 T4**

*Prerequisites: 17.031, 17.041.*

Introduction to gross anatomy, based on a study of prosected specimens. Musculoskeletal, cardiovascular, respiratory, gastrointestinal, genitourinary and nervous systems. General topographical and surface anatomy.

## Physiology and Pharmacology

**73.111 Physiology 1** **F L2 T4**

**Prerequisites: 2.241 or 2.221 and 1.001 or 2.221 and 1.021 (see notes below) 10.001 or 10.001 or 1.021B and 10.021C, 17.041. Excluded: 73.121, 73.011. Co-requisite: 41.101*

Introduction to fundamental physiological principles, dealing first with basic cellular function in terms of chemical and physical principles, and, second, with the operation of the various specialised systems in the body, for example, the cardiovascular system, whose function it is to transport materials to and from the tissues of the body; the respiratory system which must maintain the exchange of oxygen and carbon dioxide between the atmosphere and the blood; the gastrointestinal system which enables food materials to be modified by digestion and absorbed into the circulation; the kidney which is involved in the regulation of body fluid and electrolyte balance and with the excretion of the waste products of metabolism; the endocrine system which releases chemical messengers, called hormones, that are carried in the blood stream to regulate a great variety of body functions, eg metabolism and reproductive activity; the nervous system which by means of very rapidly propagated electrical impulses is responsible for all our movements, sensations, memories, emotions and consciousness itself. A substantial series of practical class experiments on these different areas of physiology is included in the course. This subject is taken by students enrolled in any of the Physiology program.

*In exceptional cases Chemistry 1T will be accepted as prerequisite in the absence of Physics 1 with the permission of the Head of School. Students intending to major in Physiology and/or Pharmacology should note Physiology 11 prerequisites.

## Law

**90.502 Industrial Safety and Health Law** **S1S2 Hpw4 C3**

The law relating to compensation for work-related injuries and disabilities and to the regulation of safety standards in industry and of the processes and substances employed therein. Topics include: the employer's common law duty of care; the development and application of workers' compensation schemes; comprehensive no-fault compensation schemes and inquiries relating thereto in their application to industrial injuries and disabilities; existing protective legislation in Australia; a comparative survey of protective legislation in other countries and its effectiveness; proposals for amendment of protective legislation; individual rights under protective legislation; regulation of industrial safety and health under compulsory arbitration schemes; management and union initiatives in the fields of industrial safety and health; new problems in industrial safety and health.

**Graduate Study**

# Course Outlines

## Faculty of Engineering Enrolment Procedures

All students re-enrolling in 1990 or enrolling in graduate courses should obtain a copy of the free leaflet *Re-Enrolling 1990* available from School Offices and the Admissions Office. This booklet provides detailed information on enrolment procedures and fees, enrolment timetables by Faculty and course, enrolment in miscellaneous subjects, locations and hours of Cashiers and late enrolments.

## Graduate School of Engineering

The Graduate School of Engineering is concerned with the co-ordination and development of the graduate activities of the Faculty and provides opportunities for well-qualified graduates to engage in advanced studies and research.

The Faculty consists of the Schools of Civil Engineering, Electrical Engineering and Computer Science, Mechanical and Industrial Engineering, Surveying and the Centres for Biomedical Engineering, Manufacturing and Automation, Safety Science and Wastewater Treatment. The Faculty is also closely associated with the Joint Microelectronics Research Centre and with the following which are joint enterprises of the Faculties of Engineering and Applied Science: Centre for Groundwater Management and Hydrogeology, Centre for Membrane and Separation Technology, Centre for waste Management.

The School of Civil Engineering consists of five departments: Geotechnical Engineering (foundation engineering, soil mechanics, rock mechanics, concrete technology, and pavement engineering); Engineering Construction and Management (civil engineering systems, engineering economy, project planning and management and civil engineering construction); Structural Engineering (structural analysis and structural design); Transport Engineering (planning, design, and operation of transport systems, statistical analysis, land use and transport modelling, economic evaluations and environmental impact studies); Water Engineering (hydraulics, hydrology, water resources , waste management and public health engineering). The **Centre for Wastewater Treatment** is also located within the School. In addition to extensive laboratory facilities on the Kensington campus, the School operates laboratories at King Street, Randwick and King Street, Manly Vale. The latter complex houses the School's Water Research Laboratory and the associated Water Reference Library. The School also uses the Fowlers Gap Arid Zone Research Station for construction camps and data collection for arid zone hydrology.

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

The School of Mechanical and Industrial Engineering consists of three departments: **Applied Mechanics** (agricultural engineering, automatic control, biomechanics, engineering design, engineering mechanics and mechanics of solids); **Fluid Mechanics and Thermodynamics** (energy utilisation and power generation, refrigeration and air conditioning, gas and liquid handling, aeronautical engineering and naval architecture); **Industrial Engineering** (economic analysis, production planning and control, product and process design, methods engineering and operations research). The **Centre for Manufacturing and Automation** is also located within the School.

The School of Surveying encompasses the following areas: **Cadastral Surveying** (knowledge of the laws and practices relating to property boundaries); **Geodetic Surveying** (the shape, size and mathematical model of the earth including small movements of the earth's crust); **Satellite Surveying** (the use of data from ground survey, air photography and satellite imagery to produce accurate maps); **Hydrographic Surveying** (the mapping of the seabed and waterways of navigation and offshore resource management); **Engineering Surveying** (the precise survey of large engineering constructions); **Land Management and Development** (environmental assessment for resource management and change of land use); **Land Information Management** (the use of computerised systems for accurate information of spatially related data); **Photogrammetry** (measurement of 3-dimensional positions from photographs and remotely sensed images).

The **Centre for Biomedical Engineering** is an interdisciplinary unit which promotes and co-ordinates biomedical engineering studies and research being conducted by a number of schools within the University and teaching hospitals. Biomedical engineering involves the application of engineering techniques to biomedical problems with particular emphasis on clinical medicine.

The **Centre for Manufacturing and Automation** promotes and co-ordinates teaching and research in the areas of manufacturing science and technology, machine control and automation, as well as computer integrated manufacturing and management.

The **Centre for Safety Science** promotes and co-ordinates teaching and research in the multidisciplinary field of occupational health and safety. The major areas of study include occupational health control, safety engineering and management for safety with an emphasis being placed on the engineering of a safe working environment.

The **Centre for Groundwater Management and Hydrogeology** was established early in 1987 as a research and training unit within the Faculties of Applied Science and Engineering. Its general aims are to research the groundwater problems of strategic national importance and to co-ordinate and develop postgraduate courses and continuing education programs, and to liaise with industry.

The **Centre for Membrane and Separation Technology** is a Commonwealth Special Research Centre established in 1988 to explore the use of synthetic membranes for separating liquid gaseous mixtures. Its laboratories are in the School of Chemical Engineering and Industrial Chemistry and Physics, with the administrative centre being in the Faculty of Engineering.

The **Centre for Remote Sensing** is a joint enterprise of the Faculties of Applied Science, and Engineering which promotes and co-ordinates remote sensing studies and research being conducted by various schools within the University. Remote sensing is the science of obtaining information about the earth's surface (in particular) using electro-magnetic imaging systems mounted on aircraft and space platforms.

The **Centre for Waste Management** is a joint enterprise of the Faculties of Engineering and Applied Science, and co-ordinates and develops teaching and research in the multidisciplinary area of waste management. Waste management is concerned with the study of treating, controlling and disposing of industrial and domestic wastes as applied to the analysis of waste disposal technologies. Particular emphasis is placed on the safe treatment, disposal and resource recovery of solid and liquid wastes.

The **Centre for Wastewater Treatment** was established with a grant provided by the Australian Water Advisory Council. The Centre conducts research in the field of wastewater treatment and offers short courses and a consultancy service for industry.

The **Joint Microelectronics Research Centre** was established in 1982 under the Commonwealth Special Research Centres Program. Its laboratories are located in the School of Electrical Engineering and Computer Science and at the Royal Melbourne Institute of Technology. The function of the Centre is to carry out research in semiconductor materials and processes, integrated circuit design, computer-aided design and computer-aided testing.

The Faculty awards seven higher degrees as follows: *Research* – Doctor of Philosophy, Master of Engineering and Master of Surveying; *Course Work Masters* – Master of Engineering Science (available in a number of areas of specialisation), Master of Surveying Science, Master of Safety Science and Master of Biomedical Engineering. In addition, the degrees of Doctor of Science and Master of Science may be awarded for research conducted in, or in association with, the Faculty of Engineering.

The administration of the various awards including admission, progress and assessment of all higher degree and diploma candidates is conducted by the Higher Degree Committee of the Faculty under the general supervision of the Faculty of Engineering.

Conditions governing the award of higher degrees and graduate diplomas are set out later in this handbook in **Conditions for the Award of Higher Degrees**. However, conditions for the award of the degree of Doctor of Science may be found in the University Calendar.

## English Language Requirements

Applicants whose first language is not English or who have not undertaken a previous degree where English was the primary language of instruction are required to provide proof of their competence by presenting for one of the following tests or by satisfying the course authority as to their level of proficiency.

| | Minimum Test Scores Required |
|---|---|
| Combined Universities Language Test (CULT) | 75% |
| Test of English as a Foreign Language (TOEFL) | 550 |
| English Language Testing Service (ELTS) | 6 |
| Short Selection Test (SST) | 'Satisfactory' |

# 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.

*Admission Guidelines* A candidate for registration for the degree of Doctor of Philosophy should hold an honours degree from the University of New South Wales or an honours degree of equivalent standing from another approved university. See also *English Language Requirements* as detailed earlier under *Graduate School of Engineering*. Applications for admission should be made to the Academic Registrar on the prescribed form at least one calendar month before the commencement of the session in which registration is to begin.

*Period of Candidature* The normal period is six academic sessions (full-time) and eight academic sessions (part-time) from the date of enrolment. In special cases the minimum period of registration may be reduced by up to two academic sessions. The maximum period of registration is ten academic sessions (full-time) and twelve academic sessions (part-time). In special cases an extension of these times may be granted.

## Master of Engineering/Master of Science/ Master of Surveying
## ME/MSc/MSurv

These are research degrees in which a thesis embodies the result of an original investigation, or design, or engineering surveying development. Candidates for the degree of ME and MSurv may be required to carry out a program of advanced study.

*Admission Guidelines* A candidate for registration for the degree of Master of Engineering, Master of Science or Master of Surveying should hold a Bachelor's degree from the University of New South Wales or from another approved university. See also *English Language Requirements* as detailed earlier under *Graduate School of Engineering*. Applications for admission should be made to the Academic Registrar on the prescribed form at least one calendar month before the commencement of the session in which registration is to begin.

*Period of Candidature* The normal period is four academic sessions (full-time) and six academic sessions (part-time) from the date of enrolment. In special cases the minimum period of registration may be reduced by up to two academic sessions. The maximum period of registration is six academic sessions (full-time) and ten academic sessions (part-time). In special cases extensions may be granted.

Research degrees may be undertaken in the Faculty of Engineering as follows:

| Degree | School/Course | Course Code |
|---|---|---|
| PhD | Civil Engineering | 1630 |
| | Electrical Engineering and Computer Science | 1641 |
| | Mechanical and Industrial Engineering | 1660 |
| | Nuclear Engineering | 1670 |
| | Safety Science | 1665 |
| | Surveying | 1680 |
| | Biomedical Engineering | 1710 |
| ME | Civil Engineering | 2650 |
| | Electrical Engineering and Computer Science | 2661 |
| | Mechanical and Industrial Engineering | 2690 |
| | Nuclear Engineering | 2700 |
| | Safety Science | 2695 |
| MSurv | Surveying | 2720 |
| MSc | Civil Engineering | 2750 |
| | Electrical Engineering and Computer Science | 2761 |
| | Safety Science | 2775 |
| | Mechanical and Industrial Engineering | 2780 |
| | Nuclear Engineering | 2785 |
| | Biomedical Engineering | 2795 |

# Course Work Masters Degrees

## Master of Engineering Science/Master of Surveying Science
## MEngSc/MSurvSc

These are Faculty-wide degrees allowing for flexibility of choice between formal course work and research. The schools in the Faculty have developed recommended programs of study leading to specialisation in certain areas.

Candidates are required to complete a program totalling 36 credits* for formal course work. Alternatively a degree may be awarded for the completion of formal course work and a report on a project or completion of a thesis only. The number of credits for a project report are 9 or 18, and 36 for a thesis.

Candidates may undertake interdisciplinary studies and, subject to approval, are able to take subjects from any school in the Faculty, other faculties of the University and other universities or institutions. By means of this system, programs of studies best suited to the needs of the candidates may be selected.

Before enrolment an applicant should submit an intended program for approval by the school division offering the majority of the credits to ensure that the prerequisite background held is adequate for all subjects including those taken in other schools or institutions.

*Admission Guidelines* An acceptable qualification is a degree at Honours level, or at Pass level to a superior standard in a four-year course in an approved discipline. The latter is defined as an average of 65% over the last two years of a full-time course (or last three stages of a part-time course) taken in minimum time. If the degree concerned is not in an acceptable

*See definition of 'credit' under Graduate Subjects later in this section.

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 transfering to the Masters program after completion of requirements prescribed by the Faculty. See also *English Language Requirements* as detailed earlier under *Graduate School of Engineering.*

Applicants for admissions to a course of study leading to the award of a course work Masters degree should apply to the Academic Registrar on the prescribed form at least two calendar months before the commencement of the session in which registration is to begin. It may be necessary to limit entry to some formal courses because of available resources. In such cases, an application may be provisionally accepted 'subject to a place being available'. When a firm offer is made, it is subject to acceptance within one month.

*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

This degree is primarily obtained through course work but includes a project report conducted in either a hospital or other institution. The course of study offers scope for original research into the application of engineering principles and technology to medical problems. Candidates must complete a program totalling 60 credits, 40 of which must be for the study of subjects at graduate level.

*Admission Guidelines* An acceptable qualification is a degree at Honours level, or at Pass level to a superior standard in a four-year course in an approved discipline. The latter is defined as an average of 65% over the last two years of a full-time course (or last three stages of a part-time course) taken in minimum time. If the degree concerned is not in an acceptable discipline, or was of less than four years full-time study, a bridging or qualifying program is usually required. This is normally arranged by enrolment in the appropriate graduate diploma with the possibility of transfering to the Masters program after completion of requirements prescribed by the Faculty. See also *English Language Requirements* as detailed earlier under *Graduate School of Engineering.*

Applicants for admission to a course of study leading to the award of a course work Masters degree should apply to the Academic Registrar on the prescribed form at least two calendar months before the commencement of the session in which registration is to begin.

*Period of Candidature* The normal period is three and one third academic sessions (full-time) or six academic sessions (part-time) from the date of enrolment. The maximum period of candidature is five academic sessions (full-time) and eight academic sessions (part-time). In special cases extensions may be granted.

## Master of Safety Science MSafetySc

The Master of Safety Science is an interdisciplinary course involving the study of the principles of engineering, law, management, medicine and science as applied to the field of occupational safety.

*Admission Guidelines* An acceptable qualification is a degree at Honours level, or at Pass level to a superior standard in a four-year course in an approved discipline. The latter is defined as an average of 65% over the last two years of a full-time course (or last three stages of a part-time course) taken in minimum time. If the degree concerned is not in an acceptable discipline, or was of less than four years full-time study, a bridging or qualifying program is required. This is normally arranged by enrolment in the appropriate graduate diploma with the possibility of transfering to the Masters program after completion of requirements prescribed by the Faculty. See also *English Language Requirements* as detailed under *Graduate School of Engineering.*

Applicants for admission to a course of study leading to the award of a course work Masters degree should apply to the Academic Registrar on the prescribed form at least two calendar months before the commencement of the session in which registration is to begin. It may be necessary to limit entry to some formal courses because of available resources. In such cases, an application may be provisionally accepted 'subject to a place being available'. When a firm offer is made, it is subject to acceptance within one month.

*Period of Candidature* The normal period is three academic sessions (full-time) and six academic sessions (part-time) from the date of enrolment. The maximum period of candidature is four academic sessions (full-time) and eight academic sessions (part-time). In special cases an extension of time may be granted. A candidate is not permitted to continue in a course if the credit value of the subjects failed totals more than six.

## Courses of Study

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

| Degree | School Course | Course Code |
|---|---|---|
| MEngSc | Electrical Engineering and Computer Science | 8500 |
| | *Specialist Programs:* | |
| | Communications | 8501 |
| | Electric Power | 8502 |
| | Electronics | 8503 |
| | Computer Science | 8504 |
| | Systems and Control | 8505 |
| | Industrial Engineering | 8530 |
| | Mechanical Engineering | 8540 |
| | Remote Sensing | 8640 |
| | Civil Engineering | 8610 |
| | Waste Management | 8610 |
| | Surveying | 8640 |
| MSurvSc | Surveying | 8650 |
| MBiomedE | Biomedical Engineering | 8660 |
| MSafetySc | Safety Science | 8670 |

The program in Remote Sensing is offered in both the Faculty of Engineering and the Faculty of Applied Science. Entry into either Faculty depends upon the background of the applicant and the orientation of the proposed program.

The program in Arid Lands Management, to which the Faculty of Engineering contributes, is available in the Faculty of Applied Science (course code 8025). Details are available from the Faculty of Applied Science Handbook.

Subjects available in the Faculty of Engineering are listed toward the end of this section. However, not all electives are offered in any particular year. Subject descriptions appear in the following section of the handbook.

## Course Work Programs

Detailed information is available from the schools offering the courses.

### 8500
### Electrical Engineering and Computer Science

### Master of Engineering Science
### MEngSc

- All candidates must possess an appropriate level of knowledge for the program subjects chosen.
- All candidates elect to study in at least one of the specific programs offered by the School of Electrical Engineering and Computer Science: each Program Co-ordinator will advise if applicants are adequately qualified to undertake the proposed subjects and must approve the chosen program.

All candidates must register in one of the following major areas and in at least one of its programs:

### Major Area

*Communications*

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
3. Power Systems Engineering (for engineers from neighbouring countries)

*Electronics*

Program Co-ordinator:
Dr R.S. Huang

1. Solid State Devices
2. Microelectronics

*Computer Science*

Program Co-ordinator:
Professor J. Hiller

1. Computer Science
2. Computer Engineering

*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 18 credits of course work (6 subjects) and an 18 credit project. However, other appropriate programs or subjects in the same major area or other areas may be substituted for the project allowing completion of the 36 credits by course work only.

### *Specialist Programs*

### 8501 Communications

#### 1. Communication Electronics

- Normally 18 credits of course work and an 18 credit project.
- One of the five elective subjects may be chosen from outside this program.

| Compulsory subject | | Credits |
|---|---|---|
| 6.340G | Communication Electronics | 3 |
| Elective subjects | | |
| 6.060G | Microprocessor Systems | 3 |
| 6.169G | Microwave Circuits: Theory and Techniques | 3 |
| 6.170G | Microwave and Optical Devices | 3 |
| 6.338G | Television Systems | 3 |
| 6.341G | Signal Processing 1 – Fundamental Methods | 3 |
| 6.343G | Digital and Analogue Communications | 3 |
| 6.404G | Real Time Computing and Control | 3 |
| 6.577G | Integrated Circuit Design | 3 |
| 6.665G | VLSI System Architecture and Design | 3 |

#### 2. Digital Communication and Systems

- Normally 18 credits of coursework and an 18 credit project.
- At least three subjects must be taken from the following list and the remaining subjects from other graduate programs within the Department and School.

| | | Credits |
|---|---|---|
| 6.336G | Digital Communication Networks 1 | 3 |
| 6.337G | Digital Communication Networks 2 | 3 |
| 6.338G | Television Systems | 3 |
| 6.343G | Digital and Analogue Communications | 3 |
| 6.347G | Digital Modulation and Coding | 3 |

#### 3. Microwave and Optical Communications

- Normally 18 credits of course work and an 18 credit project.

- One of the three elective subjects may be chosen from outside this program.

| Compulsory subjects | | Credits |
|---|---|---|
| 6.150G | Theory of Optical Fibres and Optical Signal Processing | 3 |
| 6.167G | Propagation and Transmission of Electromagnetic Waves | 3 |
| 6.170G | Microwave and Optical Devices | 3 |
| **Elective subjects** | | |
| 6.164G | Antenna Design and Applications | 3 |
| 6.169G | Microwave Circuits: Theory and Techniques | 3 |
| 6.348G | Optical Communications Systems | 3 |

### 4. Signal Processing

- Normally 18 credits of course work and an 18 credit project.
- One of the four elective subjects may be chosen from outside the program.

| Compulsory subjects | | |
|---|---|---|
| 6.341G | Signal Processing 1 – Fundamental Methods | 3 |
| 6.342G | Signal Processing 2 – Advanced Techniques | 3 |
| **Elective subjects** | | |
| 6.070G | Digital Image Processing Systems | 3 |
| 6.150G | Theory of Optical Fibres and Optical Signal Processing | 3 |
| 6.340G | Communications Electronics | 3 |
| 6.343G | Digital and Analogue Communications | 3 |
| 10.061G | Advanced Mathematics for Electrical Engineers | 3 |
| 10.361G | Statistics | 3 |

## 8502 Electric Power

### 1. Power Systems Engineering

- Normally 18 credits of course work and either an 18 credit project or a program in another area offered by the School
- Three elective subjects to be chosen.

| Compulsory subjects | | |
|---|---|---|
| 6.202 | Power Engineering 1 | 3 |
| 6.242G | Power System Analysis | 3 |
| 6.205G | Power System Planning and Economics | 3 |
| **Elective subjects** | | |
| 6.206G | Power System Operation, Control and Protection | 3 |
| 6.228G | Power System Equipment | 3 |
| 6.221G | High Voltage Technology | 3 |
| 6.215 | Industrial Electrical Systems | 3 |
| 6.229G | Fields and Materials | 3 |

### 2. Electrical Power Technology

- Normally 18 credits of course work and either an 18 credit project or a program in another area offered by the School
- Four elective subjects to be chosen.

| Compulsory subjects | | Credits |
|---|---|---|
| 6.229G | Fields and Materials | 3 |
| 6.221G | High Voltage Technology | 3 |
| **Elective subjects** | | |
| 6.228G | Power System Equipment | |
| 6.224G | Partial Discharges in Electrical Insulation | 3 |
| 6.227G | Insulation Performance in Electrical Plant | 3 |
| 6.212 | Power Engineering - Utilisation | 3 |
| 6.242G | Power System Analysis | 3 |
| 6.215 | Industrial Electrical Systems | 3 |

### 3. Power Systems Engineering (for engineers from neighbouring countries)

- Normally 18 credits of course work and an 18 credit project.
- Two elective subjects to be chosen.

| Compulsory subjects | | |
|---|---|---|
| 6.202 | Power Engineering 1 | 3 |
| 6.242G | Power System Analysis | 3 |
| 6.205G | Power System Planning and Economics | 3 |
| 6.228G | Power System Equipment | 3 |
| **Elective subjects** | | |
| 6.221G | High Voltage Technology | 3 |
| 6.212 | Power Engineering – Utilisation | 3 |
| 6.206G | Power System Operation Control and Protection | |
| 6.215 | Industrial Electrical Systems | 3 |
| 6.224G | Partial Discharges in Electrical Insulation | 3 |
| 6.227G | Insulation Performance in Electrical Plant | 3 |
| 6.229G | Fields and Materials | 3 |

## 8503 Electronics

- Normally 18 credits coursework and 18 credit project.

There are no compulsory subjects, but at least 3 subjects should be chosen from one of the programs shown below.

- The remaining three subjects may be chosen from the alternative program list or outside these lists.

### 1. Solid State Devices

| | | |
|---|---|---|
| 6.573G | Advanced Semiconductor Devices | 3 |
| 6.575G | Integrated Circuit Technology | 3 |
| 6.578G | Solar Energy Conversion | 3 |
| 6.579G | Technology and System Applications | 3 |

### 2. Microelectronics

| | | |
|---|---|---|
| 6.575G | Integrated Circuit Technology | 3 |
| 6.577G | Integrated Circuit Design | 3 |
| 6.573G | Advanced Semiconductor Devices | 3 |
| 6.665G | VLSI Systems Architecture Design | 3 |
| 6.340G | Communication Electronics | 3 |

## 8504 Computer Science

- Normally 36 credits of coursework or 18 credits of coursework and an 18 credit project.
- At least four elective subjects (coursework only program) or at least two elective subjects (thesis program) to be chosen as appropriate.

### 1. Computer Science/Computer Engineering

| Compulsory subjects | | Credits |
|---|---|---|
| 6.060G | Microprocessor Systems | 3 |
| 6.660G | Design and Analysis of Algorithms | 3 |
| 6.663G | Operating Systems | 3 |
| 6.664G | Compiling Techniques and Programming Languages | 3 |

Elective subjects (8504)

| | | |
|---|---|---|
| 6.468G | Computer Display Systems and Interactive Instrumentation | 3 |
| 6.654G | Digital Systems | 3 |
| 6.655G | Computer Organisation and Architecture | 3 |
| 6.665G | VLSI System Architecture and Design | 3 |
| 6.666G | Artificial Intelligence | 3 |
| 6.667G | Programming Languages: Fundamental Concepts | 3 |
| 6.668G | Computer Graphics | 3 |
| 6.669G | Formal Specification | 3 |
| 6.670G | Parallel and Distributed Computing Systems | 3 |

### 2. Information Science

*18 credit project stream*

Compulsory Subjects:

| | | |
|---|---|---|
| 6.002G | Advanced Data Base Management | 3 |
| 6.003G | Advanced Decision Theory for Information Science | 3 |
| 55.823G | Man Machine Communications | 3 |
| 55.817G | Information Storage and Retrieval | 3 |

Subject(s) of at least 3 credit standing to be taken in one of the areas of expert systems, knowledge based systems, decision support systems.

One of

| | | |
|---|---|---|
| 27.627G | Geographic Information Systems | 3 |
| 29.604G | Land Information Systems | 3 |

*Coursework stream*

All of the above plus:

| | | |
|---|---|---|
| 6.004G | Advanced Topics in Information Science | 6 |
| 6.336G | Digital Communication Networks 1 | 3 |

9 units may be chosen from other programs and subjects. The approval of the program coordinator for the selection made will be necessary. It is expected that these additional units will be selected from the programs offered by the School in the specialisations of:

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 choice from the programs offered by other schools.

## 8505 Systems and Control

### 1. Digital Systems and Control

- Normally 18 credits of course work and an 18 credit project.

| Compulsory subjects | | Credit |
|---|---|---|
| 6.401G | Computer Control Systems 1 | 3 |
| 6.403G | Computer Control Systems 2 | 3 |
| 6.404G | Real Time Computing and Control | 3 |
| 6.405G | Topics in Digital Control | 3 |

Elective subjects

| | | |
|---|---|---|
| 6.060G | Microprocessor Systems | 3 |
| 6.342G | Signal Processing 2 – Advanced Techniques | 3 |
| 6.406G | Advanced Control Topics | 3 |
| 6.468G | Computer Display Systems and Interactive Instrumentation | 3 |
| 6.470G | Robotics, Automation and Productivity Technology | 3 |

### 2. Cybernetic Engineering and Advanced Robotics

- Normally 9 credits of course work and an 18 credit project.
- Remaining 9 credits may be taken from the elective list or other programs and subjects.

Compulsory subjects

| | | |
|---|---|---|
| 6.457G | Cybernetic Engineering | 3 |
| 6.469G | Robot Vision | 3 |
| 6.470G | Robotics, Automation and Productivity Technology | 3 |

Elective subjects

| | | |
|---|---|---|
| 6.060G | Microprocessor Systems | 3 |
| 6.070G | Digital Image Processing Systems | 3 |
| 6.342G | Signal Processing 2 – Advanced Techniques | 3 |
| 6.404G | Real Time Computing and Control | 3 |
| 6.468G | Computer Display Systems and Interactive Instrumentation | 3 |

## 8530
## Industrial Engineering

## 8540
## Mechanical Engineering

### Master of Engineering Science
### MEngSc

A major field of study is required to be nominated and two-thirds of the 36 credits required for the degree must be taken in that major field. (Examples of major fields are heat engines, fluid mechanics and solar energy. Consult School Advisers for further details.)

All candidates take either a 9 credit or 18 credit project on a topic in their major field.

Formal lecture subjects are not restricted to the School of Mechanical and Industrial Engineering, Faculty of Engineering or this University, but two-thirds of all credits must be taken at the University of New South Wales.

In consultation with their School Adviser, candidates at enrolment put together a program which is based on these requirements, but which may be modified from time to time in the light of changes in availability of subjects. These requirements also apply to a number of specialist courses which are offered by the School of Mechanical and Industrial Engineering and which are described below. Some of these specialist programs may not run if the resources are not available. The structure of the programs is currently under review.

## Specialist Programs

### 1. Refrgeration and Air Conditioning

| 19 credits of core subjects: | | Credits |
|---|---|---|
| 5.151-2G | Refrigeration and Air Conditioning Design 1, 2 | 3,3 |
| 5.715G | Two Phase Flow and Heat Transfer | |
| 35.731G | Analysis of Heat Transfer | 4 |
| 5.755-6G | Refrigeration and Air Conditioning 1, 2 | 3,3 |

*and*

18 credit Project Report

*or*

9 credit Project plus 8 credits from:

| | | |
|---|---|---|
| 5.3289G | Control and Modelling of Mechanical Systems 1, 2 | 3,3 |
| 5.601G | Computational Fluid Dynamics | 3 |
| 5.6534G | Acoustic Noise 1, 2 | 2,2 |
| 5.655G | Energy Conservation and System Design | 3 |
| 5.700G | Power Production Assessment | 3 |
| 5.722G | Solar Thermal Energy Design | 3 |
| 5.753G | Ambient Energy Air Conditioning | 2 |
| 5.757G | Refrigeration and Air Conditioning Applications | 3 |
| 5.759G | Refrigeration and Air Conditioning Experimentation | 3 |
| 47.090G | Introduction to Occupational Health and Safety Law | 3 |

or such other subjects as may be approved by the Head of School.

### 2. Industrial AutomationCredits

18 credits of core subjects taken from:

| | | |
|---|---|---|
| 5.086G | Digital Logic Fundamentals for Mechanical Engineers | 3 |
| 5.087G | Microprocessor Fundamentals for Mechanical Engineers | 3 |
| 5.088G | Industrial Applications of Microprocessors | 3 |
| 5.089G | Elements of Industrial Automation | 3 |
| 5.090G | The Analysis and Use of Integrated CAD CAM systems | 3 |
| 5.3289G | Control and Modelling of Mechanical Systems 1, 2 | 3,3 |
| 18.260G | Computer Aided Programming for Numerical Control | 3 |

*and*

18 credit Project Report

*or*

9 credit Project and a further 9 credits of subjects selected from:

| | | |
|---|---|---|
| 5.317G | Industrial Robotics | 3 |
| 18.772G | Information Processing Systems in Organisation | 2 |
| 18.868G | Industrial Applications of Mathematical Programming | 3 |

or such other subjects as may be approved by the Head of School

### 3. Industrial Management

| 3 credits of core subjects: | | Credits |
|---|---|---|
| 18.074G | Industrial Management | 3 |
| 18.965G | Industrial Management Seminar | 0 |

at least 11 credits selected from:

| | | |
|---|---|---|
| 14.062G | Accounting for Engineers | 3 |
| 18.380G | Methods Engineering | 4 |
| 18.571G | Operations Research 1 | 6 |
| 18.675G | Economic Decisions in Industrial Management | 3 |
| 18.776G | Production and Inventory Control | 2 |

*and*

| | | |
|---|---|---|
| 18.909G | Project | 9 |

*or*

| | | |
|---|---|---|
| 18.918G | Project Report | 18 |

The remaining credits may be selected from:

| | | |
|---|---|---|
| 18.061G | Industrial Experimentation 1 | 3 |
| 18.076G | Decision Support Systems | 3 |
| 18.171G | Inspection and Quality Control | 3 |
| 18.360G | Ergonomics | 3 |
| 18.371G | Factory Design and Layout | 3 |
| 18.464G | Value Analysis Engineering | 3 |
| 18.465G | Computer-Aided Manufacturing Credits | 3 |
| 18.672G | Decision Theory for Industrial Management | 3 |
| 18.764G | Management of Distribution Systems | 2 |
| 18.772G | Information Processing Systems in Organizations | 2 |
| 18.862G | Linear Programming | 2 |
| 18.863G | Nonlinear Programming | 2 |
| 18.870G | Large Scale Optimisation in Industry | 3 |
| 18.868G | Industrial Applications of Mathematical Programming | 3 |
| 28.913G | Marketing Management | 3 |
| 30.701G | Industrial Relations A | 3 |

or such other subjects as may be approved by the Head of School

### 4. Operations Research

*Prerequisites:*

(i) 2 years of University level Mathematics

(ii) minimum 40 hours University level course in Probability and Statistics (*or* enrolment in 5.5010 Computing IM or equivalent as a co-requisite)

(iii) minimum 40 hours University level course in Engineering Economic Analysis (*or* enrolment in 18.675G Economic Decisions in Industrial Management as a co-requisite)

(iv) competence in computer programming (*or* enrolment in 5.010 Computing IM as a co-requisite).

| | | Credits |
|---|---|---|
| 12 credits of core subjects: | | |
| 14.062G | Accounting for Engineers | 3 |
| 18.571G | Operations Research 1 | 6 |
| 18.574G | Management Simulation | 3 |
| 18.970G | Operations Research Seminar | 0 |
| 18.909G | Project | 9 |
| *or* | | |
| 18.918G | Project Report | 18 |
| The remaining credits may be selected from: | | |
| 18.074G | Industrial Management | 3 |
| 18.076G | Decision Support Systems | 3 |
| 18.360G | Ergonomics | 3 |
| 18.371G | Factory Design and Layout | 3 |
| 18.380G | Methods Engineering | 4 |
| 18.464G | Value Analysis Engineering | 3 |
| 18.471G | Design Communication | 2 |
| 18.671G | Decision Theory | 2 |
| 18.672G | Decision Theory for Industrial Management | 3 |
| 18.673G | Energy Modelling, Optimisation and Energy Accounting | 3 |
| 18.675G | Economic Decisions in Industrial Management | 3 |
| 18.760G | Discrete Event Simulation Languages | 3 |
| 18.761G | Simulation in Operations Research | 3 |
| 18.764G | Management of Distribution Systems | 2 |
| 18.765G | Optimisation of Networks | 2 |
| 18.772G | Information Processing Systems in Organisations | 2 |
| 18.773G | Optimal Control in Operations Research | 2 |
| 18.776G | Production and Inventory Control | 2 |
| 18.862G | Linear Programming | 2 |
| 18.863G | Nonlinear Programming | 2 |
| 18.870G | Large Scale Optimisation in Industry | 3 |
| 18.874G | Dynamic Programming | 2 |
| 18.879G | Mathematical Programming Analysis | 3 |

or such other subjects as may be approved by the Head of School

## 5. Advanced Analysis for Design

*Prerequisites:*

(i) 5.123 Mechanical Engineering Design 3 or equivalent

(ii) 5.423 Mechanics of Solids 3 or equivalent

| | | Credits |
|---|---|---|
| 21 credits of core subjects: | | |
| 5.414G | Finite Element Applications | 3 |
| 5.415G | Stress Analysis for Mechanical Engineering Design 1 | 3 |
| 5.417G | Mechanics of Fracture and Fatigue | 3 |
| 5.909G | Project (Design and Build) | 9 |
| 18.360G | Ergonomics | 3 |
| *plus* at least 5 credits selected from: | | |
| 5.1242 | Design Technology | 2 |
| 5.1244 | Project Management | 2 |
| 5.1245 | Computer Based Engineering Design (or 18.870G) | 2 |
| 5.403G | Experimental Stress Analysis | 3 |
| 8.731G | Project Management (or 8.732G) | 3 |
| 8.732G | Advanced Project Management Theory (or 8.731G) | 3 |
| 18.464G | Value Analysis Engineering | 3 |
| 18.675G | Economic Decisions in Industrial Management | 3 |
| 18.870G | Large Scale Optimisation in Industry (or 5.1245) | 3 |

The remaining credits, resulting overall in at least 36 credits, must be chosen from an approved list of subjects, details of which may be obtained from the School of Mechanical and Industrial Engineering.

Students who elect to take the 9 credit Project will be required to take one of the following specialist options:

**Industrial Automation**

The following two subjects from the Industrial Automation package subject to availability:

| | | |
|---|---|---|
| 5.086G | Digital Fundamentals for Mechanical Engineers | 3 |
| 5.089G | Industrial Applications of Microprocessors | 3 |
| 5.090G | The Analysis and Use of Integrated CAD/CAM Systems | 3 |

**Robotics**

The following two subjects from the Industrial Automation package subject to availability:

| | | |
|---|---|---|
| 5.086G | Digital Fundamentals for Mechanical Engineers | 3 |
| 5.317G | Industrial Robots together with | 3 |
| 5.320G | Artificially Intelligent Machines | 3 |
| *or* | | |
| 6.404G | Real Time Computing and Control | 3 |
| 6.469G | Robot Vision | 3 |
| 6.470G | Robotics, Automation and Productivity Technology | 3 |

**Manufacturing Management**

| | | |
|---|---|---|
| 14.062G | Accounting for Engineers | 3 |
| 18.675G | Economic Decisions in Industrial Management | 3 |
| 18.776G | Production and Inventory Control | 3 |

**Manufacturing Design**

| | | |
|---|---|---|
| *Either* | | |
| 18.380G | Methods Engineering | 3 |
| 18.171G | Inspection and Quality Control | 3 |
| 18.371G | Factory Design and Layout | 3 |
| *or* | | |
| 14.062G | Accounting for Engineers | 3 |
| 18.461G | Design for Production | 3 |
| 18.464G | Value Analysis and Engineering | 3 |

## 6. Computer Integrated Manufacturing

| | | Credits |
|---|---|---|
| 18 credits of core subjects: | | |
| 18.074G | Industrial Management | 3 |
| 18.260G | Computer Aided Programming for Numerical Control | 3 |
| 18.465G | Computer Aided Manufacturing | 3 |
| 97.601G | Computer Aided Design for Manufacture | 3 |
| 97.602G | Computer Integrated Manufacturing | 3 |
| 97.603G | Product Design and Technological Innovation | 3 |

*and*
18 credit Project Report
*or*
9 credit Project
The remaining credits may be selected from:

**Industrial Automation** (subject to availability)

| | | Credits |
|---|---|---|
| 5.086G | Digital Logic Fundamentals for Mechanical Engineers | 3 |
| 5.088G | Industrial Applications of Microprocessors | 3 |
| 5.090G | The Analysis and Use of Integrated CAD/CAM Systems | 3 |

**Robotics** (subject to availability)

| | | |
|---|---|---|
| *Either* | | |
| 5.086G | Digital Logic Fundamentals or Mechanical Engineers | 3 |
| 5.317G | Industrial Robotics | 3 |
| 5.320G | Artificially Intelligent Machines | 3 |
| *or* | | |
| 6.404G | Real Time Computing and Control | 3 |
| 6.469G | Robot Vision | 3 |
| 6.470G | Robotics, Automation and Productivity Technology | 3 |

**Manufacturing Management**

| | | |
|---|---|---|
| 14.062G | Accounting for Engineers | 3 |
| 18.675G | Economic Decisions in Industrial Management | 3 |
| 18.776G | Production and Inventory Control | 2 |

**Manufacturing Design**

| | | |
|---|---|---|
| *Either* | | |
| 18.380G | Methods Engineering | 4 |
| 18.171G | Inspection and Quality Control | 3 |
| 18.371G | Factory Design and Layout | 3 |
| *Or* | | |
| 14.062G | Accounting for Engineers | 3 |
| 18.461G | Design for Production | 4 |
| 18.464G | Value Analysis and Engineering | 3 |
| *Or* | | |
| 5.317G | Industrial Robotics | 3 |
| 97.604G | Flexible Manufacturing Systems | 3 |
| 97.605G | Computer-Aided Design for Manufacture 2 | 3 |

## 8610
## Civil Engineering

### Master of Engineering Science
### MEngSc

The School of Civil Engineering offers a large number of graduate subjects which allow the flexibility of many combinations to provide relevant groupings both in an academic and professional sense. The main technical groupings are:

- engineering construction and management
- geotechnical engineering
- structural engineering
- transport engineering
- water engineering

All candidates are required to undertake a project with the other credits being obtained from formal course work. Full details of preferred programs in the various specialists areas are available from the School.

## 8610
## Waste Management

### Master of Engineering Science
### MEngSc

## 8085
## Waste Management

### Master of Applied Science
### MAppSc

Candidates are required to complete a course totalling at least 36 credits, made up of compulsory subjects, elective subjects and a project. The degree may be obtained internally on a full time (normally 2 sessions of 18 credits) or part time (normally 4 sessions of 9 credits) basis. An external course program is also offered (normally over 4 sessions) to students outside Sydney with resource material posted to students and evaluation made on written assignments.

Candidates would be enrolled as MEngSc or MAppSc depending on their previous qualification experience and course content.

| Compulsory subjects | | Credits |
|---|---|---|
| 8.872G/X | Solid Waste Management | 3 |
| 8.873G/X | Waste and Wastewater Analysis and Environmental Requirements | 3 |
| 8.874G/X | Waste Management Science | 3 |
| 8.881G/X | Hazardous Waste Management | 3 |
| 8.883G/X | Sources of Waste and Landfill Disposal | 3 |
| 48.388G/X | Unit Operations in Wastewater Sludge and Solids Management | 3 |
| Project (MEngSc) | | |
| 8.909G | Project | 9 |
| 8.918G | Project Report | 18 |
| Project (MAppSc) | | |
| 46.512G | Project | 9 |
| 46.513G | Project Report | 18 |

Elective subjects

Selection of the subjects for the formal course work must be approved by the Director of the Centre for Waste Management. For a graduate degree specialising in Waste Management a candidate would normally complete 18 credits of core subjects plus 9 credits selected from the list of elective subjects.

| | | |
|---|---|---|
| 7.152G | Mining Conservation | 3 |
| 7.535X | Mine Fill Technology | 2 |
| 48.392G | Atmospheric Pollution Control Practical Aspects | 3 |
| 8.857G | Sewage Treatment and Disposal | 3 |
| 8.857X | Sewage Treatment and Disposal | 3 |

| | | Credits |
|---|---|---|
| 8.870G | Hydraulics and Design of Water and Wastewater Treatment Plants | 3 |
| 8.882G | Industrial Waste Management | 3 |
| 8.882X | Industrial Waste Management | 3 |
| 25.702G | Hydrogeology | 3 |
| 25.704G | Environmental Geology | 3 |
| 25.707X | Geopollution Management | 3 |
| 25.707G | Geopollution Management | 3 |
| 42.203G | Medical Aspects | 1 |
| 46.204G | Legislative Aspects | 1 |
| 47.481G | Management of Dangerous Materials | 3 |
| 47.120G | Human Behaviour and Safety Science | 3 |
| 48.063G | Industrial Water and Wastewater Engineering | 3 |

## 8640
## Remote Sensing

### Master of Engineering Science
### MEngSc

Candidates are required to complete a course totalling at least 36 credits, made up of compulsory subjects, elective subjects and a project or research project. Compulsory subjects not offered in a particular year may be substituted by an equivalent subject, approved by the appropriate Head of School. The degree will normally comprise one year of full-time study (two sessions of 18 credits) or two years of part-time study (four sessions of 9 credits each).

Candidates who are not exempted from any of the compulsory subjects and who opt for the Research Project (18 credits), will achieve the required 36 credits without any elective subjects.

| Compulsory subjects | | Credits |
|---|---|---|
| 27.043G | Remote Sensing Applications | 3 |
| 29.600G | Principles of Remote Sensing | 3 |
| 29.602G | Remote Sensing Procedures | 3 |
| 29.605G | Ground Investigations for Remote Sensing | 3 |
| 97.580G | Image Analysis in Remote Sensing | 3 |
| 97.581G | Microwave Remote Sensing | 3 |
| Project | | |
| Project in Remote Sensing† or | | 9 |
| Research Project in Remote Sensing† | | 18 |

†The subject number for these subjects varies according to the school in which the candidate is enrolled.

Elective subjects
Candidates are required to include additional subjects selected from the following listed elective subjects, or from other relevant subjects offered within the University, as approved by the appropriate Head of School, to complete a program totalling 36 credits.

| | | Credits |
|---|---|---|
| 6.070G | Digital Image Processing Systems | 3 |
| 6.468G | Computer Display Systems and Interactive Instrumentation | 3 |
| 6.711 | Computing 1A | 4 |
| 6.712 | Computing 1A | 3 |
| 25.816G | Remote Sensing in Applied Geology | 2 |
| 27.174G | Remote Sensing Instrumentation and Satellite Programs | 3 |
| 27.644G | Computer Mapping and Data Display | 3 |
| 27.672G | Geographic Information Systems | 3 |
| 27.911G | Soil Erosion and Conservation | 6 |
| 27.914G | Terrain Evaluation | 6 |
| 29.213G | Physical Meteorology | 3 |
| 29.604G | Land Information Systems | 3 |

## 8650
## Surveying

### Master of Surveying Science
### MSurvSc

Programs of study leading to the degree of MSurvSc are offered by the School of Surveying in a range of topics including:

- advanced surveying
- geodesy
- photogrammetry
- land development and management
- land and geographic information systems

Candidates are allowed a wide choice in selecting programs. Subjects can be selected to suit individual student needs and typical programs can be supplied by the School on request. The program of study must total at least 36 credits. One credit is normally equal to attendance for one hour per week for one session but some senior undergraduate subjects may be taken for partial credit towards the degree. The program normally includes a Project of 9 credits or a Project of 18 credits. Examples of suitable external subjects are electronic computing, statistics, oceanography, and a range of others.

## 8650
## Surveying

### Master of Surveying Science
### MSurvSc in Land and Geographic Information Systems

Candidates are required to complete a course totalling at least 36 credits made up of compulsory subjects, elective subjects and a project or project report. Compulsory subjects not offered in a particular year may be substituted by an equivalent subject approved by the appropriate Head of School. The course will normally comprise one year of full-time study (two sessions of 18 credits) or two years of part-time study (four sessions of 9 credits each).

| Compulsory subjects | | Credits |
|---|---|---|
| 6.005G | Data Base Systems | 3 |
| 27.672G | Geographic Informations Systems | 3 |
| 29.604G | Land Information Systems | 3 |
| 29.532G | Computer-Assisted Mapping | 3 |
| Elective subjects | | |
| 27.043G | Remote Sensing Applications | 3 |
| 27.644G | Computer Mapping and Data Display | 3 |
| 27.952G | Special Topic in Geography | 3 |
| 97.580G | Image Analysis in Remote Sensing | 3 |

| | | Credits |
|---|---|---|
| 55.817G | Information Storage and Retrieval Systems | 6 |
| 55.815G | Economics of Information Systems | 3 |
| 6.336G | Digital Communication Networks 1 | 3 |
| 29.107G | Special Topic in Surveying B | 3 |
| 29.608G | Cadastral Systems | 3 |
| Project | | |
| 29.909G | Projects | 9 |
| 29.918G | Projects Report | 18 |

The Masters degree program in Land and Geographic Systems is offered in both the Faculty of Engineering and the Faculty of Applied Science. Entry into either Faculty depends on the background of the applicant and the orientation of the proposed program.

## 8660
## Biomedical Engineering

### Master of Biomedical Engineering
### MBiomedE

The program of study must total 60 credits and include at least 40 credits at graduate level.

Strand A subjects are directed to candidates with an engineering/physical sciences background and Strand B to those with a medical/biological sciences background. Selection of subjects is not limited to those listed below: relevant approved subjects from other areas may be undertaken. A research project is compulsory and may be undertaken concurrently with other subjects. An 18 credit Project Report is the normal requirement.

Session 1 (March-June)

| | | | Credits |
|---|---|---|---|
| 73.111 | Physiology (1 full year) (Strand A) | C | 12 |
| 70.011C | Introductory Anatomy (Strand A) | HR | 6 |
| 32.101G | Mathematical Modelling for Biomedical Engineers (Strand B) | C | 4 |
| 32.501G | Computing for Biomedical Engineers (Strand B) | HR | 4 |
| 6.481G | Introductory Physiology for Engineers[1] | | 3 |
| 32.026G | Radiation Physics | | 2 |
| 32.040G | Analogue Electronics for Biomedical Engineers | | 4 |
| 32.060G | Biomedical Systems Analysis | | 3 |
| 32.551G | Biomechanics of Physical Rehabilitation[2] | | 3 |
| 32.561G | Mechanical Properties of Biomaterials[2] | | 3 |
| 32.601G | Biomedical Applications of Microprocessors 1[3] | | 3 |
| 32.621G | Biological Signal Analysis | | 3 |
| 32.701G | Dynamics of the Cardiovascular System | | 3 |
| 42.407G | Biological Principles | | 3 |
| 47.061G | Principles of Ergonomics | | 3 |
| 72.402G | Principles of Disease Processes[4] | | 3 |

Session 2 (July-November)

| | | | Credits |
|---|---|---|---|
| 73.111 | Physiology 1 (continued) | | |
| 32.010G | Biomedical Engineering Practice | HR | 2 |
| 32.012G | Biomedical Statistics | | 4 |
| 32.027G | Medical Imaging | | 4 |
| 32.050G | Microprocessors and Circuit Design for Biomedical Engineers[5] | | 4 |
| 32.311G | Mass Transfer in Medicine | | 4 |
| 32.321G | Physiological Fluid Mechanics | | 4 |
| 32.332G | Biocompatibility | | 3 |
| 32.541G | Mechanics of the Human Body[2] | | 3 |
| 32.602G | Biomedical Applications of Microprocessors 2[7] | | 3 |
| 32.603G | Static and Flow Cytometry | | 3 |
| 32.611G | Medical Instrumentation[6] | | 3 |
| 32.018G | Project Report[8] | C | 18 |
| 32.030G | Project Report[8] | | 30 |

C Compulsory
HR Highly recommended.
1 For part-time students, ONLY, who are unable to do 73.111.
2 These 3 electives vary according to Session in which offered. Only 1 is offered per year. Prerequisite for 32.541G and 32.551G: 70.011C or equivalent.
3 Prerequisite: 32.050G or equivalent.
4 For non-medical graduates only. Prerequisite: 73.111 or equivalent; pre- or co-requisite: 70.011C.
5 Prerequisites: 32.501G and 32.040G or equivalents.
6 Prerequisite: 32.040G or equivalent.
7 Subject follows on from 32.601G.
8 Research project may be done concurrently with course work during the other Sessions. An 18-credit Project Report is the normal requirement.

## 8670
## Safety Science

### Master of Safety Science
### MSafetySc

Candidates are required to complete a program totalling 54 credits made up of 12 credits of preliminary subjects (selected according to previous qualifications), 21 credits of compulsory subjects, 12 credits of Safety Engineering electives, and a 9 credit Project. The preliminary subjects enable graduates from a wide range of disciplines (such as engineering, science, medicine, economics, law) to reach an adequate standard of comprehension for studying the compulsory and elective subjects. When undertaking a project, each condidate is expected to attend seminars and to report progress on the project.

Preliminary subjects

| | | Credits |
|---|---|---|
| No more than 4 credits selected from: | | |
| *either* | | |
| 16.901G | Health Services Statistics 1 | 2 |
| *or* | | |
| 32.012G | Biomedical Statistics | 4 |
| 47.030G | Computing for Safety Science | 3 |
| 47.009G | Organisational Communication for Safety | 3 |
| 47.051G | Principles of Engineering Mechanics | 3 |
| 70.201G | Introductory Functional Anatomy | 3 |
| 80.701G | Occupational Disease | 3 |

**Compulsory Subjects**

| | | Credits |
|---|---|---|
| 47.052G | Introduction to Safety Engineering | 3 |
| 47.061G | Principles of Ergonomics | 3 |
| 47.090G | Introduction to Occupational Health and Safety Law | 3 |
| 47.120G | Human Behaviour and Safety Science | 3 |
| 47.180G | Management for Safety | 3 |
| 47.330G | The Accident Phenomenon | 3 |
| 80.702G | Occupational Health Control | 3 |

**Safety Engineering Electives**

| | | |
|---|---|---|
| 2.251G | Toxicology, Occupational and Public Health | 6 |
| 18.380G | Methods Engineering | 4 |
| 39.908G | Community Noise Control | 2 |
| 47.054G | Machines and Structures Safety | 3 |
| 47.060G | Electrical Safety | 3 |
| 47.062G | Applied Ergonomics | 3 |
| 47.070G | Ventilation | 3 |
| 47.230G | Radiation Protection | 3 |
| 47.480G | Fire and Explosion | 3 |
| 47.481G | Management of Dangerous Materials | 3 |
| 79.616G | Occupational Epidemiology | 3 |
| 79.617G | Occupational Medicine Practice | 6 |
| 90.502 | Industrial Safety and Health Law | 4 |

**Project**

| | | |
|---|---|---|
| 47.909G | Project | 9 |
| *or* | | |
| 47.918G | Project Report | 18 |

## Graduate Diplomas

Courses of study leading to the award of a Graduate Diploma in Engineering provide graduates with opportunities to extend their professional knowledge. In most cases, candidates may choose from a range of subjects in the special area of their choice. There are also opportunities to select subjects from other professional areas in which candidates may be interested. In addition, the graduate diploma courses in Engineering Developments are intended for those who wish to take a more general program in several areas of interest.

Before enrolment, an applicant should submit an intended program for approval by the school or centre offering the majority of the credits. Candidates must complete a program totalling 30 credits. Forty per cent of these may consist of approved undergraduate subjects and the program may contain subjects from other schools of the Faculty, other faculties of the University and other universities or institutions subject to meeting any prerequisite requirements. If an applicant nominates a course of study from the list below, at least half of the credits should come from the subjects taken in that area.

*Admission Guidelines* An applicant for admission to a graduate diploma course should be a graduate of the University of New South Wales or other approved university or have other qualifications as may be approved by the Faculty of Engineering. Applicants should apply to the Academic Registrar on the prescribed form at least two calendar months before the commencement of the session in which registration is to begin. It may be necessary to limit entry because of available resources. In such cases, an application may be provisionally accepted 'subject to a place being available'. When a firm offer is made, it is subject to acceptance within one month.

*Period of Candidature* The normal period is two academic sessions (full-time) or four academic sessions (part-time) from the date of enrolment. The maximum period of candidature is four academic sessions (full-time) and six academic sessions (part-time). In special cases extensions may be granted. A candidate is not permitted to continue in a course if the credit value of the subjects failed totals more than six.

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

| School/Course | Course Code |
|---|---|
| Graduate Diploma in Engineering: | |
| Biomedical Engineering | 5462 |
| Civil Engineering | 5461 |
| Waste Management* | 5461 |
| Electrical Engineering and Computer Science: | |
| Electrical Engineering | 5468 |
| Computer Science | 5469 |
| Industrial Engineering | 5465 |
| Mechanical Engineering | 5466 |
| Graduate Diploma in Engineering Developments | 5470 |
| Graduate Diploma in Remote Sensing* | 5495 |
| Graduate Diploma in Safety Science** | 5480 |
| 0Graduate Diploma in Ergonomics** | 5485 |
| Graduate Diploma in Surveying | 5490 |

*The Graduate Diplomas in Remote Sensing and Waste Management are offered in both the Faculty of Engineering and the Faculty of Applied Science. Entry into either Faculty depends upon the background of the applicant and the orientation of the proposed program.

**The Graduate Diplomas in Ergonomics and Safety Science are interdisciplinary, structured courses for candidates from a wide range of backgrounds.

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

Subjects available in the Faculty of Engineering are listed at the end of this section. However, not all electives are offered in any particular year. Subjects available by tape correspondence as well as all subject descriptions, appear later in this handbook.

## Graduate Subjects

The subjects which may be available for a candidate proceeding to the award of the degree of Master of Engineering Science, Master of Safety Science, Master of Surveying Science, Master of Biomedical Engineering and Graduate Diploma are listed below. Not all electives are necessarily offered in any particular year.

Under the credit system in operation in the Faculty, one credit is normally equal to one hour's attendance per week for one

session. The qualification 'normally' is required because of the varying ways in which credits are distributed for course work, design, critical review or research in the different schools.

Many graduate subjects assume that students have prior, or preliminary, knowledge of the area of study. It is the responsibility of students to acquaint themselves with this level of assumed prior knowledge and take steps, if necessary, to obtain it. This may, for example, involve a course of preparatory reading before commencing the subject.

In some cases the assumed level of knowledge for a specific subject is indicated in this Handbook by the statement of assumed knowledge. This is intended as a guide to the assumed prior knowledge and often uses the description of other subjects in the Handbook (graduate and undergraduate) to indicate the content and level which the lecturer will assume. Students who are in doubt as to the adequacy of their preparation should contact the lecturer concerned and discuss the matter. The lecturer in charge of a subject has the authority to decide whether or not the student has the appropriate level of assumed knowledge.

## Civil Engineering

### Department of Transport Engineering

| | | Credits |
|---|---|---|
| 8.401G | Human Factors in Transport | 3 |
| 8.402G | Transport, Environment, Community | 3 |
| 8.403G | Theory of Land Use Transport Interaction | 3 |
| 8.404G | Local Area Transport Planning | 3 |
| 8.405G | Urban Transport Planning Practice | 3 |
| 8.406G | Regional Transport Planning | 3 |
| 8.407G | Transport System Design Non-Urban | 3 |
| 8.408G | Transport System Design Urban | 3 |
| 8.409G | Interchange Design | 3 |
| 8.410G | Highway Engineering Practice Part 1 | 3 |
| 8.411G | Highway Engineering Practice Part 2 | 3 |
| 8.412G | Economics for Transportation Studies | 3 |
| 8.413G | Transport Economics | 3 |
| 8.414G | Transport Systems Part 1 | 3 |
| 8.415G | Transport Systems Part 2 | 3 |
| 8.416G | Traffic Engineering | 6 |
| 8.417G | Transport and Traffic Flow Theory | 6 |
| 8.418G | Statistics for Transport Studies Part 1 | 3 |
| 8.419G | Statistics for Transport Studies Part 2 | 3 |
| 8.420G | Special Topic in Transport Engineering | 3 |

### Department of Engineering Construction and Management

| | | |
|---|---|---|
| 8.701G | Economic Decision Making in Civil Engineering | 3 |
| 8.702G | Network Methods in Civil Engineering | 3 |
| 8.703G | Optimisation Techniques in Civil Engineering | 3 |
| 8.704G | Stochastic Methods in Civil Engineering | 3 |
| 8.705G | Systems Modelling | 3 |
| 8.706G | Experimental Methods in Engineering Research | 3 |
| 8.707G | Numerical Methods in Civil Engineering | 3 |
| 8.710G | Special Topic in Optimisation in Civil Engineering | 3 |
| 8.714G | Special Topic in System Modelling | 3 |
| 8.723G | Construction Design | 3 |
| 8.724G | Construction Technology | 3 |
| 8.725G | Construction Accounting and Control | 3 |
| 8.726G | Construction Law and Professional Practice | 3 |
| 8.727G | Construction Planning and Estimating | 6 |
| 8.728G | Design of Construction Operations | 6 |
| 8.731G | Project Management | 3 |
| 8.732G | Advanced Project Management Theory | 3 |

### Department of Geotechnical Engineering

| | | |
|---|---|---|
| 8.753G | Soil Engineering | 3 |
| 8.776G | Rock Mechanics | 3 |
| 8.777G | Numerical Methods in Geomechanics | 3 |
| 8.781G | Advanced Concrete Technology 1 | 3 |
| 8.782G | Advanced Concrete Technology 2 | 3 |
| 8.783G | Pavement Materials | 3 |
| 8.784G | Pavement Design | 3 |
| 8.785G | Pavement Evaluation and Maintenance | 3 |
| 8.786G | Industrial and Heavy Duty Pavements | 3 |
| 8.788G | Site Investigations | 3 |
| 8.790G | Stability of Slopes | 3 |
| 8.791G | Foundation Engineering 1 | 3 |
| 8.792G | Foundation Engineering 2 | 3 |
| 8.793G | Geomechanics | 3 |

### Department of Structural Engineering

| | | |
|---|---|---|
| 8.802G | Elastic Stability 1 | 3 |
| 8.803G | Elastic Stability 2 | 3 |
| 8.804G | Vibration of Structures 1 | 3 |
| 8.805G | Vibration of Structures 2 | 3 |
| 8.806G | Prestressed Concrete 1 | 3 |
| 8.807G | Prestressed Concrete 2 | 3 |
| 8.808G | Prestressed Concrete 3 | 3 |
| 8.809G | Reinforced Concrete 1 | 3 |
| 8.810G | Reinforced Concrete 2 | 3 |
| 8.811G | Reinforced Concrete 3 | 3 |
| 8.812G | Plastic Analysis and Design of Steel Structures 1 | 3 |
| 8.813G | Plastic Analysis and Design of Steel Structures 2 | 3 |
| 8.814G | Analysis of Plates and Shells | 3 |
| 8.817G | Experimental Structural Analysis 1 | 3 |
| 8.818G | Bridge Design 1 | 3 |
| 8.819G | Bridge Design 2 | 3 |
| 8.820G | Structural Analysis and Finite Elements 1 (SAFE 1) | 3 |
| 8.821G | Structural Analysis and Finite Elements 2 (SAFE 2) | 3 |
| 8.822G | Structural Analysis and Finite Elements 3 (SAFE 3) | 3 |

### Department of Water Engineering

| | | |
|---|---|---|
| 8.830G | Hydromechanics | 3 |
| 8.831G | Closed Conduit Flow | 3 |
| 8.832G | Pipe Networks and Transients | 3 |
| 8.833G | Free Surface Flow | 3 |
| 8.835G | Coastal Engineering 1 | 3 |
| 8.836G | Coastal Engineering 2 | 3 |

| | | Credits |
|---|---|---|
| 8.842G | Groundwater Hydrology | 3 |
| 8.843G | Groundwater Hydraulics | 3 |
| 8.847G | Water Resources Policy | 3 |
| 8.848G | Water Resources System Design | 3 |
| 8.849G | Irrigation | 3 |
| 8.850G | Drainage of Agricultural Lands | 3 |
| 8.851G | Unit Operations in Public Health Engineering | 3 |
| 8.852G | Water Distribution and Sewage Collection | 3 |
| 8.855G | Water and Wastewater Analysis and Quality Requirements | 3 |
| 8.856G | Water Treatment** | 3 |
| 8.857G | Sewage Treatment and Disposal** | 3 |
| 8.858G | Water Quality Management** | 3 |
| 8.860G | Investigation of Groundwater Resources 1 | 3 |
| 8.861G | Investigation of Groundwater Resources 2 | 3 |
| 8.862G | Fluvial Hydraulics | 3 |
| 8.863G | Estuarine Hydraulics | 3 |
| 8.864G | Arid Zone Hydrology | 3 |
| 8.865G | Arid Zone Waters Resources Management | 3 |
| 8.868G | Public Health Science | 3 |
| 8.869G | Instrumentation and Control in Water Supply and Wastewater Engineering | 3 |
| 8.870G | Hydraulics and Design of Water and Wastewater Treatment Plants | 3 |
| 8.871G | Water Supply and Sanitation in Developing Countries | 3 |
| 8.872G | Solid Waste Management | 3 |
| 8.873G | Waste and Wastewater Analysis and Environmental Requirements | 3 |
| 8.874G | Waste Management Science | 3 |
| 8.875G | Hydrological Processes | 3 |
| 8.876G | Applied Hydrological Modelling | 3 |
| 8.877G | Flood Design 1 | 3 |
| 8.878G | Flood Design 2 | 3 |
| 8.879G | Flood Design 3 | 3 |
| 8.880G | Groundwater Modelling | 3 |
| 8.881G | Hazardous Waste Management | 3 |
| 8.882G | Industrial Waste Management | 3 |
| 8.883G | Sources of Waste and Landfill Disposal | 3 |

**Other Subjects**

| | | |
|---|---|---|
| 8.901G | Special Topic in Civil Engineering | 3 |
| 8.902G | Special Topic in Civil Engineering | 3 |
| 8.909G | Project | 9 |
| 8.918G | Project Report | 18 |
| 8.936G | Thesis* | 36 |

*A 36 credit Thesis is not normally approved in the school. The normal program includes a 9 credit Project.

**Students specialising in Public Health Engineering normally study 42.211G Principles of Biology and 42.214G Biotechnology in the School of Biotechnology.

## Electrical Engineering and Computer Science

**Department of Communications**

| | | Credits |
|---|---|---|
| 6.050G | Special Topic | 3 |
| 6.070G | Digital Image Processing Systems | 3 |
| 6.150G | Theory of Optical Fibres and Optical Signal Processing | 3 |
| 6.164G | Antenna Design and Applications | 3 |
| 6.167G | Propagation and Transmission of Electromagnetic Waves | 3 |
| 6.169G | Microwave Circuits: Theory and Techniques | 3 |
| 6.170G | Microwave and Optical Devices | 3 |
| 6.336G | Digital Communication Networks 1 | 3 |
| 6.337G | Data Networks 2 | 3 |
| 6.338G | Television Systems | 3 |
| 6.340G | Communication Electronics | 3 |
| 6.341G | Signal Processing 1- Fundamental Methods | 3 |
| 6.342G | Signal Processing 2- Advanced Techniques | 3 |
| 6.343G | Digital and Analogue Communications | 3 |
| 6.347G | Digital Modulation | 3 |
| 6.348G | Optical Communication Systems | 3 |

**Department of Electric Power Engineering**

| | | |
|---|---|---|
| 6.205G | Power System Planning and Economics | 3 |
| 6.206G | Power System Operation,Control and Protection | 3 |
| 6.221G | High Voltage Technology | 3 |
| 6.224G | Partial Discharges in Electrical Insulation | 3 |
| 6.227G | Insulation Performance in Electrical Plant | 3 |
| 6.228G | Power System Equipment | 3 |
| 6.229G | Fields and Materials | 3 |
| 6.242G | Power Systems Analysis | 3 |
| 6.250G | Special Topic in Power | 3 |
| 6.251G | Special Topic in Power | 3 |

**Department of Electronics**

| | | |
|---|---|---|
| 6.550G | Special Topic in Electronics | 3 |
| 6.573G | Advanced Semiconductor Devices | 3 |
| 6.575G | Integrated Circuit Technology | 3 |
| 6.577G | Integrated Circuit Design | 3 |
| 6.578G | Solar Energy Conversion | 3 |
| 6.579G | Solar Cells - Operating Principles, Technology and System Applications | 3 |

**Department of Systems and Control**

| | | |
|---|---|---|
| 6.401G | Computer Control Systems 1 | 3 |
| 6.403G | Computer Control Systems 2 | 3 |
| 6.404G | Real Time Computing and Control | 3 |
| 6.405G | Topics in Digital Control | 3 |
| 6.406G | Advanced Control Topics | 3 |
| 6.433G | Design of Advanced Microprocessor Systems | 3 |
| 6.457G | Cybernetic Engineering | 3 |
| 6.468G | Computer Display Systems and Interactive nstrumentation | 3 |

| | | Credits |
|---|---|---|
| 6.469G | Robot Vision | 3 |
| 6.470G | Robotics, Automation and Productivity Technology | 3 |
| 6.484G | Biological Signal Analysis | 3 |

**Department of Computer Science**

| | | |
|---|---|---|
| 6.002G | Advanced Data Base Management | 3 |
| 6.003G | Advanced Decision Theory for Information Science | 3 |
| 6.004G | Advanced topics in Information Science | 6 |
| 6.005G | Data Base Systems | |
| 6.006G | Human-Computer Interaction | 3 |
| 6.654G | Digital Systems | 3 |
| 6.655G | Computer Organisation and Architecture | 3 |
| 6.665G | VLS1 System Design | 3 |
| 6.666G | Artificial Intelligence | 3 |
| 6.667G | Programming Languages: Fundamental Concepts | 3 |
| 6.668G | Computer Graphics | 3 |
| 6.669G | Formal Specification | 3 |
| 6.670G | Parallel and Distributed Computing Systems | 3 |

**Other subjects**

| | | |
|---|---|---|
| 10.061G | Advanced Mathematics for Electrical Engineers | 3 |
| 10.361G | Statistics | 3 |

**Project or Thesis**

| | | |
|---|---|---|
| 6.918G | Project Report | 18 |
| 6.936G | Thesis | 36 |

## Mechanical and Industrial Engineering

| | | Credits |
|---|---|---|
| 5.045 -6-7G | Special Topics in Mechanical Engineering | 2,2,2 |
| 5.048G | Special Topic in Mechanical Engineering | 3 |
| 5.049G | Special Topic in Mechanical Engineering | 3 |
| 5.073G | Ordinary Differential Equations in Mechanical Engineering | 3 |
| 5.086G | Digital Logic Fundamentals for Mechanical Engineers | 3 |
| 5.087G | Microprocessor Fundamentals for Mechanical Engineers‡ | 3 |
| 5.088G | Industrial Applications of Microprocessors | |
| 35.089G | Elements of Industrial Automation‡ | 3 |
| 5.090G | The Analysis and Use of Integrated CAD/CAM Systems | 3 |
| 5.151-2G | Refrigeration and Air Conditioning Design 1, 2* | 3,3 |
| 5.314G | Advanced Vibration Analysis | 3 |
| 5.317G | Industrial Robotics | 3 |
| 5.318-9G | Advanced Mechanism Analysis and Synthesis 1, 2 | 3,3 |
| 5.320G | Artificially Intelligent Machines | 3 |
| 5.328-9G | Control and Modelling of Mechanical Systems 1,2‡ | 3,3 |
| 5.336G | Random Vibrations | 2 |
| 5.403G | Experimental Stress Analysis | 3 |
| 5.414G | Finite Element Applications | 3 |
| 5.415-6G | Stress Analysis for Mechanical Engineering Design 1,2 | 3,3 |
| 5.417G | Mechanics of Fracture and Fatigue | 3 |
| 5.601G | Computational Fluid Dynamics | 3 |
| 5.602G | Numerical Fluid Dynamics and Heat Transfer | 3 |
| 5.616-7G | Internal Combustion Engines 1,2 | 3,3 |
| 5.621-2G | Gasdynamics 1,2 | 2,2 |
| 5.631-2G | Lubrication Theory and Design 1,2 | 2,2 |
| 5.653-4G | Acoustic Noise 1,2 | 2,2 |
| 5.655G | Energy Conservation and System Design | 3 |
| 5.715G | Two Phase Flow and Heat Transfer* | 4 |
| 5.722G | Solar Thermal Energy Design | 3 |
| 5.731G | Analysis of Heat Transfer* | 4 |
| 5.732G | Power Plant Engineering | 3 |
| 5.753G | Ambient Energy Air Conditioning 2 | |
| 5.755-6G | Refrigeration and Air Conditioning 1, 2* | 3,3 |
| 5.757G | Refrigeration and Air Conditioning Applications | 3 |
| 5.759G | Refrigeration and Air Conditioning Experimentation | 3 |
| 5.909G | Project | 9 |
| 5.912-3G | Naval Hydrodynamics 1,2 | 2,2 |
| 5.918G | Project Report | 18 |
| 5.936G | Thesis § | 36 |

*Candidates wishing to specialise in Refrigeration and Air Conditioning should select this subject.
‡Candidates wishing to specialise in Industrial Automation should select this subject.
§A 36 credit thesis is not normally approved in the School of Mechanical and Industrial Engineering.

**Department of Industrial Engineering**

| | | |
|---|---|---|
| 18.061G | Industrial Experimentation 1 | 3 |
| 18.062G | Industrial Experimentation 2 | 3 |
| 18.074G | Industrial Management | 3 |
| 18.076G | Decision Support Systems | 3 |
| 18.171G | Inspection and Quality Control | 3 |
| 18.260G | Computer Aided Programming for Numerical Control | 3 |
| 18.261G | Computer Automation | 3 |
| 18.360G | Ergonomics | 3 |
| 18.371G | Factory Design and Layout | 3 |
| 18.380G | Methods Engineering | 4 |
| 18.461G | Design for Production | 4 |
| 18.464G | Value Analysis Engineering | 3 |
| 18.465G | Computer-Aided Manufacturing | 3 |
| 18.471G | Design Communication | 2 |
| 18.571G | Operations Research 1 | 6 |
| 18.574G | Management Simulation | 3 |
| 18.579G | Case Studies in Operations Research | 3 |
| 18.671G | Decision Theory | 2 |
| 18.672G | Decision Theory for Industrial Management | 3 |

| | | Credits |
|---|---|---|
| 18.673G | Energy Modelling, Optimisation and Energy Accounting | 3 |
| 18.675G | Economic Decisions in Industrial Management | 3 |
| 18.760G | Discrete Event Simulation Languages | 3 |
| 18.761G | Simulation in Operations Research | 3 |
| 18.763G | Variational Methods in Operations Research | 3 |
| 18.764G | Management of Distribution Systems | 2 |
| 18.765G | Optimisation of Networks | 2 |
| 18.770G | Stochastic Control | 2 |
| 18.772G | Information Processing Systems in Organisations | 2 |
| 18.773G | Optimal Control Operations Research | 2 |
| 18.774G | Applied Stochastic Processes | 2 |
| 18.775G | Networks and Graphs | 2 |
| 18.776G | Production and Inventory Control | 2 |
| 18.777G | Time Series and Forecasting | 2 |
| 18.778G | Scheduling and Sequencing | 2 |
| 18.779G | Game Theory | 2 |
| 18.862G | Linear Programming | 2 |
| 18.863G | Non-Linear Programming | 2 |
| 18.868G | Industrial Applications of Mathematical Programming | 3 |
| 18.870G | Large Scale Optimisation in Industry | 3 |
| 18.871G | Mathematics for Operations Research | 2 |
| 18.874G | Dynamic Programming | 2 |
| 18.875G | Geometric Programming | 2 |
| 18.876G | Advanced Mathematics for Operations Research | 2 |
| 18.879G | Mathematical Programming Analysis | 3 |
| 18.965G | Industrial Management Seminar | 0 |
| 18.967G | Special Topic in Production Engineering | 2 |
| 18.968G | Special Topic in Production Engineering | 2 |
| 18.969G | Special Topic in Production Engineering | 2 |
| 18.970G | Operations Research Seminar | 0 |
| 18.975G | Special Topic in Industrial Engineering | 3 |
| 18.976G | Special Topic in Industrial Engineering | 3 |
| 18.977G | Special Topic in Operations Research | 2 |
| 18.978G | Special Topic in Operations Research | 2 |
| 18.979G | Special Topic in Operations Research | 2 |
| 18.909G | Project | 9 |
| 18.918G | Project Report | 18 |
| 18.936G | Thesis† | 36 |

**Centre for Manufacturing and Automation**

| | | |
|---|---|---|
| 97.601G | Computer Aided Design for Manufacture | 3 |
| 97.602G | Computer Integrated Manufacturing | 3 |
| 97.603G | Product Design and Technological Innovation | 3 |
| 97.604G | Flexible Manufacturing Systems | 3 |
| 97.605G | CAD for Manufacture 2 | 3 |

Note 1: Candidates taking their Projects in Industrial Management are generally required to take 18.074G and 18.965G plus at least 11 credits from 18.380G, 18.571G, 18.675G, 18.776G and 14.062G Accounting for Engineers. Before enrolling in the Projects they must have had one year's relevant industrial experience and have access to industry for their project topics.
Note 2: Candidates taking their projects in Operations Research are generally required to take the 18.571G, 18.574G, 18.970G and 14.062G Accounting for Engineers.

Note 3: All Master of Engineering Science candidates in the Department of Industrial Engineering must include 18.909G or 18.918G in their programs.
†A 36 credit Thesis is not normally approved in the School of Mechanical and Industrial Engineering.

## Surveying

| | | Credits |
|---|---|---|
| 29.106G | Special Topic in Surveying A | 3 |
| 29.107G | Special Topic in Surveying B | 3 |
| 29.121G | Network and Deformation Analysis | 3 |
| 29.122G | Elements of Geodetic Equipment | 3 |
| 29.161G | Advanced Estimation Techniques | 3 |
| 29.162G | Mathematical Methods | 3 |
| 29.210G | Satellite Surveying | 3 |
| 29.211G | Introduction to Geodesy | 3 |
| 29.213G | Physical Meteorology | 3 |
| 29.217G | Gravimetric Geoid Evaluations | 3 |
| 29.530G | Analytical Photogrammetry | 3 |
| 29.532G | Computer Assisted Mapping | 3 |
| 29.600G | Principles of Remote Sensing | 3 |
| 29.602G | Remote Sensing Procedures | 3 |
| 29.604G | Land Information Systems | 3 |
| 29.605G | Ground Investigations for Remote Sensing | 3 |
| 29.608G | Cadastral Systems | 3 |
| 29.909G | Project | 9 |
| 29.918G | Project Report | 18 |
| 29.936G | Thesis | 36 |

## Centre for Biomedical Engineering

| | | |
|---|---|---|
| 32.009G | Project | 9 |
| 32.010G | Biomedical Engineering Practice | 2 |
| 32.012G | Biomedical Statistics | 4 |
| 32.018G | Project Report | 18 |
| 32.026G | Radiation Physics | 2 |
| 32.027G | Medical Imaging | 4 |
| 32.030G | Project Report | 30 |
| 32.040G | Analogue Electronics for Biomedical Engineers† | 4 |
| 32.050G | Microprocessors and Circuit Design for Biomedical Engineers | 4 |
| 32.060G | Biomedical Systems Analysis | 4 |
| 32.101G | Mathematical Modelling for Biomedical Engineers | 4 |
| 32.311G | Mass Transfer in Medicine | 4 |
| 32.321G | Physiological Fluid Mechanics | 4 |
| 32.332G | Biocompatibility | 3 |
| 32.501G | Computing for Biomedical Engineers | 4 |
| 32.541G | Mechanics of the Human Body‡ | 3 |
| 32.551G | Biomechanics of Physical Rehabilitation‡ | 3 |
| 32.561G | Mechanical Properties of Biomaterials‡ | 3 |
| 32.601G | Biomedical Applications of Microprocessors 1** | 3 |
| 32.602G | Biomedical Applications of Microprocessors 2 ††† | 3 |

| | | Credits |
|---|---|---|
| 32.603G | Static and Flow Cytometry | 3 |
| 32.611G | Medical Instrumentation* | 3 |
| 32.621G | Biological Signal Analysis | 3 |
| 32.701G | Dynamics of the Cardiovascular System | 3 |
| 72.402G | Principles of Disease Processes†† | 3 |

†Prerequisite 32.501G and 32.040G or equivalents.
‡These 3 electives vary according to session offered. Only one is offered each year.
*Prerequisite 32.040G or equivalent.
††For non-medical graduates only. Prerequisite 73.111 or equivalent; pre- or co-requisite 70.011C.
**Prerequisite 32.050G or equivalent.
†††Follows on from 32.601G.

## Safety Science

| | | |
|---|---|---|
| 47.009G | Organisational Communication for safety | 3 |
| 47.030G | Computing for Safety Science | 3 |
| 47.051G | Principles of Engineering Mechanics | 3 |
| 47.052G | Introduction to Safety Engineering | 3 |
| 47.054G | Machines and Structures Safety | 3 |
| 47.060G | Electrical Safety | 3 |
| 47.061G | Principles of Ergonomics | 3 |
| 47.062G | Applied Ergonomics | 3 |
| 47.070G | Ventilation | 3 |
| 47.090G | Introduction to Occupational Health and Safety Law | 3 |
| 47.180G | Management for Safety | 3 |
| 47.120G | Human Behaviour and Safety Science | 3 |
| 47.230G | Radiation Protection | 3 |
| 47.330G | The Accident Phenomenon | 3 |
| 47.480G | Fire and Explosion | 3 |
| 47.481G | Management of Dangerous Materials | 3 |
| 47.903G | Special Report in Safety Science | 3 |
| 47.909G | Project | 9 |
| 47.918G | Project Report | 18 |

## Graduate Diploma Subjects

Graduate Diploma programs in all schools of the Faculty may include subjects from the above list, subject to the approval of the Head of School responsible for the subject.

In addition the following subjects are offered specially for Graduate Diploma candidates. Not all electives are necessarily offered in any particular year.

**School of Electrical Engineering and Computer Science**

| | | |
|---|---|---|
| 6.060G | Microprocessor Systems | 3 |
| 6.481G | Introductory Physiology for Engineers | 3 |
| 6.659G | Data Bases and Networks | 3 |
| 6.660G | Design and Analysis of Algorithms | 3 |
| 6.661G | Business Information Systems | 3 |
| 6.663G | Operating Systems | 3 |
| 6.664G | Compiling Techniques and Programming Languages | 3 |

**School of Mechanical and Industrial Engineering**

| | | Credits |
|---|---|---|
| 5.086G | Digital Logic Fundamentals for Mechanical Engineers | 3 |
| 18.380G | Methods Engineering | 4 |
| 18.580G | Operations Research | 6 |
| 18.681G | Engineering Economic Analysis | 3 |
| 18.780G | Production Control | 2 |
| 14.001 | Introduction to Accounting A | 3 |
| 14.002 | Introduction to Accounting B | |
| 14.042G | Industrial Law | 2 |
| 14.062G | Accounting for Engineers | 3 |

# Project Reports and Theses

Supervision of project reports and theses will generally be available in the following areas of research interest in the Schools of the Faculty. Alternatively, design and other topics may be chosen by arrangement.

## Civil Engineering

**Engineering Construction and Management**
Construction techniques. Equipment selection. Field studies of spatial layout, material flow, and construction operations.
Micro, macro, and system structure of construction operations.
Civil engineering management.
Critical path methods, and operations research methods in engineering construction.
Information flow requirements and decision processes of office and field agents.

**Geotechnical Engineering**
Shear strength of jointed rock, soft rock and clay soils.
Expansive soils.
Mine tailings and power station ash disposal.
Uncertainty in geotechnical engineering.
Landsliding–groundwater response to rainfall, progressive failure, probability of failure.
Influence of soil fabric and mineralogy on properties.
Grouting with cement and chemicals.
Predicting excavatibility of rock.

**Numerical Methods in Geomechanics**
Finite element techniques and their applications in geotechnical engineering including static and dynamic loading.
Theoretical and numerical studies of rock blasting
Numerical techniques in static and dynamic fracture mechanics.
Application of artificial intelligence and fuzzi-sets in geotechnical engineering.

**Pavement Engineering**

Skid resistance.
Pavement management and rehabilitation.
Interlocking concrete block pavements.
Accelerated trafficking studies of pavements and pavement materials.
Constitutive relationships of soils and pavement materials.
Pavement designs and analysis.

**Civil Engineering Materials**

Specification and quality control of concrete.
Investigation of alternative cementicious materials.
Examination of pozzolanic potential of indigenous materials.
Utilisation of industrial waste materials in concrete.
Chemistry and mineralogy of cement and lime stabilisation.

**Groundwater**

Water movement in unsaturated soils.
Pollutant movement in soils.
Salinity studies.
Groundwater studies and modelling.
Well hydraulics.

**Hydrology**

Flood estimation.
Yield and reservoir studies.
Hydrological instrumentation, data collection, and processing.
Mathematical rainfall-runoff models.
Stochastic hydrology.
Hydrological processes.
Hydrometeorology.
Urban drainage.
Arid Lands Hydrology.

**Hydraulics**

Two-fluid systems with small density differences.
Sediment motion.
Air entrainment in water in open channels and closed conduits.
Wave action and coastal engineering.
Flow through porous media.
Hydraulic transportation of solids.
Coastal engineering and breakwater stability.
Closed conduit flow.

**Prestressed Concrete Structures**

Partially prestressed concrete beams.
Analysis and design of end blocks for post-tensioned beams.
Strength of precast prestressed concrete planks.

**Public Health Engineering**

Sewage sludge conditioning and filtration.
Clarifiers and sedimentation in water and waste water treatment.
Filtration.
Fluidised bed aerobic and anaerobic treatment.
Aerobic digestion.
Nutrient control.
Treatment of high strength waste waters.
Chemical fixation of hazardous wastes.

**Reinforced Concrete Structures**

Behaviour and strength of slender reinforced concrete columns. Studies on high-strength concrete.
Behaviour of slabs in the vicinity of columns.
Reinforced concrete deep beams.
Creep and shrinkage effects in reinforced concrete structures.
Composite steel-concrete and concrete-concrete construction.

**Structural Analysis**

Development and application of finite element techniques.
Investigation of elastic stability.
Analysis of dynamic response of off-shore structures and buildings.
Shakedown analysis of structures.

**Transport Engineering**

Problems of land use and transport interaction.
Theories of traffic structure and flow.
Measurements, planning and control of traffic.
Transport systems analysis.
Transport and the environment – accidents, energy, intrusion, noise and pollution.
Investigation of human factors.
Economic evaluation of transport investments.
Transport planning – local, urban, and regional systems.
Investigations into transport economics, policy and decision making.
Investigations of the geometric shape of the road alignment on the driver's view of the road.
Study of road alignment design in three dimensions.

**Water Resources Engineering**

Multi-objective water resources planning.
Hydro-economic studies.
Optimisation problems in water resource systems design.
Drought studies.
Flood plain management.
Arid lands management.

## Electrical Engineering and Computer Science

**Communications**

Optical communications
Optical fibres and integrated optics
Electro-optic devices including sensors
Digital communications
Digital radio and modulation methods
Computer communications and local area networks
New architectures for local area networks
Switching and stored program control systems
UHF and microwave circuits and devicess
Microwave measurements and electronics
Antennas and phased arrays
Radar and navigational aids
Mobile satellite communications
Signal processing and analysis
Active and adaptive filtering.
Digital filters
Digital signal processor chip applications
Acoustic and seismic signal processing
Speech recognition and synthesis
Real-time speech to text conversion
Communications aids for the handicapped

Digital image processing
Electronic music
Man-machine interaction
Television.
SAW Signal Processing
Land & Satellite Mobile Communications

**Computer Science**
Computer organisation
Computer graphics
Computational Geometry
Artificial intelligence
Expert systems
Operating systems
Languages
Data base Management
Data base machine projects
Computer aided design
Computer aided instruction projects (CAI)
Fault tolerant computer systems
Office automation and electronic publishing
Digital systems description languages
Integrated circuit design and logic testing
VLSI systems
Man-machine Interfaces
Computer Architecture
Microprocessor based equipment
Computer Assisted Learning
Logic Programming
Program verification
Computer arithmetic
Parsing and compiling
Fourth generation languages and program generators
Program similarity
Complexity
String matching
Mechanical Theorem Proving
Non-standard Logics (Modal and Temporal Logics)
Knowledge Representation using conceptual graphs

**Electric Power**

*(i) Power Systems*
Power systems analysis
Power System Protection
Stability, Dynamics and Control of Power Systems
Distribution System Planning and Operation
Electromagnetic Transient Analysis
Static VAR Compensation
Power System Planning and Economics
Load Management and Control
Alternative Power Sources - Remote Area Supply

*(ii) Electrical Power Equipment and Utilization*
High Voltage and High Current Phenomena
Insulating Material Application
Electrical Testing
Transformer Design
Voltage Disturbances in LV and MV Systems
Electrical Measurements and Data Acquisition
Electrical Machines and Drives
Arcing fault characteristics
Partial Discharge Detection and Location
Distribution System Protection
Gaseous discharges and insulation
Equipment for Harzardous Atmospheres
Synthetic Loading of Machines
Computer Aided Teaching

*(iii) Power Electronics*
DC/DC Converters
High Frequency Power Transformers
Inverters for Machine Drives
Microprocessor Control of Power Electronics
Variable Speed Drives
Power Electronic Simulation Studies
Electronic Commutation
Remote area supplies

**Electronics**

Semiconductor device physics
Novel Semiconductor Devices
Integrated circuit design
Integrated circuit technology
Optical & Infrared Detector Arrays
Microelectronic sensors
Photovoltaic solar energy conversion
Silicon Solar Cells
Computer-aided IC design
Plasma Processing
Intergrated Circuits for Advanced Signal processing
High-Speed Bipolar Logic

**Systems and Control**

Boiler-turbine modelling
Control and simulation
Digital systems and digital signal processing
Microprocessor Technology in:
  Control Systems
  Informatopm displays
Biomedical Engineering:
  Gait Analysis
  Physiological System Modelling
  Heart Rate Variability
Biological Signal Analysis
Analysis of Physiological Systems
Computer Modelling of Information Processing
Cybernetic Engineering and Advanced Robotics:
  Signal, Pattern, Image and Scene, Analysis and Processing
  Brain Modelling
  Neural Computing and Learning Machines
  Vision Robotics and Assembly
  Formal Systems and Functional Representation
Industrial Applications of Control and Simulation
Adaptive Control
Hierarchical Control
Digital control
Multivariable control
Control applications of expert systems
Identification and systems modelling
Video Image Acquisition for Measurement and Inspection
Concurrent Software for Real Time Control
Computer Interface Electronics and Computer Based Instrumentation
Control drives for PM machines

## Mechanical and Industrial Engineering

**Applied Mechanics**
Biomechanics
Mechanics of solids
Stress analysis
Impact mechanics
Adaptive control systems1Process stimulation and control
Spatial and planar mechanisms
Dynamics of machines
Rotor bearing dynamics
Multi-mode vibrations
Lubrication and wear
Hydrodynamic dampers
Computer aided design
Industrial automation
Mechanical harvesting of fruit and vegetables
Mechanical handling, grading and processing of agricultural produce
Development of shearing equipment
Metering and placement of seed and fertiliser

**Fluid Mechanics Thermodynamics – IncludingAeronautical Engineering and Naval Architecture**
Two-phase flow with and without heat transfer
Slurries
Conveying of solid dusts by gases
Hydraulic transients
Hydrodynamics, water hammer
Fluidics
Conduction, convection, and radiation
Natural convection
Computational fluid dynamics and heat transfer
Refrigeration and air conditioning
Energy conversion and conservation
Solar energy and systems
Engine performance and emissions
Gas dynamics. Transonic flow. Shock waves.
Jets, turbulent mixing. Noise. Hot wire and optical measuring methods
Large scale structures
Light aircraft design and performance
Development of a ship structure optimisation system
Analysis and design of plated grillages
Vortex shedding in aeronautical and maritime engineering
Economic studies relative to ship industry
Hydrodynamics of planing surfaces
Problems in wave resistance
Finite element methods

**Industrial Engineering – comprising Operations Research and Production Engineering**
Engineering economic analysis
Efficiency of production lines
Optimum shearing policies for rolled bars
Application of probability theory in the allocation of engineering tolerance
Computer generation of timetables
Job shop scheduling
Least-cost tolerance
Optimum reject allowance
Operational simulation
Variety reduction
Probabilistic networks
Optimisation techniques relevant to information processing systems
Statistical decision theory
Production scheduling for variable demand
Inventory and production control
Optimum control
Mathematical programming
Dynamic programming
Geometric programming
Integer programming
Large scale optimisation
Applications of operations research to real-world problems
Stochastic processes
Applications of optimisation techniques
Experimental and theoretical investigations of the following process: machining, extrusion, indentation, compression, rolling, drawing
Performance of single and multipoint cutting tools including tool life and economics of machining
Properties of materials at high rates of strain
Materials handling studies
Factory design and location studies
Plant layout by computer
Ergonomics
Occupational safety and health
Production design studies
Engineering design analysis and tolerance technology
Metrology studies
Group technology studies

## Surveying

**Geodesy and Satellite Positioning**
Positioning with GPS
Geoid and gravimetric studies
Satellite geodesy and precise orbit determinations
Geodynamics: crustal motion studies using satellite laser ranging and very long baseline interferometry data and GPS
Adjustment of continental control networks
Ionospheric and tropospheric effects in GPS measurement

**Photogrammetry**
Design of analytical plotter
software
Aerotriangulation, computer applications, block adjustment, independent model triangulation
Digital terrain models
Photogrammetry with digital images
Location of features on digital images
Geometry of image sensors, remote-sensing imaging devices
Mapping applications of remotely sensed data
Non-topographic applications

**Land Information Systems (LIS)**
LIS pertaining to Local Government needs
Role of Local Government in a state-wide LIS

Incorporation of remote sensing into LIS
Data acquisition and upgrading in LIS
LIS networks
LIS in developing countries
Land tenure, land registration and cadastral surveying systems
Integration of remotely sensed data and vector data

**Surveying**
Precise navigation with GPS
GPS surveying
Testing and calibration of GPS instruments
Application of GPS to engineering projects
Analysis of deformation measurements
High precision electronic distance measurement
Applications of inertial technology
Precision surveys in industry
Monitoring of structures and terrains
Metrology
Design of networks in engineering

## Biomedical Engineering

Modelling of respiratory function, cardiovascular function, nervous system, artificial kidney therapy, extracorporeal heart-lung support, endocrine system and other body systems
Development of biomaterials
Investigation of physiological fluid mechanics
Microprocessor control of medical equipment
Limb and joint dynamics studies
Development of implantable electrodes
Development of rehabilitation devices
Statistical analysis of patient therapy and modes of patient treatment
Development and evaluation of new hospital equipment and treatment procedures
Signal analysis of wave forms from medical diagnostic equipment
Implants for fracture support and joint replacement
Improved drug administration
Arterial haemodynamics and ventricular-vascular interaction
Mechanisms of age-related arterial degeneration and hypertension
Isolated heart studies of the coronary circulation and electrophysiology

## Remote Sensing

Incorporation of auxiliary data into classification procedures
Application of satellite data to Urban Area studies
Monitoring land use change using remotely sensed data
Determining the characteristics of surface reflectance
Analysis of image quality
Application of satellite imagery to small scale mapping
Multispectral linear transformations
Application of spaceborne synthetic aperture radar data
Application of aircraft and satellite data to arid land studies
Application of satellite data to geological studies
Synergism of radar, visible and infrared remotely sensed data
Analysis of high resolution SPOT and Landsat TM data

## Safety Science

Safety engineering
Occupational ergonomics
Biomechanics
Fires and explosions
Slips and falls
Machine guarding
Radiation safety (ionising & non-ionising radiation)
Electrical safety
Air quality, measurement, ventilation systems
Human computer interaction
Safety equipment
Lock out and other safety control systems
Occupational hygience
Occupational disease
Epidemiology
Risk Management
Management of safety
Human behaviour
Accident reporting & analysis

## Waste Management

Landfill site selection
Leachate testing
Chemical fixation
Domestic solid waste collection routing
Hydrogeological sampling
Acid waste treatment
Metals removal
Toxicity testing
Legal aspects of hazardous waste

# Subject Descriptions

## Identification of Subjects by Number

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

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

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

**1.** The authority offering the subject, normally a School of the University, is indicated by the number before the decimal point.

**2.** Each subject number is unique and is not used for more than one subject title.

**3.** Subject numbers which have previously been used are not used for new subject titles.

**4.** Graduate subjects are indicated by a suffix 'G' to a number with three digits after the decimal point. In other subjects three or four digits are used after the decimal point.

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

Appropriate subjects for each school appear at the end of each school section.

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

Servicing Subjects are those taught by a school or department outside its own faculty. Their subject descriptions are published in the handbook of the faculty which originates the subject and are also published in the handbook of the faculty in which the subject is taught. These subjects will be found at the back of this handbook.

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

HSC Exam Prerequisites

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

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

**Information Key**

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

**S1** Session 1, **S2** Session 2
**F** Session 1 *plus* Session 2, ie full year
**S1** or **S2** Session 1 *or* Session 2, ie choice of either session
**SS** single session, but which session taught is not known at the time of publication
**CCH** class contact hours
**L** Lecture, followed by hours per week
**T** Laboratory/tutorial, followed by hours per week
**hpw** hours per week
**C** credit or Credit units
**CR** Credit level
**DN** Distinction
**HD** High Distinction
**X** External

| | School, Department etc *Subject also offered for courses in this handbook | Faculty |
|---|---|---|
| 1 | School of Physics* | Science |
| 2 | School of Chemistry* | Science |
| 3 | School of Chemical Engineering and Industrial Chemistry (New Course) | Applied Science |
| 4 | School of Materials Science and Engineering | Applied Science |
| **5** | **School of Mechanical and Industrial Engineering*** | **Engineering** |
| **6** | **School of Electrical Engineering and Computer Science*** | **Engineering** |
| 7 | School of Mines (Mineral Processing and Extractive Metallurgy and Mining Engineering) | Applied Science |
| **8** | **School of Civil Engineering*** | **Engineering** |
| 9 | School of Fibre Science and Technology (Wool and Animal Science) | Applied Science |
| 10 | School of Mathematics* | Science |
| 11 | School of Architecture | Architecture |
| 12 | School of Psychology | Biological Sciences |
| 13 | School of Fibre Science and Technology (Textile Technology) | Applied Science |
| 14 | School of Accounting* | Commerce and Economics |
| 15 | School of Economics* | Commerce and Economics |
| 16 | School of Health Services Management | Professional Studies |
| 17 | Faculty of Biological and Behavioural Sciences* | Biological and Behavioural Sciences |
| **18** | **School of Mechanical and Industrial Engineering (Industrial Engineering)** | **Engineering** |
| 19 | School of Information Systems | Commerce and Economics |
| 20 | Centre for Petroleum Engineering Studies | Applied Science |
| 21 | Department of Industrial Arts | Architecture |
| 22 | Faculty of Professional Studies | Professional Studies |
| 23 | School of Primary and Computer Education | Professional Studies |
| 25 | School of Mines (Applied Geology) | Applied Science |
| 26 | Centre for Liberal and General Studies | Liberal and General Studies |
| 27 | School of Geography | Applied Science |
| 28 | School of Marketing* | Commerce and Economics |
| **29** | **School of Surveying*** | **Engineering** |
| 30 | School of Industrial Relations and Organizational Behaviour | Commerce and Economics |
| 31 | School of Optometry | Science |
| **32** | **Centre for Biomedical Engineering** | **Engineering** |
| 33 | School of Sports and Leisure Studies | Professional Studies |
| 35 | School of Building | Architecture |
| 36 | School of Town Planning * | Architecture |
| 37 | School of Landscape Architecture* | Architecture |
| 39 | Graduate School of the Built Environment | Architecture |
| 40 | Academic Board | |
| 41 | School of Biochemistry* | Biological and Behavioural Sciences |
| 42 | School of Applied Bioscience (Biotechnology) | Applied Science |
| 44 | School of Microbiology* | Biological and Behavioural Sciences |
| 45 | School of Biological Science | Biological and Behavioural Science |
| 46 | Faculty of Applied Science | Applied Science |
| **47** | **Centre for Safety Science** | **Engineering** |
| 48 | School of Chemical Engineering and Industrial Chemistry (Old course) | Applied Science |
| 49 | School of Applied Bioscience (Food Science and Technology) | Applied Science |
| 50 | School of English | Arts |
| 51 | School of History | Arts |
| 52 | School of Philosophy | Arts |
| 53 | School of Sociology | Arts |
| 54 | School of Political Science* | Arts |
| 55 | School of Lbrarianship | Professional Studies |
| 56 | School of French | Artts |
| 57 | School of Theatre Strudies | Arts |
| 58 | School of Education | Professional Studies |
| 59 | Department of Russian Studies | Arts |
| 60 | Faculty of Arts | Arts |
| 61 | Department of Music | Arts |
| 62 | Scjhool of Science and Technology Studies | Arts |
| 63 | School of Social Work | Professional Studies |
| 64 | School of German Studies | Arts |
| 65 | School of Spanish and Latin Ameriocan Studies | Arts |
| 66 | Subjects Available from Other Universities | |
| 67 | Faculty of Science | Science |
| 68 | Board of Studies in Science and Mathematics | Board of Studies in Science and Mathematics |
| 69 | School of Arts Education | Professional Studies |
| 70 | School of Anatomy | Medicine |
| 71 | School of Medicine | Medicine |
| 72 | School of Pathology | Medicine |
| 73 | School of Physiology and Pharmacology | Medicine |

| School, Department etc *Subject also offered for courses in this handbook | Faculty |
|---|---|
| 74 School of Surgery | Medicine |
| 75 School of Obstetrics and Gynaecology | Medicine |
| 76 School of Paediatrics | Medicine |
| 77 School of Psychiatry | Medicine |
| 78 School of Medical Education | Medicine |
| 79 School of Community Medicine | Medicine |
| 80 Faculty of Medicine | Medicine |
| 81 Medicine/Science/ Biological Sciences | Medicine |
| 85 Australian Graduate School of Management | AGSM |
| 90 Faculty of law | Law |
| 97 Faculty of Engineering | Engineering |
| 98 School of Banking and Finance | Commerce and Economics |
| 99 Department of Legal Studies and Taxation | Commerce and Economics |

# Chemistry

## Graduate Study

**2.251G Toxicology, Occupational and Public Health** **F L1 T3**

Important classes of toxic materials found in the environment; treatment of pesticide residues, industrial chemicals of various types, toxic gases, mould metabolites and bacterial toxins occurring in food, carcinogenic substances, toxic metals, etc. Effects of these substances on living organisms, particularly man. Practical work: pesticide residue analysis, blood and urine analysis, gas sampling and analysis, trace metal determination and experiments on the animal metabolism of toxic substances.

# Mechanical and Industrial Engineering

**5.045G Special Topic in Mechanical Engineering** **C2**

**5.046G Special Topic in Mechanical Engineering** **C2**

**5.047G Special Topic in Mechanical Engineering** **C2**

**5.048G Special Topic in Mechanical Engineering** **C3**

**5.049G Special Topic in Mechanical Engineering** **C3**

These syllabi change to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

**5.073G Ordinary Differential Equations in Mechanical Engineering** **C3**

Solutions and their meaning, integration constants, linearity; special methods of solution; integration factors; variation of parameters; Euler, higher order linear equations; physical origins of ordinary differential equations and linear systems; linearization of engineering problems; stability of engineering systems.

**5.086G Digital Logic Fundamentals for Mechanical Engineers** **C3**

*Excluded 6.021E, 6.631 and equivalent.*

Discrete logic elements; assembly design; misoriented design; support devices; microprocessor units.

**5.087G Microprocessor Fundamentals for Mechanical Engineers** **C3**

*Prerequisite: 5.086G or equivalent. Excluded 6.0318,6.432,6.613,6.060G, 6.433G, 6.651G and equivalent.*

Microprocessor chips; system design; memory; past design; programming; applications.

**5.088G Industrial Applications of Microprocessors** **C3**

*Prerequisite: 5.087G or equivalent. Excluded 6.432, 6.433G, 6.651G and equivalent.*

Coding and programming. Transducer selection. Information transfer. Data storage. Power output device control. Application to industrial automation and control. Laboratory complement to lectures.

**5.089G Elements of Industrial Automation** **C3**

An introductory overview of the elements of Industrial Automation systems and the factors governing their use in industry.

**5.090G The Analysis and Use of Integrated CAD/CAM Systems** **C3**

*Prerequisite: 5.089G.*

Economic background to the use of CAD/CAM systems. Elements in systems for use with machining centres, lathes and sheet metal machinery. Data input techniques. Coordinate handling. Machine specific post processors. Data verification and output integrity analysis. Techniques for interfacing machine tools with computers. Restrictions imposed by requirements for real time control. Integration with accounting and cost analysis systems. Choice of computer. Factors in CAD CAM system selection.

**5.151G Refrigeration and Air Conditioning Design 1** **C3**

*Assumed Knowledge: 5.715G, 5.755G, 5.756G or equivalent.*

**5.152G Refrigeration and Air Conditioning Design 2** **C3**

*Prerequisite: 5.151G or equivalent.*

Design of refrigeration equipment compressors; throttling devices; condensers; evaporators. Cooling towers: evaporative condensers; air conditioning coils. Generators and absorbers for absorption systems. Piping systems. Air ducts. Steam raising and water heating equipment. Calculation of transient heating and cooling loads. Air conditioning systems. Load analysis and system capability.

**5.314G Advanced Vibration Analysis**

*Assumed Knowledge: 5.3130 or equivalent. Exclusions: 5.338G, 5.348, 5.335G, 5.3140.*

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.

**5.317G Industrial Robotics** C3

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.

**5.318G Advanced Mechanism Analysis and Synthesis 1** C3

*Assumed knowledge: 5.301 or 5.3021 or 5.333 or equivalent. Excluded 5.3040, 5.315G.*

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

**5.319G Advanced Mechanism Analysis and Synthesis 2** C3

*Excluded 5.316G and equivalent.*

A selection of topics from *Planar mechanisms:* kinematic analysis of complex mechanisms; kinetic analysis; kinematic geometry; precision position synthesis. *Cams:* basic and common curves; equations of motion; development of profile; determination of system geometry and mechanical properties; noise, wear, backlash and manufacture. *Spatial linkages:* structural analysis; closure equations; screw system algebra; special configurations.

**5.320G Artificially Intelligent Machines** C3

The principles of operation of machines into which limited powers of decision making have been delegated. The grouping of intelligent machines. Cognition; sensor technology; parsing; information representation; convolutions; software and hardware environments.

**5.328G Control and Modelling of Mechanical Systems 1** C3

As for 5.329G.

**5.329G Control and Modelling of Mechanical Systems 2** C3

*Prerequisite: 5.328G or equivalent.*

Development of modelling techniques using both digital and analogue computation, with special emphasis on the representation of non-linearities. Typical examples of mechanical systems.

**5.336G Random Vibrations** C2

*Assumed knowledge: 5.331 or 5.333 or equivalent.*

Probability, vibration theory review, linear mechanical system response to random vibrations. Statistical characteristics: autocorrelation, spectral density, convolution, narrow band processing, consistency, applications.

**5.403G Experimental Stress Analysis** C3

*Excluded 5.401G.*

Strain gauging: practice, theory, instrumentation, data acquisition and processing, applications, load cell design. Photoelasticity: transmission and reflective. Brittle coatings. Dye penetrants. Practical laboratory classes throughout.

**5.414G Finite Element Applications** C3

*Excluded 5.419, 5.823.*

Introduction to finite element and associated graphics packages. Principles of mesh design and validation. Specification of boundary conditions including use of symmetry. Estimation of the cost of solution. Interpretation of results. Assessment of the accuracy of the results. Convergence to the exact solution. Selection of applications from linear and non-linear elasticity: three dimensional solids, plates and shells, plasticity, buckling and post-buckling behaviour, thermal stresses, dynamics including natural and forced vibration.

**5.415G Stress Analysis for Mechanical Engineering Design 1** C3

*Assumed knowledge: 5.423 or equivalent. Excluded 5.434 and equivalent.*

Plates, shells: primary, secondary and peak stresses, relations to strength. Pressure vessels. Current design philosophies.

**5.416G Stress Analysis for Mechanical Engineering Design 2** C3

*Assumed knowledge: 5.423 or equivalent.*

Topics selected from: Plastic collapse. Limit state design. Stress concentrations. Plate girder panel structures. Lightweight structures. Machine frames. High temperature components. Gears.

**5.417G Mechanics of Fracture and Fatigue** C3

*Excluded 5.428G and 5.429G and equivalent, 5.424.*

Theories of fracture; failure modes. Ductile, brittle fracture. Mechanics of crack propagation, arrest. Measurement of static fracture properties. Fatigue crack initiation, propagation. Engineering aspects of fatigue.

**5.601G Computational Fluid Dynamics** C3

Incompressible flow: primitive equations; stream function, vortic- ity equations. The conservative property. Stability analysis. Explicit, implicit methods. Upwind differences. SOR methods. Fourier series methods. Pressure, temperature solutions. Solving the primitive equations.

**5.602G Numerical Fluid Dynamics and Heat Transfer** C3

*Assumed knowledge: 5.623. Excluded 5.717G, 5.635.*

Introduction: Review of the mechanisms of heat transfer. Governing equations for convection: continuity, Navier-Stokes, energy. Boundary layer equations for forced and natural convection. Boundary conditions. *Approximate analytical solution methods:* momentum and energy integral equations. Polhausen technique. Similarity formulation. Solution by conversion to initial value problem. *Finite*

*difference methods:* finite difference approximations of partial differential equations. Consistency stability and convergence. Application to the boundary layer and full equations of motion and energy.

**5.616G Internal Combustion Engines 1** **C3**

*Excluded 5.643.*

Thermodynamic cycles. Combustion, reaction kinetics. Real engine cycles. Chart, computer analysis. Spark ignition engines. Flame physics. Combustion chamber design. Charging, discharging; heat transfer; friction. Emissions, fuels, computer modelling: efficiency, performance, emissions. Testing. Laboratory.

**5.617G Internal Combustion Engines 2** **C3**

*Prerequisite: 5.615G or 5.616G or equivalent.*

Modifications, alternatives to SI engine: Stratified charge, rotary, orbital, turbo charged, two stroke. Compression ignition engine: combustion knock, chamber design, emissions. Gas turbines. Cycles, limitations, regeneration, combustion, emission. Axial, centrifugal compressors, turbines; matching. Aircraft, automotive, industrial types. Stirling engines: cycle analysis, design. Laboratory.

**5.621G Gasdynamics 1** **C2**

*Excluded 5.653, 5.811.*

One dimensional steady flow: isentropic channel flow, normal shock waves, supersonic wind tunnels and diffusers. Two dimensional steady flow: oblique shock waves, Prandtl-Meyer expansions, nozzles, airfoils. One dimensional unsteady flow: moving waves, reflections, explosions in ducts, shock tubes; method of characteristics, internal flows, piston and valve effects.

**5.622G Gasdynamics 2** **C2**

*Prerequisite: 5.621G or equivalent.*

Kinematics, dynamics, thermodynamics, vorticity. Nozzle. Wind tunnel. Diffusers. Shock waves; steady, moving. Method of characteristics. Combustion. Real gas behaviour at high temperature. Hypersonic aerodynamics, free molecule flow, re-entry; high energy experimental methods.

**5.631G Lubrication Theory and Design 1** **C2**

*Excluded 5.6342.*

History of lubrication, types of bearing and bearing operation, nature of surfaces and their contact, modes of lubrication, 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.

**5.632G Lubrication Theory and Design 2** **C2**

*Prerequisite: 5.631G or equivalent.*

Continuum equations of hydrodynamic lubrication. Journal bearing dynamics. Rolling contacts. Elastohydrodynamic lubrication. Grease lubrication. Plasto-elastohydrodynamic lubrication. Metal forming, cutting lubrication.

**5.653G Acoustic Noise 1** **C2**

*Excluded 5.3541.*

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

**5.654G Acoustic Noise 2** **C2**

*Prerequisite: 5.653G or equivalent. Excluded 5.3542.*

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

**5.655G Energy Conservation and System Design** **C3**

Examination of some existing systems, assessment of their energy losses and their improvement by tuning. Alternative energy sources and their availability, energy utilization and efficiency in various systems. Environmental aspects, assessment of emissions, means of improvement. Economically viable energy technology under present conditions. Expected trends in energy technology in the short and long term. A number of case studies.

**5.700G Power Production Assessment** **C3**

*Assumed knowledge: 5.630 and 5.636 or equivalent.*

Components of hydro, coal and nuclear fuel power station designs. Economics of power production. Operation and maintenance of costs. Efficiency and heat balance calculations of thermal power stations. Comparison of electrical energy production costs of different power stations.

**5.715G Two Phase Flow and Heat Transfer** **C3**

*Assumed knowledge: 5.636 or equivalent. Excluded 5.664.*

Nature of multiphase flow. Flow regime maps. Two-phase flow in vertical, horizontal and inclined pipes. Modelling of two-phase flow: homogenous model; drift flux model; drift velocity model; separated model. Annular and stratified flows. Flow in adiabatic pipes. Flow in heated pipes. The critical flow of a two-phase mixture. Pressure drop and heat transfer correlations in pipes. Subcooled, nucleate, pool and film boiling. Forced convection surface boiling. Critical heat fluxes in boiling. Mechanisms of heat transfer in boiling. Nucleation, bubble dynamics and bubble parameters. Film and dropwise condensation on flat plates. Condensation on horizontal tubes and tube banks. Condensation inside tubes. Two-phase heat exchangers. Experimental techniques in two-phase flow.

**5.722G Solar Thermal Energy Design** **C3**

*Excluded 5.644, 5.720G and equivalent.*

Characteristics of solar radiation and solar collectors. Collector efficiency evaluation and prediction of long term performance. System modelling, energy storage; computer simulation and modelling of performance and economic worth.

**5.731G Analysis of Heat Transfer** **C4**

*Assumed knowledge: 5.636 or equivalent. Excluded 5.716G, 5.717G.*

Steady-state and transient heat conduction in one, two and three dimensions with application of analytical, numerical and

analogical techniques. Conduction in solids with a heat source. Heat transfer in moving fluid media. Free and forced convection for internal and external flows. Differential and integral treatments of boundary layer problems. Laminar and turbulent boundary layers. Heat exchange between two fluids separated by a wall. Radiation properties of surfaces and gases. Analysis of radiation exchange between real and idealized surfaces. Interaction of radiation with conduction and convection. Heat transfer analysis of selected problems.

**5.732G Power Plant Engineering** **C3**

*Assumed knowledge: 5.620, and 5.626 or equivalent.*

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

**5.753G Ambient Energy Air Conditioning** **C2**

*Assumed knowledge: 5.636 or equivalent.*

Prediction of heat storage effects in air conditioned structures. Performance of passive and active ambient energy heating and cooling systems using correlations and simulation. Use of TRNSYS program package. Simple evaporative cooling. Open cooling cycles: single and double regenerative evaporative cooling and applications; nearly reversible evaporative cooling; adiabatic desiccant open cooling cycles.

**5.755G Refrigeration and Air Conditioning 1** **C3**

Review of thermodynamic principles; evaluation of thermodynamic properties of real fluids. Refrigerants, their properties and applications. Gas cycle refrigeration. Steam-jet refrigeration. Vapour compression refrigeration; analysis and performance characteristics of the complete cycle; analysis and performance of multipressure systems. Analysis of the performance of compressors, condensers, evaporators and expansion devices. Thermo-electric refrigeration.

**5.756G Refrigeration and Air Conditioning 2** **C3**

*Assumed knowledge: 5.755G or equivalent*

Psychrometrics; application to air conditioning design. Direct contact heat and mass transfer; application to the design of cooling towers and air washers. Cooling and dehumidifying coils. Properties of homogeneous binary solutions; steady flow processes with binary mixtures. Rectification of a binary mixture. Analysis of absorption systems. Production of low temperatures. Liquefaction and rectification of gases. Magnetic cooling.

**5.757G Refrigeration and Air Conditioning Applications** **C3**

Industrial, commercial and domestic applications of refrigeration and air conditioning. Refrigeration technology. The science and technology of foods. Building design and construction.

**5.759G Refrigeration and Air Conditioning Experimentation** **C3**

*Prerequisites: 5.755G, 5.756G. Co-requisites: 5.151G, 5.152G.*

Performance testing and system evaluation of multistage R22 brine system, R12 forced draft cooler system and dual duct air conditioning plant. Instrumentation, data acquisition and control of refrigeration plant. Use of calorimeter rooms for testing and rating of equipment. Transient performance characteristics of direct expansion coil and system, under different ambient conditions. Group project involving the designing, building, commissioning, instrumenting and testing of refrigeration and air conditioning equipment.

**5.909G Project** **C9**

**5.912G Naval Hydrodynamics 1** **C2**

*Assumed knowledge: 5.630 or 10.411A or equivalent.*

As for 5.913G

**5.913G Naval Hydrodynamics 2** **C2**

*Prerequisite: 5.912G or equivalent.*

Advanced treatment of topics selected from: ship waves and ship resistance; ship manoeuvrability; ship motion and seakeeping; hydrofoil and propeller theory; aero and hydrodynamics of surface effect machines.

**5.918G Project Report** **C18**

**5.936G Thesis** **C36**

## Electrical Engineering and Computer Science

**6.002G Advanced Data Base Management** **C3**

*Prerequisites: 6.659G or equivalent.*

Topics to be covered to include a selection from: higher normal forms, evaluation of query language, optimisers, distributed systems, concurrency control, temporal data bases, object data bases, deductive data bases, geographic data bases, data bases systems in an office environment.

**6.003G Advanced Decision Theory for Information Science** **C3**

*Prerequisites: A graduate level in expert systems or D55, 55.821G or equivalent.*

Topics to be covered to include a selection from: Review of signal processing, and information theory; review of expected utility theory and its axioms; Bayesian estimates of the value of information; developments of m.e.u. including prospect theory, regret theory, duality theory; possibilty theory; theory of evidence; Baconian statistics.

**6.004G Advanced Topics in Information Science** **C6**

*Prerequisites: 55.821G or equivalent.*

The subject will be oriented and will typically involve the design or evaluation of a software product such as a data base query language. Material to be covered in the lecture portion will typically include statistical aspects of experiment design and hypothesis testing.

**6.005G Data Base Systems** **C3**

*Prerequisites: Knowledge of storage structures. 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.

**6.006G Human-Computer Interaction** **C3**

*Corequisites: Knowledge of data base query languages. Excluded: 55.821G*

This subject will discuss man-machine communication with an emphasis on applications related to use of high level query languages and searching techniques.

Topics to be covered include: theories and principles of interface design; interaction styles; interaction devices; interface and language testing; approaches to the null value problem; information overload.

**6.050G Special Topic C3**

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

**6.060G Microprocessor Systems** **S2 C3**

*Assumed knowledge: 6.012D or 6.621 and 6.021E or 6.631. Excluded 6.0318, 6.613, 5.087G, 5.088G.*

Basic computer architecture: fetching and executing instructions; Microprocessor registers and instructions; assemblers, addressing modes; bus waveforms; interfacing to a bus; parallel interfacing; the PIA; handshaking: interrupts; critical regions; buffered I O; stack data frames; recursion; serial interfacing: the ACIA; direct memory access (DMA); dynamic memory; Microprocessor examples.

**6.070G Digital Image Processing Systems** **C3**

*Excluded 6.467G.*

The fundamentals of digital image processing with topics selected from the following: Visual perception and the image model, transforms, enhancement, sharpening and smooting, restoration, encoding, segmentation, reconstruction of images from projections and tomography, satellite imaging and imaging in remote sensing; image processing hardware and systems; picture processing; measurement and inspection.

**6.150G Theory of Optical Fibres and Optical Signal Processing** **C3**

Wave propagation in single mode and multimode optical fibres, gaussian approximation of fields in single mode fibre, spot size, equivalent step index of single mode fibre, material and waveguide dispersions, birefringent fibres. Ray theory in multimode fibre, intermodal dispersion, optimal profile, mode coupling, optical equalization. Measurement of fibre characteristics. Fundamentals of optical image formation. Spatial filtering. Optical sensors. Optical signal processing including holography and Radon transform.

**6.164G Antenna Design and Applications** **C3**

*Prerequisite: 6.167G.*

Principles of phased arrays and reflector antennas with some emphasis on space-borne and ground-terminal antennas for satellite communications. Analysis and synthesis of phased array, null steering theory. Single and dual reflector antennas, offset- reflector systems, optimization techniques. Effects of satellite orbital saturation on design of ground terminal antennas. Monopulse tracking antennas. Antenna tolerance theory.

**6.167G Propagation and Transmission of Electromagnetic Waves** **C3**

Fundamental concepts and analytical techniques of guided wave propagation. Waveguide theory; coaxial lines, rectangular and circular waveguides and surface wave propagation. Poynting theorem, power flow, impedances. Wave attenuation: evanescent modes, conductor and dielectric losses. Phase and group velocities, dispersion. Numerical techniques; the finite difference method. Tropospheric and ionospheric propagation. Basic antenna theory. Aperture antennas. Phased Arrays.

**6.169G Microwave Circuits: Theory and Techniques** **C3**

A review of transmission line theory, the Smith Chart and matching networks. The measurement and use of scattering parameters. Passive component design for microstrip circuits. Noise properties of two-port networks. The characterization and use of microwave transistors and diodes. Microwave subsystems.

**6.170G Microwave and Optical Devices** **C3**

Principles and applications of microwave amplifying and control devices. Includes microwave transistors, Gunn and impatt diodes and recent developments in ultra high speed transistors. Principles and applications of optical sources and detectors. Includes lasers, LEDS, electro-optic and acoustic-optic modulators and switches, optical detectors.

**6.205G Power System Planning and Economics** **C3**

Review of conventional planning techniques and their limitations. Introduction of a novel approach based on welfare maximisation. Examples of its application to coordinated supply and demand side planning in problems such as demand forecasting, supply reliability, maintenance scheduling, transmission planning and demand management.

**6.206G Power System Operation, Control and Protection** **C3**

Control of system frequency: system frequency dynamics, load frequency control of interconnected systems, automatic generation control. Unit commitment and economic despatch. Control of system voltage and reactive power. Problems of power system operation: security of supply, load forecast, power flow control, fault level containment, stability. Protection of power system and transmission lines: main protection, back

up protection, system protection under emergency. Protection in distribution systems.

**6.221G High Voltage Technology** **C3**

*Assumed knowledge: 6.202 or equivalent. Excluded 6.222.*

Introduction to the technology involved in the design and testing of high voltage power system equipment. Study of the practical applications of relevant materials, with emphasis on properties of insulation systems (gases, liquids and solids) and the interaction of the materials in non-uniform fields. Methods of testing under steady state, AC and DC, and surge conditions are incorporated in the laboratory work. Design examples are taken from insulator, bushing, cable, power capacitor, transformer, rotating machine and switchgear technologies.

**6.224G Partial Discharges in Electrical Insulation** **C3**

*Assumed knowledge: 6.202 or 6.222 or equivalent.*

Aspects of partial discharge phenomena and their effect on electrical insulation. The physical processes involved in partial discharges plus the interpretation of results from measurements on simple and complex apparatus, such as power cables, power capacitors, rotating machines and transformers. Techniques studied include digital based systems with particular emphasis being given to practical applications, in order to relate theoretical concepts to measurements which are subject to laboratory or on-site limitations.

**6.227G Insulation Performance in Electrical Plant** **C3**

*Assumed knowledge: 6.202 or 6.222 or equivalent.*

Design test requirements. Forms of high voltage works test: alternating, impulse, switching surge and direct. Non-destructive tests: dielectric loss angle, partial discharge and insulation resistance. Methods of determining material condition: moisture content, gas in oil, liquid chromatography, impurities, statistical breakdown tests, determination of aging and residual life. Commissioning and site tests.

Demonstrations and projects to support the lecture material.

**6.228G Power System Equipment** **C3**

*Assumed knowledge: 6.202 or equivalent.*

Operating characteristics and design features of the major equipment components of a power system. Includes a general treatment of equipment rating, thermal design, electrodynamic forces, equipment protection and data acquisition. Specific items of equipment include power transformers, instrument transformers, switchgear, overhead lines and underground cables, surge arrestors, gas insulated systems, power factor correction equipment and alternators. Protection of electrical equipment. Effects of electromagnetic fields on personnel.

**6.229G Fields and Materials** **C3**

General description of the inter-relationship between the different types of fields (electric, magnetic and thermal) and materials when used in various areas of electric power engineering. Topics include: a general coverage of dielectric, conducting, magnetic and thermal materials; solution of Poisson's Laplace's and Fourier's equations for simple geometries and calculation of electric, magnetic and thermal fields, including boundary effects; a selection of typical applications from thermal rating, electric heating, contact effects, laser action, surface electron emission, etc; a brief outline of some measurement techniques applicable to the above.

**6.242G Power System Analysis** **S2 C3**

*Assumed knowledge: 6.202 or equivalent. Excluded 6.203.*

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

**6.250G Special Topic in Power**

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

**6.251G Special Topic in Power** **C3**

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

**6.336G Digital Communication Networks 1** **C3**

*Excluded 6.652.*

Discussion of networks, their characteristics and suitability for data communication. Data transmission on telephone networks; modems and interfaces. ISO OSI reference model with particular reference to the physical layer, data link layer and network layer. LAN's and their interconnection through a WAN. Contention and token passing systems. Protocols. Elements of network architecture. Channel capacity. Queuing problems. Noise and handling of errors. Error detection coding. Selected elements of IEEE802 recommendations. Examples of some LAN's. Digital services in Australia.

**6.337G Data Networks 2** **C3**

*Prerequisites: 6.651*

Data transmission on telephone networks. Data in mixed traffic environment. Local area network interconnecation. Analysis of protocols for data link, network and transport layers. TCP/IP protocols. Operating system views of communications; network protocol drivers, network servers. Case studies: ARPAnet and ACSnet. Laboratory work covers experiments on network layer to application layer protocols in a practical network.

**6.338G Television Systems** **C3**

*Prerequisites: 6.167G, 6.341G. Excluded 6.333.*

Principles and practice of modern television systems. Human perception of coloured visual images. Techniques and standards for terrestrial and satellite broadcasting, and cable TV systems. High definition television. Digital television. Data transmission within the television signal: Teletext. Networks. Recording techniques on video tapes and laser discs.

**6.340G Communication Electronics** C3

*Assumed knowledge: 6.0316 or similar.*

Electronic aspects of modern analogue and digital communication systems. Topics selected from: electronic systems design; electromagnetic compatibility and interference; electronic system noise; analogue modulators, demodulators, frequency conversion circuits, AM and FM transmitters and receivers; television electronics; phase locked loops; switched capacitor and other practical filter technologies; surface acoustic wave devices.

**6.341G Signal Processing 1 – Fundamental Methods** C3

*Excluded 6.042.*

Fundamental principles of the analysis and processing of analogue and digital signals with emphasis on digital methods. Generalized Fourier analysis; convolution, correlation, energy and power density spectra for signals and linear systems. Sampling, the discrete Fourier transform (DFT) and fast Fourier transform (FFT) algorithms. Fundamentals of filter design and reali zation of analogue and digital filters, including active filters and special purpose programmable digital signal processors. Digital processing of analogue signals, filter stability, sensitivity and finite word length effects in the realization of digital filters.

**6.342G Signal Processing 2 – Advanced Techniques** C3

*Prerequisite: 6.341G or similar.*

Advanced techniques of digital signal processing with applications in communications and control, radar and sonar and the processing of speech, seismic signals and images. Topics selected from: digital methods for sampling rate changes, advanced FFT algorithms and the chirp z-transform algorithm. Advanced digital filtering methods. Analysis of random signals and noise in linear systems and non-linear devices. Estimation and measurement of power density spectra. Linear prediction and parameter estimation for speech analysis and spectrum estimation. Mean-square estimation and adaptive filtering for the detection and estimation of signals in noise, equalization, echo and noise cancelling and deconvolution. Nonlinear techniques; homomorphic signal processing and cepstral analysis, median filtering, etc. Short-time spectral analysis and time-frequency distributions. Two-dimensional signal processing.

**6.343G Digital and Analogue Communications** C3

*Corequisite: 6.042 or 6.341G or similar. Excluded 6.323 or similar.*

Prerequisite or co-requisite for 6.347G. Digital Communications and 6.348G Optical Communications.

Fundamentals of modern telecommunications systems, including theoretical and practical aspects of: linear and non-linear analogue modulation (AM, SSB, FM, etc), digital signal transmission, pulse code modulation, computer communication, effects of noise in analogue and digital systems, error control, multichannel systems (FDM, TDM, etc), synchronization, relay systems, optimum transmitters and receivers.

**6.347G Digital Modulation** C3

*Prerequisite: 6.343G or similar.*

Advanced and unified treatment of digital transmission systems. Baseband ASK digital communication systems including intersymbol interference, eye patterns, power spectral density, probability of error estimates and bounds, Nyquist criterion partial response signals (eg simple and modified duobinary). Digital modulation including various types of shift keying modulation such as amplitude, amplitude and phase, phase, frequency and minimum shift keying (ASK, APSK, OAPSK, PSK, FSK and MSK), power spectral density, probability of error, signal constellations and system comparison. Equalization including linear, non-linear, adaptive and automatic equalization and Viterbi decoders.

**6.348G Optical Communications Systems** C3

*Prerequisites: 6.150G, 6.170G.*

Calculation of bandwidth of single mode and multimode fibres. Review of transmitter and receiver circuits. Connection and launching efficiency between fibre and optical source. Fibre to fibre splicing and connection, losses due to fibre imperfection, fault location. Fibre cable, mechanical strength of fibre. Direct intensity modulation system, sensitivity of receiver, repeater design. Coherent optical communication system: laser frequency and intensity stability, polarization-maintaining optical fibre, heterodyne receiver. Coding for digital optical communication systems: OOK, PSK, FSK, DPSK. Analogue optical communication system: optical source linearity, PFM, repeater spacing calculation. Wavelength division multiplex. Optical fibre local area networks. Synchronization. Optical communication in hostile environments.

**6.401G Computer Control Systems 1** C3

An introduction to the use of CAD packages and coverage of the control theory necessary to understand the design of fundamental control systems. Selected computer packages, sampling and conversion, difference equation models, polynomial forms, z-transforms, differential equation models, operator forms, s-transforms, block diagrams, flow diagrams and state space models, connections between discrete and continuous models, classical continuous design, Root locus, Nyquist, Bode, classical discrete design, w-transforms, PID controllers, simple controller design schemes (time polynomial), Dahlin Higham, pole placement, approximations, Smith predictor, deadbeat, stochastic observers, pre-whitening, stochastic processes, time domain, frequency domain, correlation, identification, moving average models.

**6.403G Computer Control Systems 2** C3

*Prerequisite: 6.401G.*

Builds on the material of 6.401G, completing coverage of basic material considered necessary for modern control system synthesis and design. Revision of model forms: discrete-continuous, polynomial-state space. Observability, controllability, observers – deterministic, stochastic processes, stochastic models, innovation models, prediction, multivariable PI tuning, linear quadratic regulator design, Kalman filtering,

stochastic control, LQG, disturbances, measured disturbances, feedforward control, estimated disturbances, identification, simultaneous estimation of states and parameters, simple adaption, servomechanism problems, cascade control, multiple sampling rates, non-linear elements.

**6.404G Real Time Computing and Control** **C3**

*Prerequisites: 6.401G or assumed knowledge equivalent to 6.432 or 6.413.*

Examines the implementation of modern control techniques and associated instrumentation using distributed computers. Practical hardware aspects, including measurement and actuation, data conditioning, acquisition and transmission, microprocessor devices, and other distributed computing components. Commercial realisations ranging from PLCs to full process control computing systems. Software: executive operating systems, concurrency, control algorithms, numerical problems, languages and development tools in the real-time context. Design of the man-machine interface using interactive computer display systems. The role of simulation and other CAD tools. Steps of engineering development from concept to commissioning. The viewpoint of industrial design is maintained throughout.

**6.405G Topics in Digital Control** **C3**

*Prerequisites: 6.401G, 6.403G.*

Possible modules include: identification, estimation, multivariable systems, robust control, optimatization, adaptive control, biomedical applications, instrumentation and sensors, robotics, industrial design case studies, non-linear identification, non-linear control, variable structure systems, expert systems and others to be decided.

**6.406G Advanced Control Topics** **C3**

*Prerequisites: 6.401G, 6.403G.*

From one to three models, covering advanced control theory, with an emphasis on applications. The modules are not limited to digital control. Typical modules include: identification, estimation, multi-variable systems, robust control, optimization, adaptive control, biomedical applications, instrumentation and sensors, robotics, industrial design case studies, non-linear identification, non-linear control, variable structure systems, expert systems and others to be decided.

**6.433G Design of Advanced Microprocessor Systems** **C3**

*Prerequisite: 6.060G.*

Aims to familiarize the systems designer with the architecture and applications of the rapidly expanding family of microprocessor hardware support devices for dedicated control functions. Topics include: review and comparison of bus protocols of common systems: architecture, programming and applications of specialized system support devices and peripheral control chips; single chip microprocessors, architecture and applications to dedicated control tasks. *Laboratory work* includes individual design projects involving typical systems application of these devices.

**6.457G Cybernetic Engineering** **C3**

The genesis of cybernetics; fundamentals of cybernetic engineering; machines modelled on life and their evolution to robots. Topics include biological information transmission, memory and efficiency with aspects of biochemical coding and control, genetic and neural; basics of brain models and the development of pattern recognition techniques, learning machines and syntactic structures; includes the Perceptron view and brain modelling; neural networks and neural computing the albus approach to robotics, anthropomorphic robots; the social consequences of the dual evolution of robots.

**6.468G Computer Display Systems and Interactive Instrumentation** **C3**

*Prerequisite: 6.060G.*

Man-machine-process communication and control, and associated microprocessor based instrumentation. Review of appropriate analog and digital technology. Microcomputer hardware and programming for interactive communication using both machine and high-level languages. Display devices, operating principles and performance limitations. Hardware and software techniques for computer-generation and processing of pictures. Colour and movement. Interactive design and graphics creation. The geometry of transformations and projections. Light pens and other input devices.

**6.469G Robot Vision** **C3**

*Assumed knowledge: 6.070G or equivalent.*

Material oriented towards image understanding, scene analysis and world models for robots incorporating vision; including imaging techniques and geometries for vision, modelling the imaging process and image understanding, edges, range information, surface orientation, boundaries and regions, motion and optic, flow, texture, structural description, matching and inference, vision robotics.

**6.470G Robotics, Automation and Productivity Technology** **C3**

Principles of Robotics relevant to future trends in automating the manufacturing process. Such aspects as arm configurations, dynamics and control with relevant sensing methods; image understanding for inspection, assembly and control together with trends in artificial intelligence for Robotics are discussed.

**6.481G Introductory Physiology for Engineers** **S1 L2 T2 C3**

*Excluded 6.402.*

This subject is intended primarily for Biomedical Engineering students.

An introduction to biophysics and physiology for Engineers. Cells, tissues and organ systems with emphasis on their functional and regulatory characteristics and their interaction. An introduction to computer models of physiological control systems demonstrating their value in understanding the dynamics of complex neural, hormonal and circulatory responses to changes in homeostasis.

**6.484G Biological Signal Analysis** **C3**

*Excluded 6.341G.*

Digital computer methods of extracting information from biological signals using filtering and averaging, expectation density functions, correlation functions, spectral analysis and other techniques. Methods of constructing models of biological systems.

**6.550G Special Topic in Electronics C3**

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

**6.573G Advanced Semiconductor Devices C3**

*Excluded 6.512.*

Theory and operating characteristics of a range of semiconductor devices including bipolar diodes and transistors, MOS devices and circuit connections, charge coupled devices, solar cells, light emitting diodes and semiconductor lasers.

**6.575G Integrated Circuit Technology C3**

Fabrication processes for MOS and bipolar integrated circuits. Crystal growth, wafer preparation, maskmaking, photolithography, oxidation, diffusion, ion implantation, selective oxidation, plasma processing, silicon deposition, conductor systems and contacts. Advanced technologies.

**6.577G Integrated Circuit Design C3**

*Assumed knowledge: 6.0316 or 6.322.*

An advanced treatment of the design of integrated circuits with emphasis on the relationships between technology, device characteristics and circuit design. Includes properties and modelling of bipolar and MOS circuit components, circuit analysis and simulation, layout rules, analog functions such as oper- ational and power amplifiers; multipliers, D A and A D converters. Analog MOS circuits. Digital circuits include gates, compound functions, RAM, ROM, speed and power analysis. Economics and yield analysis for MSI, LSI and VLSI devices.

**6.578G Solar Energy Conversion C3**

World and Australian energy resources. General energy conversion principles and their application. Characteristic of received solar radiation. Thermal conversion and selectively absorbing surfaces. Biological methods of conversion. Fundamentals of photovoltaic generation.

**6.579G Solar Cells – Operating Principles, Technology, and System Applications C3**

*Excluded: 6.540*

Harnessing of sunlight by using solar cells to convert it directly to electricity. The properties of sunlight and of the semiconductors used in solar cells are reviewed and their interaction described. Factors important in the design of solar cells and the current technology used to produce cells. Likely future developments in this technology. System applications ranging from systems which are currently viable economically to residential and central power systems which may be a possibility for the future.

**6.654G Digital Systems C3**

*Assumed knowledge: 6.021E. Excluded 6.612.*

Computer architecture, implementation and realization. Use of hardware description languages for the analysis, design and specification of arithmetic units, storage and control Microprogramming techniques.

**6.655G Computer Organization and Architecture C3**

*Assumed knowledge: 6.0318 or 6.613.*

Basic principles of computer architecture. A comparative study of the architectural features of a number of significant computer systems.

**6.659G Data Bases and Networks C3**

*Assumed knowledge: 6.641 Pass Conceded PC awarded prior to Session 2, 1983, is not acceptable for this subject.*

Excluded: 6.633, 14.607, 14.608, 19.607, 55.823G.

Data base management systems: data models; relational and network structures; data description languages; data manipulation languages; multi-schema structures. Data integrity and security; recovery; privacy. Computer Networks: economic and technological considerations; digital data transmission; error detection and recovery; network configurations; circuit switching, packet switching; communication protocols, current international standards; data compression; encryption and decryption.

**6.660G Design and Analysis of Algorithms C3**

*Assumed knowledge: 6.641 Pass Conceded PC awarded prior to Session 2, 1983, is not acceptable for this subject. Excluded 6.642.*

Techniques for the design and performance analysis of algorithms for a number of classes of problems. Analysis of algorithms: order notation, recurrence equations, worst case and expected order statistics. Design of efficient algorithms: recursion, divide and conquer, balancing; backtracking algorithms, branch and bound, dynamic programming; set manipulation problems; fast search algorithms, balanced optimal and multiway trees; graph representations and algorithms; pattern matching algorithms. NP -complete problems. Design and specification of programs: modularization, interface design, introduction to formal specification techniques.

**6.661G Business Information Systems C3**

*Assumed knowledge: 6.641 Pass Conceded PC awarded prior to Session 2, 1983, is not acceptable for this subject, 14.501. Excluded 6.647, 14.602, 14.603, 14.605.*

Accounting concepts and terminology. Auditing, internal controls. Systems Analysis. Flowcharting. Decision tables. Models of business information systems. System design. Feasibility studies, presentation of designs, implementation testing. The COBOL programming language. Data files: sequential, random, index sequential, inverted. File updating. Data bases, integrated information systems.

**6.663G Operating Systems C3**

*Assumed knowledge: Background in basic logical design and computer programming equivalent to 6.631 and 6.641. Exclusions: 6.672, 6.632.*

Introduction to operating systems via an intensive case study of a particular system, namely the UNIX Time-sharing. Includes system initialization, memory management, process management, handling of interrupts, basic input output and

file systems. A comparison of UNIX with other operating systems. General principles for operating system design.

**6.664G Compiling Techniques and Programming Languages** **C3**

*Assumed knowledge: Background in data structures equivalent to subject 6.641. Exclusions: 6.643.*

Language description: phrase structure grammars. Chomsky classifications, context-free grammars, finite state grammars, Backus Naur Form, syntax graphs, LL(k), LR(K), LAL(k). Lexical analysis: translation of an input (source) string into a (machine independent) quasi-terminal symbol string Finite state recognizers. Syntax analysis: top-down compilation for LL1 grammars using syntax graph driven analysers or recursive descent. Bottom-up compliation for simple and weak-precedence and LR(k) grammars. Semantic analysis: program translation and code generation, attributed grammars. Compiler generators: automatic generation of compilers for LALR(1) grammars. Code optimization by systematic program transformation. Run-time organization: activation record stacks heap management.

**6.665G VLSI System Design** **C3**

*Assumed knowledge: Background in electronic design equivalent to 6.532.*

The design and implementation of very large scale integrated systems, using both nMOS and CMOS technologies. The use and construction of CAD tools, including simulators, layout generators, and plot utilities. MOS failure modes, testing and design for testability. A study of some digital subsystems, digital architectures and design styles will be carried out. An integral part of the course is an MSI LSI design project. Selected project designs will be submitted for fabrication and returned to students for testing.

**6.666G Artificial Intelligence** **C3**

*Assumed knowledge: Background to final year Computer Science level, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.*

Overview of current research in Artificial Intelligence. Some of the topics are: the representation of knowledge, search techniques, problem solving, machine learning, expert systems, natural language understanding, and languages for 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.

**6.667G Programming Languages: Fundamental Concepts** **C3**

*Assumed knowledge: Background to final year Computer Science level, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.*

Fundamental aspects of programming language definition, semantics and implementation models. The current approach uses denotational semantics. Denotational semantics is a formal method for describing the abstract meaning of programming languages.

**6.668G Computer Graphics** **C3**

*Assumed knowledge: Background to final year Computer Science levels, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.*

Background to use and evaluate existing graphics packages, or to write a graphics package of your own. Topics include graphics hardware - raster, random scan, and storage tube displays, graphical imput devices, scan conversion of lines and polygons, basic 2D transformations, windowing, clipping, viewports, display segmentation, the user interface for graphics, basic 3D transformations, perspective transformation, 3D clipping, hidden line and surface removal, shading and lighting, modelling curves and sorfaces with splines and fractals. Existing graphics standards will be examined - GKS, PostScript, CGM, PHIGS. Use will be made of the Apollo packages GPR, GMR-2D GMR-3D and Dialog.

**6.669G Formal Specification** **C3**

*Assumed knowledge: Background to final year Computer Science Level, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.*

Introduction to formal specification techniques; use of predicate logic and modern set theory to describe computing systems; Schema notation for structuring large specifications; Schema calculus to prove properties of specifications: Refinement techniques for transformation of specifications into executable programs; refinement of abstract data types.

**6.670G Parallel and Distributed Computing Systems** **C3**

*Assumed knowledge: Background to final year Computer Science level, equivalent to subjects 6.613, 6.642, 6.632 and 6.643.*

Parallelism concurrency in functionally coupled and distributed communicationally coupled, hardware and software, computing systems. Topics will be selected from: Synchronisation, communication and arbitration; Computational paradigms -s; concurrent synchronous processing, lists, trees; Computational paradigms - p: vectors, arrays, APL tables, associative 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: super-imposed code-word processors, image identifiers, inner product processors; Object based systems; Languages with communication and processes; CSP, ADA C; Locally and geographically distributed systems: Failure tolerant computer systems.

**6.918G Project Report** **C18**

**6.936G Thesis** **C36**

## Mines

**7.152G Mining Conservation**

The reclamation of excavated land; integration with operational stages of mining. Mining cycles of alluvial, strip, and open cuts, land clearing, stabilizing the mined area, socio-economic aspects of mining, rehabilitation costs, government regulations. Examination and evaluation of a current operation.

**7.535X Mine Fill Technology** **F2**

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.

**7.917G Fire and Explosion** **S1 or S2 L2**

Chemistry and physics of combustion reactions; types of flames; deflagration and detonation; ignition; fire point; flammable limits. Industrial fuel-fired appliances; fire risks in buildings; fire fighting equipment; flame proofing; fire and explosive risks in chemical process industries; case studies. Use of appropriate standards and legislation. Fire research; insurance.

## Civil Engineering

**8.401G Human Factors in Transport** **SS C3**

Human capabilities, ergonomic principles, attitudes to new concepts, planning, the law; application to transport planning, design and implementation. The human as a processor of information, influence on design of transport facilities particularly information displays, signals, signs and lighting.

**8.402G Transport, Environment, Community** **F C6**

Effect of transport on public health, environment and communities. Analysis of unwanted effects of transport activity: accidents, noise, pollution, intrusion; causation, measurement, preventative and remedial action. Community reaction to transport activity; government, bureaucracy and public involvement in transport policy and environment impact statements.

**8.403G Theory of Land Use Transport Interaction** **SS C3**

Theoretical aspects of land use transport planning. Basic concepts, data collection methods, systems models and equation of state function (behavioural, optimizing). Introduction to land use-transport modelling (land use, generation, distribution, modal assignment, network assignment, evaluation). Planning methodologies (short-, medium-, long-term; action planning, strategic planning; local, urban, regional national).

**8.404G Local Area Transport Planning** **SS C3**

Application of theoretical methods to local area planning. Local government planning and engineering: pedestrian planning, frontage land use problems, analysis of residential areas, industrial estates, shopping centres and recreational facilities, accessibility studies, environmental studies, parking studies.

**8.405G Urban Transport Planning Practice** **SS C3**

Analytical techniques for urban land use/transport planning practice. Planning methodology: traffic generation, trip distribution, modal-choice, traffic assignment, evaluation. Land use forecasting: calibration and verification of behavioural models, application of mathematical programming models, case studies, public transport problems.

**8.406G Regional Transport Planning** **SS C3**

The role of transport in economic and social development in regions including Third World countries; historical and contemporary analysis. Analytical techniques for regional planning. Planning practice, feasibility studies, evaluation methods. Case studies.

**8.407G Transport Systems Design (Non-Urban)** **S1 C3**

Process of location of road, railway and airport facilities. Data collection, alternative routes, public discussion, methods, techniques, aids, plans and diagrams produced. Geometric form; differences between road, railway and airport carriageway layout. Optical guidance, design models, landscape, provision for surface-water signposting, fencing and posts.

**8.408G Transport Systems Design (Urban)** **S2 C3**

Types of urban transport facilities. Distributors, streets, bicycle routes, walk-oriented areas, bus lanes and rapid transit lanes, stops and change terminals, noise control. Minimum geometric form; speed range controls, provision for surface water on urban roads, landscape. Design of intersection and parking areas.

**8.409G Interchange Design** **SS C3**

Central projection theory and application to alignment design; perspective drawing methods, introduction to aerial and terrestrial photogrammetry, photomaps and photomontage as applied to transport facilities. Speed change lanes, exit and entrance terminals, ramp types, ramp speeds and design. Interchange location and layout, provision for surface water, signposting. Computer use. Safety measures during maintenance.

**8.410G Highway Engineering Practice Part 1** **S1 C3**

Highway systems and organization. Roles and interaction of public and statutory highway and transportation authorities and research organizations. Sources and administration of highway finance. Highway programming. Feasibility studies. Engineering investigation and planning of highways and interchanges. Factors affecting long-term performance of transport facilities. Definition of design parameters. Factors of safety.

**8.411G Highway Engineering Practice Part 2** **SS C3**

Selection, comparison and critical evaluation of design procedures. Roles of ICES and other computer-oriented engineering systems in highway planning, design and construction. Maintenance systems. Economic modelling, investment costs. Prediction of performance. Implementation and revision of design decisions. Optimal use of resources. Project management for roads and interchanges. Choice of construction techniques. Upgrading of existing facilities, stage construction.

**8.412G Economics for Transportation Studies** **SS C3**

Introductory macro and micro economic theory. The pricing mechanism in transport and distinctive characteristics of

transport demand and costs. National income and social accounts with particular reference to the transport sector. Economics of public enterprise. Cost-benefit analysis and modelling. Engineering economics (compound interest) and budget determination. Econometrics. Selected special problems in the economics of transport modes.

**8.413G Transport Economics** **SS C3**

Cost and price analysis for each of the transport modes (road, rail, air and sea). Welfare analysis and taxation theory with respect to transport. Economics of location, economics of land use models; regional trade model.

**8.414G Transport Systems Part 1** **S1 C3**

Definition of basic traffic elements, zero flow travel time, capacity, impedance flow relationship. Transport Networks. The determination of shortest path, maximum flow, in networks. The topological description of networks. System parameters, performance. Application of network analysis to existing road, rail and air transport systems.

**8.415G Transport Systems Part 2** **S2 C3**

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

**8.416G Traffic Engineering** **F C6**

Road inventory; traffic measurements; flow, speed, origin-destination, accidents, road structure. Road capacity: controlled and uncontrolled intersections, highways and freeways. Signal systems. Traffic operations and control; arterial and network systems. Parking. Hazard analysis and safety improvement. Enforcement. Bus service operation.

**8.417G Transport and Traffic Flow Theory** **F C6**

Analysis of deterministic and stochastic models of the traffic stream. Topics covered include the following. Definition and measurement of traffic stream parameters. Space and time distribution of speed. Overtaking models and the moving-observer method. Fundamental diagram of traffic. Car-following theory. Headway and counting distributions. Introduction to queueing theory. Simulation techniques. Signalized and unsignalized intersections.

**8.418G Statistics for Transport Studies Part 1** **SS C3**

Data collection and processing. Probability, variates, sampling of values. Standard distributions, sampling distributions. Inference: point estimation, hypothesis testing and interval estimation; power, confidence, sample size. Regression. Generating functions. Sums of random variable. Distribution-free inferences.

**8.419G Statistics for Transport Studies Part 2** **SS C3**

*Assumed knowledge: 8.418G*

Linear models. Analysis of variance and co-variance. Simple and multiple regression. Design of experiments, interpretation of resuls. Sample survey design and analysis.

**8.420G Special Topic in Transport Engineering** **SS C3**

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

**8.701G Economic Decision Making in Civil Engineering** **S1 C3**

Review of practical engineering decision-making problems and relevant techniques. Engineering economics, benefit/cost analysis, consideration of inflation and taxation in investment decisions, bidding, decision theory, microeconomic theory, objectives and criteria, multiple objective planning.

**8.702G Network Methods in Civil Engineering** **S2 C3**

Graphs, flow-in networks, optimal paths, critical path schedule, resources levelling, simulation networks, stochastic networks, project management, further applications.

**8.703G Optimization Techniques in Civil Engineering** **SS C3**

Search, linear programming, non-linear programming, geometric programming, calculus of variations, maximum principle, applications.

**8.704G Stochastic Methods in Civil Engineering** **S1 C3**

Queueing, Markov processes, theory of storage, reliability, renewal, application, transportation and allocation.

**8.705G System Modelling** **S2 C3**

The development of system models for specific problem areas and decision positions. Problem environment, goals, objectives, and definition established by field contact and team discussion, information flow requirements and the design of user-oriented decision processes. Class size is limited to selected students.

**8.706G Experimental Methods in Engineering Research** **SS C3**

Purposes of experimentation in engineering research. Design of experiments; factorial and other designs; replication. Analysis of experimental data: analysis of variance and covariance; special analysis; other statistical methods. Decision theory.

**8.707G Numerical Methods in Civil Engineering** **SS C3**

Numerical integration, iterative processes. Solution of linear equations, especially sparse and banded systems. Approximation of functions. Eigenvalue problems Design of programs. Implementation using PASCAL. Comparison study of FORTRAN and PASCAL.

**8.710G Special Topic in Optimization in Civil Engineering** **SS C3**

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

**8.714G Special Topic in System Modelling** **SS C3**

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

**8.723G Construction Design** **SS C3**

Design of field services and structures; compressed air services, cofferdams, ground anchors, floating plant, formwork and falsework, bridge centring, well-points and dewatering systems.

**8.724G Construction Technology** **SS C3**

A selection of topics from; drilling, blasting techniques, tunnelling, rock-bolting and other ground support, earth/rock transport, harbours, railways, dams, bridges, structural steelwork techniques, pipeline construction, foundation grouting, compressed air work.

**8.725G Construction Accounting and Control** **S1 C3**

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

**8.726G Construction Law and Professional Practice** **SS C3**

Nature and sources of law, court procedures, interpretation of documents, evidence, technical opinions. Contract law. Company law. Arbitration. Duties of an engineer.

**8.727G Construction Planning and Estimating** **F C6**

Project initiation and development, feasibility studies, planning and estimating procedures, contract administration; estimating cost of labour plant and materials, indirect cost and overheads, profit; construction administration. Preparation of cost estimate for a major civil engineering project.

**8.728G Design of Construction Operations** **F C6**

Heavy equipment, labour intensive, and composite operations; spatial layout and material flow concepts; the modelling of operations at the micro, macro, and systems level; engineered estimates and productivity prediction models; analysis of construction operations by timelapse methods; field methods at foreman, superintendent, engineer, and project manager levels; field studies of specific construction operations.

**8.731G Project Management** **S1 C3**

A problem-oriented approach to Project and Mission Management; the nature of engineering and construction projects; the project team; behavioural aspects of project management; the organization and management of project resources; short term field planning and management strategies.

**8.732G Advanced Project Management Theory** **S2 C3**

A theoretical and formative approach to Project and Mission Management; management strategies and project success evaluation techniques; organizational and behavioural aspects of the project team structure; behaviour norms and their impact on project team motivation; project management decision processes; case studies in project management.

**8.753G Soil Engineering** **S2 C3**

Clay mineralogy and its effect on soil properties. Principles of preloading of soils and its effect on foundation behaviour. Design and construction aspects of soil improvement techniques including lime and cement stabilization, chemical grouting, vertical drains, dynamic consolidation, vibroflotation, sand and gravel piles, lime piles, freezing, electro-osmotic dewatering. Design and construction of diaphragm walls, ground and rock anchors.

**8.776G Rock Mechanics** **SS C3**

Description of rock mass and discontinuities, strength and failure criteria, classification systems. Data collection and presentation. Initial stresses and their measurements, methods of stress analysis, stresses around underground openings. Selection of design of tunnel support systems, steel sets, rock bolts and shotcrete. Design of large underground openings. Excavation. Methods of prediction. Blasting.

**8.777G Numerical Methods in Geomechanics** **SS C3**

Fundamentals of finite element and boundary element methods; application to practical geotechnical design and case studies; deformation and flow problems; linear and non-linear analysis; application to underground opening, stability of slopes, foundations, mining excavation; seepage and consolidation soil-structure interaction problems; earth pressures, retaining walls and buried pipes, thermal stress analysis.

**8.781G Advanced Concrete Technology 1** **S2 C3**

Basic structure of concrete. Morphology of hydrated cement paste. Constituents of cements. Paste – aggregate bond, strength microcracking and failure mechanisms. Code and special criteria for acceptance and rejection of concrete. Statistical principles, applications to specification and quality control of concrete non-destructive testing. Accelerated curving and special high strength concretes for column and prestressed construction. Recent developments in constituent materials, special cements and admixtures. Workability, mix design theories and practical applications.

**8.782G Advanced Concrete Technology 2** **SS C3**

Concrete as structural material. Elastic properties. Volume changes, shrinkage and thermal stresses; creep; predicated and design values. Cracking of plain and reinforced concrete, extenibility; cracking problems caused by volume changes and creep effects in mass structures. Bond and impact strengths. Durability and fatigue of reinforced and prestressed concrete. Types of durability breakdown, reinforcement corrosion in marine and environments and sea water attack, sulphate attack from aggressive ground water. Waste water

attack. Design recommendations for durability. Engineered repair of concrete structures.

**8.783G Pavement Materials** **S2 C3**

Properties and usage of soil and rock as pavement materials. Response of pavement materials to traffic and environmental factors. Concepts of durability. Improvement of soil properties by stabilisation. Compaction. Selection and comparative evaluation of selected subgrade, sub-base and base materials. Specifications and acceptance testing. Quality control. Properties and usage of bitumens, asphalts and tars. Manufacture and use of bituminous concrete. Mix design. Sprayed seals. Concrete for rigid pavements and sub-bases. Lean concrete, cement-grouted bituminous concrete.

**8.784G Pavement Design** **S1 C3**

Types of pavement, selection on basis of cost and performance. Sub-grade conditions, working platforms and use of geofabrics. Soil moisture equilibrium and drainage requirements. Prediction and characterisation of traffic wheel loadings. Role of environmental factors including temperature and moisture. Stress distribution in flexible and rigid pavements. Computer-based and approximated methods of analysis. Principles of mechanistic design. Comparative evaluation of design criteria and design procedures for flexible and rigid pavements for roads and airfields.

**8.785G Pavement Evaluation and Maintenance** **S2 C3**

Types of pavement distress, their origins and remedy. Evaluation and prediction of pavement condition. Pavement instrumentation and monitoring. Routine monitoring using deflection, role of accelerated trafficking tests. Measurement and reporting of physical distress including cracking, rutting and roughness. Measurement and prediction of skid resistance. Environmental factors. Pavement maintenance for flexible and rigid pavements. Overlays and membranes, recycling. Maintenance scheduling and management. Optimal use of maintenance funds.

**8.786G Industrial and Heavy Duty Pavements** **SS C3**

Functions of industrial and heavy-duty pavements. Port pavements, container facilities, bulk cargo areas, mine haulage roads, factory and warehouse floors and hardstands operation requirements. Economic considerations. Types of industrial pavement. Advantages and disadvantages of flexible, rigid and segmented pavements. Types of load, industrial vehicles, contained stacking, bulk cargo. Load equivalency concepts, Port Area wheel loads, standard design vehicles, formulation and application of loading spectra. Pavement design procedures for new pavements and overlays. Selection of pavement materials. Construction, maintenance and rehabilitation of industrial pavements. Railtrack design, integration of railtrack and vehicular pavements. Settlement and drainage considerations.

**8.788G Site Investigations** **S1 C3**

Engineering geology mapping and terrain classification. Drilling, trenching and sampling of rock and soil. In-situ testing of soil and rock. Laboratory testing of soil and rock. Assessment of design parameters. Instrumentation to measure pore pressure, stress, displacement.

**8.790G Stability of Slopes** **S1 C3**

Stability of natural and constructed slopes in civil and mining engineering. Stability analysis; stabilization methods and design; monitoring. Design of slopes in soft ground, soil and rock, and in partially saturated slopes; design of open cut mines. Probabilistic methods.

**8.791G Foundation Engineering 1** **S1 C3**

Stress distribution beneath foundations, settlement analysis, design of shallow footings, design of pile foundations, cast insitu piles, foundation on shrink-swell soils, lateral earth pressures, foundations on rock, site investigations.

**8.792G Foundation Engineering 2** **S2 C3**

Advanced consolidation theory, non-linear behaviour, soil structure interaction, design of rafts and piled rafts, analysis and construction of piled foundations, steel piles, braced cuts, temporary support of excavations, design of foundations for dynamic loading, machine foundations.

**8.793G Geomechanics** **S1 C3**

The fundamentals of the effective stress concept, clay mineralogy, seepage analysis and Laplace equation, method of fragments, fundamentals of liquefaction and cyclic mobility, basic and advanced consolidation theory including Terzaghi's 1D theory, nonlinearity and Biot's theorem, critical state soil mechanics theory, hyperbolic model, fundamentals of continuum stress analysis, theory of elasticity, constitutive relationships and failure criteria for real soils and rocks and soil plasticity.

**8.802G Elastic Stability 1** **S1 C3**

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

**8.803G Elastic Stability 2** **SS C3**

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

**8.804G Vibration of Structures 1** **SS C3**

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

**8.805G Vibration of Structures 2** **SS C3**

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

**8.806G Prestressed Concrete 1** **S1 C3**

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

**8.807G Prestressed Concrete 2** **S2 C3**

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

**8.808G Prestressed Concrete 3** **SS C3**

Partially prestressed concrete; cracked section analysis; crack control and deflection calculations; determination of appropriate level of prestress; strength calculations. Rational design procedures for prestressed members. Continuous beams; secondary moments; practical design procedures.

Prestressed slabs; two-way slabs; flat slabs; load balancing approach to design, effect of tendon distribution; design procedures, flexural and shear strength; deflections.

**8.809G Reinforced Concrete 1** **S1 C3**

Historical development. Methods of analysis and design, including limit state concepts. Analysis and design for bending, compression and combined bending and compression. Slenderness effects in columns. Shear and torsion. Serviceability requirements.

**8.810G Reinforced Concrete 2** **S2 C3**

Application of limit theorems to structural concrete. Lower bound methods of design. Analysis and design of plates and slabs. Detailing of members and connections for strength and serviceability. Joints.

**8.811G Reinforced Concrete 3** **SS C3**

Preliminary design of concrete structures. Fatigue effects. Composite construction. Design of multi-storey buildings. Marine structures.

**8.812G Plastic Analysis and Design of Steel Structures 1** **S1 C3**

The perfectly plastic material, the plastic hinge; plastic collapse of beams and frames; upper and lower bound theorems; introduction to design principles and methods.

**8.813G Plastic Analysis and Design of Steel Structures 2** **S2 C3**

Estimation of deflections; factors affecting plastic moment; shakedown; three-dimensional plastic behaviour; minimum weight design.

**8.814G Analysis of Plates and Shells** **SS C3**

Stress and strain in thin elastic plates bent by transverse loads. Solutions of the plate equation. Application. Stress and strain in thin plates loaded in the plane of the plate. Applications.

**8.817G Experimental Structural Analysis 1** **SS C3**

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

**8.818G Bridge Design 1** **S1 C3**

Historical development. Design philosophies. Loadings and factors of safety. Design of slab and slab-and-beam bridges; skew and stiffened-kerb bridges, multibeam bridge decks. Analysis of orthotropic plates and grid frames. Plate web girders and box girders.

**8.819G Bridge Design 2** **S2 C3**

Advanced bridge design. Box girder and cable-braced bridges in steel and reinforced concrete. Orthotropic plate construction. Design of bridges by limit state methods. Serviceability requirements.

**8.820G Structural Analysis and Finite Elements 1** **S1 C3**

Stiffness analysis of structures. Basis of finite elements: Principle of virtual work, variational theorems, constraint equations. Effects of inplane rigid floors and axially rigid members on the behaviour of multi-storey frames.

**8.821G Structural Analysis and Finite Elements 2** **S2 C3**

Variational formulation of the finite elements. Plane stress and plate-bending elements. Mesh grading. Flat slabs and flat plates in building frames. Hybrid elements and shear wall analysis. Isoparametric elements, numerical integration. Finite elements methods in numerical analysis.

**8.822G Structural Analysis and Finite Elements 3** **SS C3**

Application of the finite method to analysis of structures. Verification of the results of standard computer programs. Structural stability and vibration of structures.

**8.830G Hydromechanics** **SS C3**

General equation of fluid motion, potential flow, conformal mapping, laminar flow, Navier-Stokes equations; turbulence, shear flows, jets and wakes, boundary layers, turbulent mixing, diffusion, air entrainment, cavitation, stratification.

**8.831G Closed Conduit Flow** **SS C3**

Theories for energy loss in conduit flows, roughness at pipe walls and tunnels, design applications. Cavitation in conduits, transport of waterborne mixtures in pipes, accuracy of flow measurement in pipe lines.

**8.832G Pipe Network and Transients** **SS C3**

Multiple and branching pipes, energy distribution in pipe systems. Computer solution of pipe network problems. Unsteady flow in pipes. Branching pipes and reflectors. Effect of pumping plant behaviour.

**8.833G Free Surface Flow** **S1 C3**

Theory of waterflow in open channels. Application of theory to design of hydraulic structures, spillways, control gates, energy dissipators, channel transitions. Use of hydraulic models.

**8.835G Coastal Engineering 1** **SS C3**

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

**8.836G Coastal Engineering 2** **SS C3**

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

**8.842G Groundwater Hydrology** **SS C3**

Confined and unconfined aquifers, analogue and digital models of aquifer systems, water movement in the

unsaturated zone, recharge, groundwater quality, sea water intrusion.

**8.843G Groundwater Hydraulics** **SS C3**

Mechanics of flow in saturated porous materials, steady and unsteady flow to wells, leaky aquifers, partial penetration, multiple aquifer boundaries, delayed yield from storage, regional studies.

**8.847G Water Resources Policy** **S2 C3**

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

**8.848G Water Resource System Design** **SS C3**

Principles of the optimal design and operation of multiple purpose, multiple component, water resource system; evaluation of cost and benefits in complex and simple systems.

**8.849G Irrigation** **S1 C3**

Soils, soil-water relationships, plants, climate, crop requirements; water budgets, sources, quality, measurement; irrigation efficiency. Design of irrigation systems, appurtenant works, distribution.

**8.850G Drainage of Agricultural Land** **SS C3**

Characteristics of drainage systems, steady and unsteady state drainage formulae, conformal transformation solutions, soil characteristics field measurement of hydraulic conductivity and soil water pressure, significance of unsaturated zone, practical aspects.

**8.851G Unit Operations in Public Health Engineering** **S1 C3**

Theory of physical, chemical, biological, and hydraulic processes used in both water and wastewater treatment. Applications where these are common to both water and wastewater treatment.

**8.852G Water Distribution and Sewage Collection** **S2 C3**

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

**8.855G Water and Wastewater Analysis and Quality Requirements** **S1 C3**

The effects of impurities in water and wastewater on its suitability for various beneficial uses, and methods used for detecting impurities. Analytical methods used in water and wastewater treatment for monitoring and process control.

**8.856G Water Treatment** **S2 C3**

Application of processes and process variations used to upgrade the quality of water for specified uses, with particular reference to the treatment of water for municipal use.

**8.857G Sewage Treatment and Disposal** **S2 C3**

**8.857X Sewage Treatment and Disposal (external)** **S2 C3**

Application of processes and process variations used to improve the quality of sewage effluent, and the disposal of the effluent. Re-use of effluents where applicable. Sludge treatment and disposal.

**8.858G Water Quality Management** **SS C3**

Fundamental concepts; systems approach to quality aspects of water resource systems; quality interchange systems; quality changes in estuarine, surface, and ground water. Quality management by engineered systems. Economic criteria relating to water use and re-use systems.

**8.860G Investigation of Groundwater Resources 1** **SS C3**

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

**8.861G Investigation of Groundwater Resources 2** **SS C3**

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

**8.862G Fluvial Hydraulics** **S2 C3**

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

**8.863G Estuarine Hydraulics** **S1 C3**

Classification of estuary types and their characteristics. Tides, their origin, prediction and effect on estuarine circulation. Entrainment and mixing process in estuaries. Salinity intrusion, tidal flushing, dispersion of pollutants. Sediment transport, channel stability.

**8.864G Arid Zone Hydrology** **SS L1.5 T1.5 C3**

*Co-requisite: 8.837G, 8.838G.*

Arid zone rainfall characteristics, data collection and instrumentation, runoff processes, infiltration, transmission loss, recharge processes, flood characteristics and design; water yield, storage of water; evaporation and evaporation suppression; sediment transport and measurements.

**8.865G Arid Zone Water Resources Management** **SS L1.5 T1.5 C3**

Water as a resource: demand for and supply of water; works and management to match demand with supply. Special features of the arid zone climate, water uses, quantification of demand quantities and qualities; measurement of flow rate, volume, quality. Engineering works: design, construction, operation and maintenance of work, including excavation tanks, dams, pipelines, pumps, windmills, engines and motors, troughs; costs; reliability; energy sources for pumping. Special practices: water spreading, irrigation including trickle irrigation; evaporation reduction, desalination.

**8.868G Public Health Science** **SS C3**

Impact of water and wastewater treatment on disease transmission. Monitoring methods used for pathogens and indicator organisms, structure and degradation of large molecules, biochemical pathways of anabolism and catabolism and the characterization of micro-organisms.

**8.869G Instrumentation and Control in Water Supply and Wastewater Engineering** **SS C1**

Principles of primary elements, instrument response and reliability, control methods and the response of plants to control conditions in water and wastewater treatment and supply systems.

**8.870G Hydraulics and Design of Water and Wastewater Treatment Plants** **SS C3**

*Corequisites: 8.856G, 8.857G or equivalent.*

Application of hydraulic principles to flows within treatment plants. Selection and integration of unit processes required for water and wastewater treatment, plant layout, plant design including hydraulic profiles, the influence of flow and load variability, instrumentation and control strategies.

**8.871G Water Supply and Sanitation in Developing Countries** **SS C3**

*Prerequisites: 8.851G, 8.855G, 8.868G or equivalent.*

Selection of appropriate technology for water supply and wastewater treatment and disposal to account for hot climates and low per capita incomes. Design basis for systems and the operating requirements.

**8.872G Solid Waste Management** **S2 L2 T1 C3**

**8.872X Solid Waste Management (external)** **S2 C3**

Economics of all elements of solid waste management. Collection: route design, equipment, labour. Transfer and transport, recycling, processing, incineration. Planning of solid waste systems. Fundamentals of management.

**8.873G Waste and Wastewater Analysis and Environmental Requirements** **S1 L1.5 T1.5 C3**

**8.873X Waste and Wastewater Analysis and Environmental Requirements (external)** **S1 C3**

Principles of analytical methods used in chemical analysis of wastes and wastewaters, sampling schemes, statistical evaluation of data, environmental requirements to prevent pollution.

**8.874G Waste Management Science** **S1 L2 T1 C3**

**8.874X Waste Management Science (external)** **S1 C3**

Aspects of chemistry, biology and geology relevant to waste management, equilibrium and kinetic approaches, cell structure and metabolisms, formation and classification of rocks and soils.

**8.875G Hydrological Processes** **S1 C3**

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

**8.876G Applied Hydrological Modelling** **SS C3**

Introduction to hydrological models, deterministic catchment models, model calibration and verification, stochastic models, storage yield analysis for reservoir design, extension of records, stochastic reservoir analysis or identification of groundwater systems, conjunctive use systems.

**8.877G Flood Design 1** **S1 C3**

Introduction to flood estimation, frequency analysis of hydrological data, design rainfall data, hydrograph analysis, storm rainfall-runoff relations, design flood estimation for small to medium sized catchments including the rational method, introduction to urban drainage design.

**8.878G Flood Design 2** **S2 C3**

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

**8.879G Flood Design 3** **SS C3**

Flood frequency analysis, river flood routing, catchment characteristics, estimation of extreme floods, synthetic unit hydrographs, design hydrograph methods, application of runoff routing models.

**8.880G Groundwater Modelling** **SS C3**

Groundwater modelling of porous media, fractured rock and low permeability materials. Analogue, numerical analytical models. Matrix structure and inverse methods, stochastic modelling and characterization of variability, Modelling Multiphase Fluids and regional groundwater flow. Applications to borefield management, salt water intrusion, mine dewatering, geotechnical problems.

**8.881G Hazardous Waste Management** **S2 C3**

**8.881X Hazardous Waste Management (external)** **S2 C3**

Characteristics of hazardous wastes, such as dioxins, PCB's, chlorinated organic pesticides, explosives, heavy metals, arsenic and cyanide.

Transportation, treatment and disposal of hazardous wastes, incineration, secure landfill, risk assessment, social issues relating to hazardous waste management.

**8.882G Industrial Waste Management** **S1 C3**

**8.882X Industrial Waste Management (external)** **S1 C3**

Atmospheric Pollution Control: Meterology, effects of air pollutants, characteristics of specific air pollutants (particulates, sulphur oxides, nitrogen oxides), air pollution control techniques. Liquid and Solid Wastes: low and medium toxicity wastes, oily and greasy wastes from the petro-chemical and food industries, organic wastes, mining

wastes, plating and metal working wastes, nitrogenous wastes.

**8.883G Sources of Waste and Landfill Disposal S2 C3**

**8.883X Sources of Waste and Landfill Disposal (external) S2 C3**

Sources, quantitites and characteristics of residential, commercial and industrial solid waste. Landfill: site selection, design, operation, equipment selection, leachate, gas protection, legal guidelines.

**8.901G Special Topic in Civil Engineering S1 C3**

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

**8.902G Special Topic in Civil Engineering S2 C3**

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

**8.909G Project C9**

**8.909X Project (external)**

A minor research investigation involving analysis and interpretation of data, or a critical review and interpretation of literature on a selected topic, or a design project.

**8.918G Project Report C18**

**8.918X Project Report external**

As for 8.909G but involving more substantial investigation.

**8.936G Thesis C36**

## Mathematics

**10.061G Advanced Mathematics for Electrical Engineers C3**

Boundary value problems in partial differential equations. Selected topics from complex variable analysis, integral transforms, and orthogonal functions and polynomials.

**10.361G Statistics C3**

Probability theory, a survey of random processes with engineering applications – processes in discrete and continuous time. Markov processes, ergodicity, stationarity, auto-correlation, power spectra, estimation of auto-correlation and power spectra.

## Accounting

**14.062G Accounting for Engineers 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.

## Health Administration

**16.901G Health Service Statistics 1 S1 L2**

Statistical methods and theory; frequency distributions and their descriptions; an introduction to probability; principles of sampling; estimation and hypothese testing; statistical decision theory; normal, Poisson and binomial distributions; linear regression; index numbers; time series analysis. Data drawn from the health planning field used to illustrate these methods.

## Industrial Engineering

Industrial Engineering is a Department within the School of Mechanical and Industrial Engineering.

**18.061G Industrial Experimentation 1 C3**

*Excluded: 18.003 or equivalent.*

Design of experiments with reference to industrial problems; planning experiments; significance testing; simple comparative experiments, accelerated experiments; economic aspects of experimental design; analysis of variance or randomized block, latin square and factorial experiment designs.

**18.062G Industrial Experimentation 2 C3**

Regression analysis; use of orthogonal polynomials in regression analysis and analysis of variance; confounding in factorial design; response surfaces and determination of optimum conditions.

**18.074G Industrial Management C3**

Definitions of management; evolution of management thought, classical, quantitative and behavioural schools; interactions between organizations and their environment. The planning process; strategic and tactical planning, developing planning premises, nature of managerial decision making, quantitative aids, management by objectives. Organizational structures; 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.

**18.076G Decision Support Systems** **C3**

Perspectives on organizational and individual decision making; basic philosophy of Decision Support Systems; knowledge representation techniques; DSS models and operators; Data Base Management systems in DSS; iterative design techniques; the DSS user interface; practical design and implementation of a Decision Support System.

**18.171G Inspection and Quality Control** **C3**

Economics of measurement; advanced measuring and inspection methods; non-destructive testing; quality control systems; sampling by attributes and variables; standardization; case studies; process capability and variability; machine tools acceptance testing; alignment procedures.

**18.260G Computer Aided Programming for Numerical Control** **C3**

*Assumed knowledge: 5.0721, 5.5010 or equivalent. Excluded 18.224.*

Overview of N.C. systems and manual programming. Computer assisted programming dealing with specific and generalized part programming. Mathematics for computer assisted part programming. High level language requirements for part programming. Study of the structure and use of automatic programmed tools (APT). Selection of operating conditions.

**18.261G Computer Automation** **C3**

Computer architecture including central processer, randomaccess memory, read only memory, input output ports, peripherals, and the relationships between each. A systematic study of the requirements for interfacing computers to the real world. Machine code, assembly language, and high level languages such as BASIC or FORTRAN with a comparison of each for particular applications. Development of smallcomputer system for machine tool control, automated inspection, supervision, stock control, etc.

**18.360G Ergonomics** **C3**

Applied anatomy and kinesiology, anthropometry; application to work place arrangement, seating and bench design, tool and equipment design, lifting techniques, consumer product and architectural design. Physiological and psychological aspects of work and fatigue; measurement of energy consumption, limits to energy expenditure at work, static muscular fatigue, boredom. Environment effects; natural and artificial lighting arrangements, problems of perception, colour; noise and vibration, preventive measures; heat and ventilation, thermal regulation in humans, criteria for comfort, effects of pollutants. Man-machine interface. Displays, machine controls, reaction times, vigilance. Applications of ergonomics to occupational safety and health. Ergonomic research methology.

Note: A project forms a substantial proportion of the assessment for this subject.

**18.371G Factory Design and Layout** **C3**

*Assumed knowledge: 18.303 or 18.380G or equivalent.*

Production requirements: processes, machines and storage; optimum factory size, multiple factories. *Plant location:* single and multiple factories and warehouses; location models and economic analysis. *Factory design:* function; appearance; economic factors; environmental factors. *Materials handling systems:* influence on layout; economic choice between alternatives; long-distance transport. *Layout design:* by product: types of production line, means of line balancing, queueing theory applications. By process: travel charts and computer programs for optimization. Group technology. Practical aspects; provision of services and amenities; layout visualization methods.

Note: A project forms a substantial proportion of the assessment for this subject.

**18.380G Methods Engineering** **C4**

Methods study: history and objectives. Charting and systematic improvement of methods, factory and workplace layout. Ergonomics. Physical and social aspects of working conditions. *Work measurement:* defining and using 'standard times'. Time study techniques and problems, predetermined motion-time systems, work sampling, standard data and formulae. Accuracy and statistical testing of data. *Industrial psychology:* motivation to work, socio-technical systems, sources of job satisfaction. Financial incentive schemes, job enrichment and worker participation. Laboratory exercises.

**18.461G Design Production** **C4**

Influence of manufacturing processes on design; design simplification and standardization; value engineering; economics of process selection; case studies. planning experiments; significance testing; simple comparative experiments, accelerated experiments; fatigue testing, tool life.

**18.464G Value Analysis and Engineering** **C3**

Cost reduction through value analysis engineering illustrated by case studies. Selection of projects to be studied, collection of information, creative problem solving, development of alternatives, functional analysis system technique, functional evaluation, cost-function relationship, decision making, communication and implementation of the proposal. Applications to engineering design and services.

**18.465G Computer-Aided Manufacturing** **C3**

Brief review of numerical control (NC) manufacturing systems. Elements of the CAM systems: CAM data base, production management, manufacturing control. Computers in manufacturing. Computer process monitoring and control. Production systems at the plant and operations levels. Supervisory computer control. Flexible manufacturing systems.

**18.471G Design Communication** **C2**

Communication systems in design; aids to design communication; engineering drawing practice; standardization; interpretation of design information.

**18.571G Operations Research 1** **C6**

*Excluded 6.646, 18.503, 18.551, 18.580G.*

The formation and optimization of mathematical models. The development of decision rules. Some techniques of operations research such as mathematical programming, queueing theory, inventory models, replacement and reliability models and simulation. These techniques are applied to situations drawn from industrial fields, for example, production planning and control. Practical problems of data collection, problem formulation and analysis.

**18.574G Management Simulation** **C3**

Problem definition. Principles of model building. Participation in an operational simulation. Construction of decision rules. Operations. Research case studies and seminars.

**18.579G Case Studies in Operations Research** **C3**

Problems confronting management are seldom in the form of clear cut textbook type exercises; rather they are often ill-structured and ambiguous. A variety of such problems in operations research management science is considered with emphasis on the common pitfalls that arise in solving real world problems and the comparison of different strategies for solution. Students are expected to prepare written reports on certain cases considered suitable for submission to management.

**18.580G Operations Research** **C6**

*Excluded 6.646, 18.503, 18.551, 18.571G.*

The formulating and optimization of mathematical models. The development of decision rules. Some techniques of operations research such as mathematical programming, queueing theory, inventory models, replacement and reliability models; simulation. These techniques applied to situations drawn from indus trial fields, eg production planning and inventory control. Practical problems of data collection, problem formulation and analysis.

**18.671G Decision Theory** **C2**

*Excluded 18.672G.*

Theories of choice, value, risk and uncertainty for the individual and for multi-person situations. Statistical decision theory. Bayes and minimax rules. Optimum sampling.

**18.672G Decision Theory for Industrial Management** **C3**

*Excluded 18.671G.*

Decisions with multiple objectives. Indifference curves and tradeoffs. Value functions for two or more attributes. Decisions under uncertainty. Utility theory. Bayesian decisions in discrete and continuous space. Value of information. Optimal sampling. Applications in investment, marketing, production.

**18.673G Energy Modelling, Optimization and Energy Accounting** **C3**

The analysis of energy systems using computer models. Applications of such models range from policy analysis at government level investment analysis within individual industries. Covers both the formulation of energy models and the techniques used to obtain optimized solutions, with examples from actual studies. Effects of uncertainty and the use of energy accounting as an analytical tool.

**18.675G Economic Decisions in Industrial Management** **C3**

*Excluded 18.603.*

General aspects: the economic objective, the single-period investor's model, economic criteria, the mathematics of finance. *Deterministic models:* project evaluation using discounted cash flow analysis; capital structure; debt and equity financing; cost of capital and the minimum acceptable rate of return; taxation; inflation and its effects. *Probabilistic models:* multiple objectives and multi-attribute value systems based on means and variances of cash flows. *Particular applications of economic decision-making:* venture and risk analysis, risk management, static and dynamic replacement models, rent-or-buy decisions, breakeven analysis, expansion and economic package concepts, analysis of projects with public financing.

**18.681G Engineering Economics Analysis** **C3**

Price-output decisions under various competitive conditions. The time-value of money, net present worth and DCF rate of return, and their application in the selection and replacement of processes and equipment. Construction and optimization of particular models, eg replacement, capital rationing. Measures of profitability.

**18.760G Discrete-Event Simulation Languages** **C3**

*Assumed knowledge: 18.503 or 6.646 or 18.761G or equivalent.*

Basic elements of simulation languages: random number generation, process generation, list and set processing, data structures, time advance and event scanning, gathering and resetting statistics, graphics, Simulation language world views. Comparative review of commercially available simulation languages such as Simscript, GPSS, ECSL, and Simula, and a study of one of them in depth. Simulation using personal computers. Simulation language preprocessors.

**18.761G Simulation in Operations Research** **C3**

*Excluded 18.503, 6.646.*

The relationship of simulation to other methods of comparing alternative solutions to industrial problems. Computer simulation languages. Process generation. Variance reduction techniques. Analysis of simulation generated time series. Formulation and construction of models for simulation. Problems of simulation. Design of simulation experiments. Optimization through simulation. Examples of the use of simulation. Heuristics.

**18.763G Variational Methods in Operations Research** **C2**

The variational problem and its history. The modern formulations. Mathematical Theory. Application to a wide range of problem areas such as production and inventory control, advertising, machine maintenance and natural resource utilization.

**18.764G Management of Distribution Systems** **C2**

*Assumed knowledge: 18.503.*

The distribution system: single depot location, multi-depot location, vehicle scheduling, vehicle loading, fleet size, case studies.

**18.765G Optimization of Networks** **C2**

*Prerequisite: 18.551.*

Network representation of decision problems. Activity networks PERT-CPM, Euler and Hamiltonian paths, shortest path, maximum flow, multi-commodity flow, out-of-kilter algorithm, convex cost networks, stochastic cost networks - GERT.

**18.770G Stochastic Control** **C2**

Markov decision processes for finite and infinite planning horizons. Optimality criteria. Contraction mappings. Computational techniques. Optimal stopping. Semi-markov decision processes. Application to inventory, replacement and queues.

**18.772G Information Processing Systems in Organizations** **C2**

The place of operations research in information processing systems. Computer hardware and software. Data structures and data manipulation techniques. Typical structures of suites of programs. The life cycle of information processing systems. System design. Applications packages with emphasis on systems for production and inventory control. Major problems in information processing systems.

**18.773G Optimal Control in Operations Research** **C2**

Brief survey of dynamic optimization techniques. Introduction to the calculus of variations and the maximum principle for both continuous and discrete systems. Applications to operations research problems drawn from the areas of production and inventory control, machine maintenance, investment and natural resource utilization.

**18.774G Applied Stochastic Processes** **C2**

Examples of stochastic processes, basic concepts and Markov chains. Renewal theory. Applications to queues, inventory replacement, risk, business and marketing. Markov decision processes.

**18.775G Networks and Graphs** **C2**

Basic concepts. Application of Hamiltonian paths, Euler cycles, tress, planar graphs, dominating and independent sets to operations research problems. Shortest route algorithms. Concept of maximum flow in a network applied to transportation assignment and scheduling problems.

**18.776G Production and Inventory Control** **C2**

*Excluded 18.004*

Overview of the basic issues in Production and Inventory control. Material Requirements Planning: the Master Production Schedule; structuring Bills of Materials for MRP; Capacity planning and control; shop floor scheduling and lead time reduction; cycle counting; lot sizing techniques; implementation of MRP systems in practice. Just-in-Time (JIT) production; the Kan Ban system; production planning and control in Flexible Manufacturing Systems (FMS); the relation between MRP, JIT and FMS.

**18.777G Time Series Forecasting** **C2**

Stationary series. Autoregression. Spectral analysis. Estimation of trends, seasonal effects and parameters. Exponential smoothing. Error analysis and tracking signal. Choice of method.

**18.778G Scheduling and Sequencing** **C2**

Criteria for evaluation schedules. Scheduling of single machines. Job-shop scheduling with two, three or more machines. Permutation schedules. Groups of machines. Scheduling constrained resources.

**18.779G Game Theory** **C2**

Two-person zero-sum games: the minimax theorem, relationship to linear programming. Two-person general-sum games. Non-cooperative and co-operative n-person games. Games without side payments. Economic market games.

**18.780G Production Control** **C2**

Modes of manufacture; information flow in multi-stage production systems; classical production and inventory models and control techniques; Material Requirements Planning; Just-in-Time Production; Flexible Manufacturing Systems and their control.

**18.862G Linear Programming** **C2**

Formulation of models. The revised simplex method. Sparse matrix techniques. Implementation on computers. Duality and postoptimality analysis. Extensions to the simplex method. Generalized upper bounding. Decomposition. Integer programming. Applications in industry.

**18.863G Nonlinear Programming** **C2**

Formulation of models. Single variable optimization. Numerical techniques for unconstrained optimization. Methods for linear constraints. Penalty function methods for nonlinear constraints: Lagrangian methods. Applications in industry.

**18.864G Applied Geometric Programming** **C2**

Optimization concepts developed for function of polynomial form. Solution techniques for such problems, sensitivity of solution. Applications of geometric programming to problems from engineering and operations research.

**18.868G Industrial Applications of Mathematical Programming** **C3**

Problem formulation: development of objective and constraints. Conventions for large-scale matrix construction; list and table processing. Matrix generator languages; the MGG package. Data organization, interpretation of output, automatic preparation of report. Examples from industry. Case studies and projects.

**18.870G Large Scale Optimization in Industry** **C3**

*Excluded 5.1245.*

Large-scale linear programming: sparse constraint matrices, updating basis factorizations. Large-scale nonlinear programming: the limitations of classical quasi-Newton and conjugate gradient methods, sparse Hessian approximations, superbasic variables, augmented Lagrangian methods for sparse nonlinear constraints. Applications, examples and case studies from industry: optimal power flow, steam and power plant design, pipeline network optimization and other.

**18.871G Mathematics of Operations Research** **C2**

Classical optimization techniques. Convexity. Kuhn-Tucker conditions. Search and gradiant methods in one and several dimensions. Probabilistic models and their optimization. Curve fitting, correlation and regression.

**18.874G Dynamic Programming** **C2**

The principle of optimality. Structure and formulation of dynamic programming problems. One-dimensional deterministic and probabilistic sequential decisions. Approximations in function and policy space. Multidimensional problems, computational aspects. Applications to allocation problems, inventory theory, replacement.

**18.875G Geometric Programming** **C2**

The geometric programming theory is developed for convex and non-convex mathematical programs. The theory is applied to polynomial and posynomial programming. As projects actual polynomial and posynomial programs will be solved.

**18.876G Advanced Mathematics for Operations Research** **C2**

A survey of mathematical ideas which are of value in operations research. Topics will be selected from the following areas: set theory, real analysis, matrix theory, topology, function spaces, linear operatory theory, inequalities, stability, complex analysis, convex analysis, distribution theory, group theory and measure theoretic probability theory.

**18.879G Mathematical Programming Analysis** **C3**

*Corequisites: 18.871G; Linear Programming section of 18.571G.*

Methods for the analysis of mathematical programs. Analysis of the properties of linearity, separability, convexity, quasi-convexity and duality, providing the basis of the conversion of mathematical programs to potentially simpler formulations. Includes the areas of geometric programming, convex programming and quasi-convex programming.

**18.909G Project** **C9**

**18.918G Project Report** **C18**

**18.936G Thesis** **C36**

**18.965G Seminar Industrial Management** **C0**

**18.967G Special Topic in Production Engineering** **C2**

**18.968G Special Topic in Production Engineering** **C2**

**18.969G Special Topic in Production Engineering** **C2**

Allows the presentation of special topics, particularly by visiting academics.

**18.970G Seminar Operations Research** **C0**

**18.975G Special Topic in Industrial Engineering** **C3**

**18.976G Special Topic in Industrial Engineering** **C3**

**18.977G Special Topic in Operations Research** **C2**

**18.978G Special Topic in Operations Research** **C2**

**18.979G Special Topic in Operations Research** **C2**

These syllabi change to allow presentation of a special topic of current interest particularly by visitors with recognised expertise in the topic.

# Mines

## Department of Applied Geology

**25.702G Hydrogeology** **S1 L1.5 T1.5 C3**

Surface and sub-surface methods of geological and geophysical investigation; groundwater exploration of confined and unconfined 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.

**25.704G Environmental Geology** **S1 L1.5 T1.5 C3**

Geological hazards: seismic risk, landslides, subsidence, floods, erosion, volcanic eruptions, discrete and continuous hazards, event return time. Geological resources and their management: types of resources, use and potential environmental conflict, resource economics and policy formulation. Waste disposal and the mineral industry, reclamation and rehabilitation of land used for extractive purposes. Swamp drainage. Geology and urban planning: map preparation, multiple land use principle, aesthetic criteria for landscape evaluation. Environmental impact of dams, roads, explorative and extractive stages of mining, impact statement techniques, case studies. Communication of geological information to technical and non-technical people. Geological legislation for water resources and waste disposal.

**25.707G Geopollution Management** **S1 L1.5 T1.5 C3**

**25.707X**

Material properties and hydrodynamic factors influencing surface and subsurface flow of pollutants in rocks and soils. Dispersion theory and modelling for pollutants in aquifers. Water quality and the problems of standards. Use of field instruments for quality determination. Geological and

technological factors in waste disposal: domestic and industrial wastes, including the Rocky Mountain Arsenal Well case study, deep well injection methods. Management of radioactive wastes, waste disposal problems in limestone areas. Case studies of aquifer pollution and practical measures for preventing pollution. Rational planning of water resources for industrial and domestic use.

**25.816G Geological Remote Sensing** **S1 L4**

The physics of various remote sensing techniques; interpretation of conventional aerial photography in exploration; Infra-red remote sensing techniques; side linking airborne radar; theory and applications of Landsat imagery; enhancement techniques for satellite imagery; interpretation of Landsat photographic products and application to several case history areas. Integration of remote sensing information with the overall data base as applied to exploration.

†weeks 8-14 only

## Geography

**27.043G Remote Sensing Applications** **S1 L1 T2 C3**

The application of remotely-sensed data and information in the description, classification and assessment of earth resources and environmental conditions. Different types of remote sensing data and imagery, their attributes, acquisition and uses. Relevance of remote-sensing data and imagery to a range of applications, including assessment of conditions of terrain, soils and surface materials; multitemporal monitoring and inventory of rangelands, croplands and forests; rural and urban land use assessment; surveillance of surface water resources and sedimentation; appraisal of changes in the coastal zone. Use of remote sensing in environmental management and in environmental impact assessment.

**27.174G Remote Sensing Instrumentation and Satellite Programs** **S1 L2 T1 C3**

Aircraft and satellite platforms; sensor types; image formation and end products including panchromatic, colour, colour IR and thermal IR photographic products, microwave imagery and computer tape products. The organization, acquisition, processing and analysis of imagery obtained from the following satellite programs; Landsat, Skylab, Heat Capacity Mapper Mission, Nimbus Coastal Zone Colour Scanner, Seasat, Space Shuttle, Spot and Soyuz-Salyut.

**27.644G Computer Mapping and Data Display** **C3**

Introduction to automated cartography and thematic mapping; theoretical and practical problems in displaying and mapping data by computer; review and application of selected computer mapping packages. INFO is used for database management, and ARC-INFO for cartographic manipulation and output.

**27.672G Geographic Information Systems** **C3**

Study of selected geographic information systems; problems of data capture and display, data storage and manipulation, system design and development; cartographic displays and computer mapping. INFO is used for database management, and ARC-INFO and MAP for spatial data manipulation and display.

**27.911G Soil Erosion and Conservation** **S1 or S2 L2T4 C6**

Climatic, vegetational, geomorphic and pedologic controls of erosion. Physical processes of sediment transport and deposition. Conservational measures for the prevention of erosion including constructional and management practices. Methods of assessing soil loss risk and erosion hazard evaluation.

**27.914G Terrain Evaluation**

Principles and techniques for natural resource surveys and land evaluation including: land systems, terrain patterns, land capability and economic aspects of evaluation; examination of mapping, taxonomic and descriptive units; the problem of map scale and accuracy; styles of presentation for practitioners and other uses. Application of principles in selected other contexts.

**27.952G Special Topic in Geography**

## Marketing

**28.913G Marketing Management** **S1 L3**

*Prerequisites: 28.911G and 28.912G or co-requisite.*

Conceptual framework relevant to the practice of marketing management developing an understanding of the market function. Emergence of a broader concept of marketing; relationship between corporate and marketing strategy; the marketing environment; market segmentation; marketing planning; determination of product, price channel, advertising and salesforce policies; marketing control.

## Surveying

**29.106G 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.

**29.107G Special Topic in Surveying B** **C3**

A special subject taken by an individual student or a small group of students by private study in conjunction with tutorial sessions with the member(s) of staff in charge of the subject.

**29.121G Network and Deformation Analysis SS L2 T1 C3**

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, cae studies of monitoring networks.

**29.122G Elements of Geodetic Equipment SS L2 T1 C3**

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.

**29.161G Advanced Estimation Techniques SS L2 T1 C3**

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.

**29.162G Mathematical Methods SS L2 T1 C3**

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.

**29.210G Satellite Surveying SS L2 T1 C3**

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.

**29.211G Introduction to Geodesy S1 L2 T1 C3**

Geodesy in the service of mankind. The earth's gravity field. The earth's motion in space. Co-ordinate and time systems used in geodesy. Horizontal and vertical control networks. Earth satellite motion. Principles of satellite positioning. Gravimetric geodesy. Space geodetic methods. Variations of geodetic positions with time.

**29.213G Physical Metereology S2 L2 T1 C3**

Electromagnetic wave propagation, geometrical optics approximation, emission and transfer of radiation. Structure of the earth's atmospheric envelope, surface layer and boundary layer meteorology, structure of the ionosphere, atmospheric turbulence, meteorological measurements. Interaction and propagation of electromagnetic radiation. Refraction, scattering, absorption, dispersion, reflection. Description, models and solutions of geodetic refraction effects. Atmospheric effects on remote sensing (visible, infrared and microwaves). Remote sensing of atmospheric parameters.

**29.217G Gravimetric Geoid Evaluations SS L2 T1 C3**

Introduction to the representation of the earth's gravity field Physical model for the earth. Geodetic boundary value problem. Techniques, for evaluating Stokes' integrals. Relative geoid determinations. Combination techniques.

**29.530G Analytical Photogrammetry SS L2 T1 C3**

Fundamental relationship, image and object space. Interior orientation, deviations from collinearity. General orientation of one and two images by collinearity. Simultaneous block adjustment by bundles. Additional parameters. Calibration of metric and non-metric cameras. Control requirements in analytical photogrammetry.

**29.532G Computer-Assisted Mapping SS L2 T1 C3**

Introduction to principles of Computer Assisted Mapping. Collection and editing of feature coded digital terrain data in vector and raster form. Digital elevation models; acquisition interpolation and processing. Automation of mapping procedures. Archival of digital map data. Mapping systems based on computer assisted techniques.

**29.600G Principles of Remote Sensing S1 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.

**29.602G Remote Sensing Procedures S2 L2 T1 C3**

Review of atmospheric correction procedures and application to multi-temporal Landsat MSS data. Review of image registration, enhancement and classification procedures with particular reference to multi-source remote sensing data sets. Analysis of techniques over a varied land use area. Land use change project and analysis using multi-source and multi-temporal remotely sensed imagery, including Landsat MSS, TM, SPOT and SAR.

**29.604G Land Information Systems SS L2 T1 C3**

Land information as maps and records. Methods of data collection. Integrated surveys and coordinate systems. Legal boundaries. Land tenure. Identifiers. Computerization of land information. Data input methods. Data storage methods. Data processing and manipulation, including management, searching, existing data base languages, and interactive data editing. Data output, including computer graphics, line printer maps, and digital plotters. Application of Arc-Info LIS software.

**29.605G Ground Investigations for Remote Sensing S1 L2 T1 C3**

The spectral, temporal and spatial characteristics of various surfaces, and the available sensors to effect maximum differentiation. Ground and image comparisons. Instruments available for field measurements. Field investigation procedures including positioning and sampling considerations.

**29.608G Cadastral Systems SS L2 T1 C3**

The cadastral concept. Cadastral surveying and mapping, land registration, valuation of land, land tenure and land administration. Cadastres and land information systems

(L.I.S.). Strategies for improving cadastral systems. Cadastral systems in developing countries; legal, technical, administrative, economic and social issues.

**29.909G Project** **C9**

**29.918G Project Report** **C18**

**29.936G Thesis** **C36**

## Industrial Relations and Organizational Behaviour

**30.701G Industrial Relations A** **S1 L3**

*Prerequisite: Nil.*

Concepts and issues in Australia industrial relations at the macro or systems level, with overseas comparisons where appropriate. Labour movements and the evolution of employee-employer relations in the context of industrialization and change; origins and operations of industrial tribunals at the national and state levels: structure, operations and objectives of Australian trade unions and employer bodies; role of governments and their instrumentalities, nature of industrial conflict resolutation such as arbitration and bargaining; and national wage policy.

## Biomedical Engineering

**32.009G Project** **C9**

**32.010G Biomedical Engineering Practice** **S2 L2 C2**

Introduction to clinical situations in hospitals. Presentation of guest lectures by eminent people working in this field. Lecture topics include cardiology, neurology, orthopaedics, rehabilitation, etc. Visits to various biomedical engineering units.

**32.012G Biomedical Statistics** **S2 L2.5 T1.5 C4**

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.

**32.018G Project Report** **C18**

**32.026G Radiation Physics** **S1 L3 T2 C2**

Basic physics of interaction of photons and particules 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.

**32.027G Medical Imaging** **S2 L2 T2 C4**

Fundamentals of producing a medical image, image collection techniques, image reconstruction algorithms. Four main areas of medical imaging will then be examined in detail: Nuclear Medicine, Ultrasound, Diagnostic Radiology, Magnetic Resonance Imaging; Clinical application of each area.

**32.030G Project Report** **C30**

**32.040G Analogue Electronics for Biomedical Engineers** **S1 L2 T2 C4**

Basic theory of passive components, simple network analysis, small signal amplifiers, feedback and oscillators, operational amplifiers and their uses, analogue integrated circuits. Transistors as logic devices, gates. Safety requirements for medical instruments, circuit diagram analysis and component identification. Laboratory work involves both design and construction of analogue circuits.

**32.050G Microprocessors and Circuit Design for Biomedical Engineers** **S2 L2 T2 C4**

*Prerequisite: 32.040G and 32.501G or equivalents.*

Examination of the fundamental digital and analogue signal conditioning circuits commonly found in medical applications. Emphasis is given to project-oriented practical experience involving aspects of biological signal acquisition by microcomputers. Fundamentals of microprocessor hardware and software.

**32.060G Biomedical Systems Analysis** **S1 L2 T1 C3**

Compartmental analysis serves to unify modelling and analysis in many diverse fields. It has wide application in pharmocokinetics, metabolic, ecosystem and chemical kinetic modelling, and in the future will be applied increasingly to engineering systems. Topics include: classes of compartmental structure; fundamental properties; rate processes; inferred parameters; input-dependent kinetics; optimal input design; algorithms for identification and control.

**32.101G Mathematical Modelling for Biomedical Engineers** **S1 L3 T1 C4**

Model formulation and validation, solution of ordinary and partial differential equations by analytical and numerical techniques.

**32.311G Mass Transfer in Medicine** **S2 L2 T2 C4**

Material and energy balances, modelling of intrabody mass transfer, elementary treatment of diffusion, convection, hydraulic permeability and osmosis in biological and synthetic membranes. Applications to hemodialysis, blood oxygenators, artificial pancreas and slow release drug delivery systems.

**32.321G Physiological Fluid Mechanics** **S2 L2 T2 C4**

Fundamentals of biological fluid flow by way of the governing equations. Kinematics and dynamics, viscous and inertial flow,

boundary layers, separation, physiological flows (cardiac, vascular, pulmonary, urinary, etc.) and flow in artificial organs.

**32.332G Biocompatibility** **S2 L2 T1 C3**

Interaction of biological fluids and cells with foreign surfaces, in vitro tests to assess biocompatibility and thrombogenicity, current status of biocompatible materials as applied to extracorporeal systems, surgical implants and prosthetic devices.

**32.501G Computing for Biomedical Engineers** **S1 L2 T2 C4**

Algorithm design and documentation, printer plotting, editing, using the VAX VMS systems. Programming in FORTRAN and PASCAL languages. Overview of computing in biomedical engineering and hospitals. Automated patient monitoring and laboratory testing. Data storage and information retrieval.

**32.510G Introductory Biomechanics** **S1 L2 T1 C3**

The principles of the mechanics of solid bodies: force systems; kinematics and kinetics of rigid bodies; stress-strain relationships; stress analysis of simple elements application to musculoskeletal system.

**32.541G Mechanics of the Human Body** **SS L2 T1 C3**

*Prerequisite: 32.510G or equivalent.*

Statics and dynamics of the musculoskeletal system: mathematical modelling and computer simulation, analysis of pathological situations.

**32.551G Biomechanics of Physical Rehabilitation** **SS L2 T1 C3**

*Prerequisite: 32.510G or equivalent.*

The application of biomechanics principles to the areas of: performance testing and assessment, physical therapy, design of rehabilitation equipment, design of internal and external prostheses and orthoses.

**32.561G Mechanical Properties of Biomaterials** **SS L2 T1 C3**

*Prerequisite: 32.510G or equivalent.*

The physical properties of materials having significance to biomedical engineering; human tissues; skin; soft tissues; bone; metals; polymers and ceramics: the effects of degradation and corrosion.

**32.601G Biomedical Applications of Microprocessors 1** **S1 L3 C3**

*Prerequisite: 32.050G or equivalent.*

Definitions of the physiological problem, specification of physiological biological signals. Definition of instrument specification, analysis of signal conditioning in relation to relevant physiological information. Analogue circuit development, techniques of analogue digital conversion, data acquisition. Technical specifications of host microcomputer and its use as a development tool. Implementation of data manipulation algorithms, software development for assembly routines and compiled applications.

**32.602G Biomedical Applications of Microprocessors 2** **S2 L3 C3**

The aim of this subject is to obtain the microcomputer-developed system from the previous subject (32.601G) and to produce a stand-alone printed circuit board. Use of logic analyzer and debugging techniques for machine language programs and hardware design. Exposure to different types of microprocessors by use of simulators and emulators. Definition and selection of microprocessor. Transfer of microcomputer-developed system to specified microprocessor. Implementation of hardware on printed circuit board. Testing of stand-alone device.

**32.603G Static and Flow Cytometry** **S2 L3 C3**

Technology, techniques and uses of flow and static cytometry. Flow cytometers analysis and cell sorting, image analysis and cell counting from slides. Preparation and staining of cells. Data acquisition and analysis. Applications in medical research and diagnosis.

**32.611G Medical Instrumentation** **S2 L2 T1 C3**

*Prerequisite: 32.040G or equivalent.*

A critical survey of the theory and practical applications of medical transducers and electromedical equipment in common use in hospitals and research laboratories.

**32.621G Biological Signal Analysis** **S1 L3 C3**

Use of digital computers to extract information from biological signals. Signal processing using filtering, averaging, curve-fitting and related techniques, and analysis using model simulations, correlation, spectral analysis etc.

**32.701G Dynamics of the Cardiovascular System** **S1 L2 T1 C3**

Structure of the heart; organization of the mammalian vasculature; mechanical, electrical and metabolic aspects of cardiac pumping; the solid and fluid mechanics of blood vessels; rheology of blood.

## Graduate School of the Built Environment

**39.908G Community Noise Control** **S1 L1 T1 C2**

Introduction; sound and sound propagation, sound power, sound pressure, decibels; sound perception, psychoacoustics loudness, annoyance, phons and dBA; hearing conservation; acoustic measuring and analysing instruments – sound level meters, filters, analysers, recorders; sound sources, community noise assessment; the NSW Noise Control Act; practical exercises in sound recording, analysis and assessment; noise control – source noise reduction, use of barriers, enclosures, distance, sound absorbing materials; sound transmission through building elements; noise components of environmental impact statements.

## Biotechnology

**42.407G Biological Principles** **SS L3**

A study of the characteristics of living systems. Biological molecules: carbohydrates, lipids, proteins and nucleic acids. Cell structure and function: prokaryotic and eukaryotic cells. Basic biochemistry: thermodynamics and catalysis of metabolism; catabolic and anabolic processes; properties of enzymes; DNA replication; protein synthesis. Comparative metabolism of viruses, bacteria, fungi, plants and animals. Metabolic regulation. Modes of nutrition and nutrient cycles. Reproduction and genetics: eukaryotic and prokaryotic systems; sexual and asexual reproduction; bacterial genetics; recombinant DNA technology. Microorganisms of commercial significance. Biodeterioration and biodegradation. Pathogenic micro-organisms; aetiology and epidemiology of infection; host defence mechanisms; chemotherapy; mechanisms of drug action; drug resistance.

## Faculty of Applied Science

**46.203G Medical Aspects** **C2**

Aspects of medicine bearing upon physiological consequences of pollutants. Synergism and antagonisms, photosynthesis and phytotoxicity, metabolic machanisms; morbidity and mortality surveys; exposure indices. Particular pollutants aldehydes, nitroolefins, carbon monoxide, sulphur dioxide, oxides of nitrogen, hydrocarbons, ozone and oxidants, particulates, carcinogens.

**46.204G Legislative Aspects** **C2**

Resources in law for the preservation of satisfactory environments. Local government, town planning, environmental, common law. History of Australian legislation – consequences in border regions. Types of legislation and machinery measures and actions thereunder. Problems administration of available law. American experience. Economic and sociological factors.

## Safety Science

**47.009G Organisational Communication for Safety** **C3**

Introduction to the theory and structure of organisations. Overview of development of communication skills. Principles and processes of effective communication. Communication exercises. Designing information forms. Review of currently available computer based occupational health and safety data systems. Locating sources of occupational health and safety information. Design and conduct of personnel training and development programmes. Organisational communication – diagnosis and change.

**47.030G Computing for Safety Science** **C3**

Micro-computer hardware and software; the DOS operating system; creation and storage of data and files; fundamentals of word processing, data bases, and spreadsheets; management and analysis of occupational health and safety related data; the BASIC programming language; flow charts, program structure and errors; writing BASIC programs to analyse safety science related problems and/or to calculate related parameters.

**47.051G Principles of Engineering Mechanics** **C3**

Solid mechanics: Force systems, friction equilibrium and stability, linear and rotational motion, energy, momentum, collisions, simple machines, stress strain relationships, bending stress, applications in safety and biomechanics. Fluid mechanics: properties of fluids, static and dynamic pressure in flowing systems, laminar and turbulent flow, friction losses. Forces on submerged objects, bouyancy, ship stability. Hydraulic and pneumatic systems. Applications in safety and ventilation.

**47.052G Introduction to Safety Engineering** **C3**

The engineering improvement of potentially hazardous workplace situations with reference to the following: Basic safety practice; management of dangerous materials; fire and explosion; ventilation; noise control; radiation protection; electrical safety; biosafety, machine dangers and machine guarding; construction safety; transport safety; environmental safety; plant safety assessment.

**47.054G Machines and Structures Safety** **C3**

*Prerequisite: 47.051G or equivalent.*

Machinery contact dangers; machine guarding; safety during maintenance. Materials handling safety: cranes, slings, fork-lift trucks, conveyors. Construction safety: ladders, scaffolds, formwork, excavations. Structural failures, fractures, pressure vessels.

**47.060G Electrical Safety** **C3**

Electric current; effects of current flow and electric fields; elementary circuit representation, typical supply situations; likely dangerous conditions; static electricity; hazardous location; some special problem areas: codes of safe working; treatment of electric shock.

**47.061G Principles of Ergonomics** **C3**

Applied anatomy and kinesiology, anthropometry; application to work place arrangement, seating and bench design, tool and equipment design, lifting techniques, consumer product and architectural design. Physiological and psychological aspects of work and fatigue; measurement of energy consumption, limits to energy expenditure at work, static muscular fatigue, boredom. Environment effects; natural and artificial lighting arrangements, problems of perception, colour; noise and vibration, 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.

Note: A project forms a substantial proportion of the assessment for this subject.

**47.062G Applied Ergonomics** C3

*Prerequisite: 47.061G at credit level or equivalent.*

Decision making, vigilance, effects of workload and stress, applications to screen-based equipment. Human error in relation to human/system interaction. Work systems: the systems approach, practical evaluation and re-design of work systems. Experimental methodology: experimental design in ergonomics, critical evaluation of the literature.

**47.070G Ventilation** C3

*Prerequisite: 47.051G or equivalent.*

Nature of airborne contaminants: gases, vapours, dusts, heat and fumes. Assessment criteria. Ventilation systems for contaminant control: booths, enclosures, receiving and capture hoods, general dilution systems and natural ventilation. Design methods based on capture velocity, face velocity, control velocity and flow ratio principles. Properties of fan and duct systems. Alternatives to ventilation. Three laboratory sessions: air flow measurement, fans, capture hoods.

**47.090G Introduction to Occupational Health and Safety Law** C3

The concept of law; the creation and interpretation of statutes; the judicial and court systems; locus standi; common law and equity; basic principles of legal liability (civil and criminal); basic principles of administrative law and the liability of the Crown; the common law of employment; statutory regulation of employment; compulsory arbitration of industrial disputes. Outline of occupational health, safety and compensation legislation of the Australian States. Actions under the common law.

**47.120G Human Behaviour and Safety Science** C3

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.

**47.180G Management for Safety** C3

*Prerequisite: 47.120G.*

Accounting for accident costs; safety management and loss control; intergrating safety into the organisation and management systems; cost effectiveness of safety programs. Selection and training of personnel. Comparison and evaluation of occupational health and safety 'off the shelf' data management systems. Communication relevant to the safety practitioner's role. The safety practitioner as change agent.

**47.230G Radiation Protection** C3

Radiation physics; radiation dosimetry and instrumentation; radiation biology; shielding and control of radiation; waste management; emergency procedures; environmental impact, non-ionizing radiation. Relevant legislation and codes of safe practice. Special topics; practical work and site visit.

**47.330G The Accident Phenomenon** C3

*Assumed knowledge: 10.331 or equivalent.*

Causes of accidents and defensive strategies; energy storage and transfer; risk benefit concepts; epidemiology of accidents; reduction of loss from accidental injury; human factors; the environment and accidents; system reliability and fault-tree analysis in the study and control of accidents; Hazan, Hazop and Mort study of some major accidents; accident investigation and analysis; case studies in transport, industry, recreation and the home.

**47.480G Fire and Explosion** C3

Chemistry and physics of combustion reactions; types of flames; deflagration and detonation. Properties of flammable materials: gases, vapours, liquids, dusts and solids. Ignition, self heating and pyrophoric substances. Fire behaviour in buildings, detection, control and extinguishment. Smoke: properties and control. Building regulations and application of appropriate fire and explosion standards. Process industry fires, thermal radiation estimation and assessment. Explosion prevention, suppression and venting. Detonation and blast waves: overpressure, impulse, scaled distance and blast damage estimation. Hazard analysis.

**47.481G Management of Dangerous Materials** C3

Introduction. Measurement of environmental concentration of gases and particulate hazardous materials. Atmospheric dispersion of gaseous and particulate materials. Protection against dangerous materials for operators and other personnel. Respiratory protection and protective clothing. Storage, handling and transport of flammable liquids, dangerous goods and cryogenic material. Storage and transport of compressed gases. Disposal of dangerous materials; incinerators; flare stacks, landfill, dispersal. Relevant legislation. Field excursion.

**47.903G Special Report in Safety Science** C3

Only for students enrolled in the Graduate Diploma course in Safety Science.

**47.909G Project** C9

**47.918G Project Report** C18

## Chemical Engineering and Industrial Chemistry

**48.063G Industrial Water and Wastewater Engineering** S1 or S2 L3

Environmental consequences of water pollution. Water quality criteria and regulations related to industrial use and disposal. Water sources and requirements of industry. Theoretical and practical aspects of treatment methods, including screening, sedimentation, oil separation, coagulation and flocculation, filtration, biological treatment, adsorption, ion exchange, membrane processes. Strategies for industry including waste surveys, prevention at source, correction before discharge

water reuse. Economic aspects. Seminars. Factory visits/laboratory.

**48.388X Unit Operations in Wastewater, Sludge and Solid Waste Management**

Physical wastewater treatment processes including sedimentation, flotation, flocculation, procipitation. Sludge management including conditioning, filtering, lagoons, drying. Introductory fuel engineering. Combustion principles. Incineration. Pyrolysis. Gasification. Resource recovery and recycling. Incinerator and after-burner design.

**48.392G Practical Aspects of Air Pollution Measurement and Control** **S1 or S2 T3**

*Prerequisite: 48.391G.*

Laboratory and tutorial programs in the measurement and analysis of ambient and industrial air pollutants. Computation tutorials in advanced dispersion models, aerosol dynamics and control equipment design parameters.

## Librarianship

**55.815G Economics of Information Systems** **S1**

Use of surveys, user studies and market research to determine demand. Costing, financial planning, control and forecasting. Cost-benefit analysis. Economics of networks. Economic implications of new technologies.

**55.817G Information Storage and Retrieval Systems**

Role of thesauri and other indexing language structures. Automated thesaurus design and maintenance. Automatic indexing and classification systems. Concept co-ordination, use of Boolean operators and search strategy design. Systems analysis, design and costing. Design of user and interactive cueing tutorials. Choice criteria for on-line and batch systems. Testing, analysis and evaluation of systems. Advanced technologies for information storage and retrieval

## Anatomy

**70.201G Introductory Functional Anatomy**

An overview of basic human anatomy and physiology with an emphasis on structures and systems such as the eye, ear and skin, which are most vulnerable to chemical and physical trauma under industrial conditions. Other systems studied include the musculo skeletal system, central and peripheral nervous systems, circulatory, respiratory, gastrointestinal, endocrine and urogenital systems.

## Pathology

**72.402G Principles of Disease Processes** **S1 L3 C3**

*Prerequisites: 73.111 or equivalent, 70.011C or equivalent.*

Not offered in 1990.

The reaction of cells to injury, the inflammatory reaction; necrosis-vascular changes and infarction; reparative processes; fracture healing; neoplasia; reaction to implants; specific processes requiring prosthetic assistance.

## Medicine

**79.616G Occupational Epidemiology** **S1 L3 C3**

*Prerequisite: 16.901G or equivalent. Prerequisite or co-requisite: 80.701G or equivalent.*

Epidemiology – the narrow sense, historical development. Genes and environment in human variation. Basic demography. Perceptions of 'disease' – professional and lay. Sources of data in occupational epidemiology. Survey design and applications. Screening. Recording of data – graphical, tabular, parametric. Registers. Computer hardware and software in occupational epidemiology. Bias and its control. Confounding factors. Morbidity, mortality, life tables. Analysis of epidemiological data. Interpretation of results. Quantification of risk. Investigation of observed associations. Causation.

**79.617G Occupational Medicine Practice** **F C6**

*Prerequisite: Approved medical degree, 80.702G and 79.616G or equivalent.*

Provides experiential learning for those medical graduates undertaking the MSafetySc course who intend to join the College of Occupational Medicine. Students visit industrial sites and centres for occupational Medicine. Students visit industrial sites and centres for occupational health control. A comprehensive series of reports on investigations at these visits is required. It is expected that this subject will be taken towards the end of the MSafetySc course.

**80.701G Occupational Disease** **S2 L3 C3**

*Prerequisite: 70.201G or equivalent.*

Physical environment and disease: Musculoskeletal system, physical trauma; heat and cold, burns, electric shock; radiation; pressure, vibration, noise, hearing. *Chemical environment and disease:* Metallic poisons, toxic compounds, gaseous poisons, carcinogens, allergens. *Microbial environment and disease. Systems approach:* Gastrointestinal tract; renal system; central and peripheral nervous systems; visual system, respiratory system, airbone particulates; skin.

**80.702G Occupational Health Control** **S1 L3 C3**

*Prerequisite: 80.701G or equivalent.*

Introduction; dose response; risk, codes of safe practice; protection of the worker; design of safe workplace; protective equipment; occupational health surveillance; epidemiology; occupational safety program; emergency arrangements; environmental health; non-occupational safety; safety services.

## Faculty of Engineering

**97.580G Image Analysis in Remote Sensing** **C3**

*Prerequisite: 10.361 or similar.*

Techniques for extracting information from remotely sensed data with particular emphasis on satellite imagery. Topics taken from: nature and characteristics of earth resources and related satellites; satellite sensors and data formats; image enhancement techniques; image classification methods, including clustering, classification and feature selection; image classification methodologies; new horizons in remote sensing image analysis.

**97.581G Microwave Remote Sensing** **C3**

Use of passive and active (radar) microwave techniques in remote sensing of earth resources. Topics include: real and synthetic aperture radar systems; passive microwave radiometry; energy-surface interactions; interpretation of microwave image data: applications in agriculture, geology, oceanography and hydrology; issues in signal and image processing; characteristics of airborne and spaceborne microwave sensors.

**97.601G Computer Aided Design for Manufacture** **C3**

Principles underlying the interactive computer graphics packages such as AUTOCAD, CADAM, CATIA. Applications to design and engineering processes. Projects on building packages for design or upgrading the existing packages.

**97.602G Computer Integrated Manufacturing** **C3**

*Prerequisite: 18.465G.*

Systems analysis and design of computer integrated manufacturing, including flexible manufacturing systems and automated factories.

**97.603G Product Design and Technological Innovation** **C3**

Definitions of design and innovation. Product design. Technological innovation. The creative process. Organizational strategies and practices for innovation. Design, marketing and the consumer. Diffusion of innovations. Government policies for design and innovation. Design evolution, technological innovation and economic growth. Innovation projects.

**97.604G Flexible Manufacturing Systems** **C3**

*Prerequisite: 18.465G.*

Technical aspects of FMS components, including automated material-handling devices, job selection design and their aggregation. Hierarchical structure of FMS; mathematical models of FMS.

**97.605G CAD for Manufacture 2** **C3**

*Prerequisite: 97.601G.*

Topics related to methods of geometric modelling for curves, surfaces and solid models, and their applications to computer-aided design problems in manufacturing industry. Finite element methods in CAD. Intelligent CAD systems: principles and applications.

**Graduate Study**

# Conditions for the Award of Higher Degrees

## First Degrees

Rules, regulations and conditions for the award of first degrees are set out in the appropriate Faculty Handbooks.
For the list of undergraduate courses and degrees offered see **Faculty (Undergraduate Study)** in the Calendar.

## Higher Degrees

The following is the list of higher degrees and graduate diplomas of the University, together with Higher Degrees the publication in which the conditions for the award appear.
For the list of graduate degrees by research and course work, arranged in faculty order, see **Table of Courses (by faculty): Graduate Study** in the Calendar.

For the statements **Preparation and Submission of Project Reports and Theses for Higher Degrees** *and* **Policy with respect to the Use of Higher Degree Theses** see later in this section.

**Higher Degrees**

| Title | Abbreviation | Calendar/Handbook |
|---|---|---|
| Doctor of Science | DSc | Calendar |
| Doctor of Letters | DLitt | Calendar |
| Doctor of Laws | LLD | Calendar |
| Doctor of Medicine | MD | Calendar<br>Medicine |
| Doctor of Philosophy | PhD | Calendar<br>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 Arts | MA | Arts<br>University College |
| Master of Biomedical Engineering | MBiomedE | Engineering |
| Master of Building | MBuild | Architecture |
| Master of the Built Environment | MBEnv | Architecture |

**Higher Degrees (continued)**

| Title | Abbreviation | Calender/Handbook |
|---|---|---|
| Master of the Built Environment (Building Conservation) | MBEnv | Architecture |
| Master of Business Administration | MBA | AGSM |
| Master of Chemistry | MChem | Sciences* |
| Master of Cognitive Science | MCogSc | Arts |
| Master of Commerce (Honours) | MCom(Hons) | Commerce |
| Master of Commerce | MCom | Commerce |
| Master of Community Health | MCH | Medicine |
| Master of Construction Management | MConstMgt | Architecture |
| Master of Education | MEd | Professional Studies |
| Master of Educational Administration | MEdAdmin | Professional Studies |
| Master of Engineering | ME | Engineering<br>Applied Science<br>University College |
| Master of Engineering *without supervision* | ME | Applied Science<br>Engineering |
| Master of Engineering Science | MEngSc | Engineering<br>University College<br>Applied Science |
| Master of Environmental Studies | MEnvStudies | Applied Science |
| Master of Health Administration | MHA | Professional Studies |
| Master of Health Personnel Education | MHPEd | Medicine |
| Master of Health Planning | MHP | Professional Studies |
| Master of Industrial Design | MID | Architecture |
| Master of Landscape Architecture | MLArch | Architecture |
| Master of Landscape Planning | MLP | Architecture |
| Master of Laws | LLM | Law |
| Master of Librarianship | MLib | Professional Studies |
| Master of Management Economics | MMgtEc | University College |
| Master of Mathematics | MMath | Sciences* |
| Master of Music | MMus | Arts |
| Master of Nursing Administration | MNA | Professional Studies |
| Master of Optometry | MOptom | Sciences* |
| Master of Paediatrics | MPaed | Medicine |
| Master of Physics | MPhysics | Sciences* |
| Master of Project Management | MPM | Architecture |
| Master of Public Health | MPH | Medicine<br>Professional Studies |
| Master of Psychology (Applied) | MPsychol | Sciences § |
| Master of Psychology (Clinical) | MPsychol | Science§ |
| Master of Psychotherapy | MPsychotherapy | Medicine |
| Master of Safety Science | MSafetySc | Engineering |
| Master of Science | MSc | Applied Science<br>Architecture<br>Engineering<br>Medicine<br>Sciences*§<br>University College |
| Master of Science *without supervision* | MSc | Applied Science<br>Architecture |

| Title | Abbreviation | Calender/Handbook |
|---|---|---|
| Master of Science *without supervision* (continued) | MSc | Engineering<br>Medicine<br>Sciences*§<br>University College |
| Master of Science (Acoustics) | MSc(Acoustics) | Architecture |
| Master of Science (Industrial Design) | MSc(IndDes) | Architecture |
| Master of Science and Society | MScSoc | Arts |
| Master of Social Work | MSW | Professional Studies |
| Master of Statistics | MStats | Sciences* |
| Master of Surgery | MS | Medicine |
| Master of Surveying | MSurv | Engineering |
| Master of Surveying *without supervision* | MSurv | Engineering |
| Master of Surveying Science | MSurvSc | Engineering |
| Master of Town Planning | MTP | Architecture |
| Master of Welfare Policy | MWP | Professional Studies |
| Graduate Diploma | GradDip | Applied Science<br>Architecture<br>Engineering<br>Sciences*§ |
| | DipPaed | Medicine |
| | DipEd | Professional Studies |
| | DipIM-ArchivAdmin<br>DipIM-Lib | |
| | DipFDA | Sciences* |

*Faculty of Science.
§Faculty of Biological and Behavioural Sciences.

**Higher Degrees (continued)**

**Graduate Diplomas**

**Higher Degrees**

**Doctor of Philosophy (PhD)** *(under review)*

**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 and Progression

**3.** (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar at least one calendar month before the commencement of the session in which enrolment is to begin.

(2) In every case, before permitting a candidate to enrol, the head of the school* in which the candidate intends to enrol shall be satisfied that adequate supervision and facilities are available.

(3) An approved candidate shall be enrolled in one of the following categories:

(a) full-time attendance at the University;

(b) part-time attendance at the University.

* Or department where a department is not within a school, or schools or departments where the research is being undetaken in more than one school or department.

(4) A full-time candidate shall be fully engaged in advanced study and research except that the candidate may undertake not more than five hours per week or a total of 240 hours per year on work which is not related to the advanced study and research.

(5) Before permitting a part-time candidate to enrol, the Committee shall be satisfied that the candidate can devote at least 20 hours each week to advanced study and research for the degree which (subject to (8)) shall include regular attendance at the school* on an average of at least one day per week for 48 weeks each year.

(6) A candidate shall be required to undertake an original investigation on an approved topic. The candidate may also be required to undergo such assessment and perform such other work as may be prescribed by the Committee.

(7) The work shall be carried out under the direction of a supervisor appointed from the full-time academic members of the University staff

(8) The work, other than field work, shall be carried out in a school of the University except that the Committee:

(a) may permit a candidate to spend not more than eighteen months of the program in advanced study and research at another institution provided the work can be supervised in a manner satisfactory to the Committee;

(b) may permit a candidate to conduct the work at other places where special facilities not possessed by the University may be available provided the direction of the work remains wholly under the control of the supervisor;

(c) may permit a full-time candidate, who has been enrolled as a full-time candidate for at least six academic sessions, who has completed the research work and who is writing the thesis, to transfer to part-time candidature provided the candidate devotes at least 20 hours each week to work for the degree and maintains adequate contact with the supervisor.

(9) The progress of a candidate shall be reviewed annually by the Committee following a report by the candidate, the supervisor and the head of the school* in which the candidate is enrolled and as a result of such review the Committee may cancel enrolment or take such other action as it considers appropriate.**

(10) No candidate shall be awarded the degree until the lapse of six academic sessions from the date of enrolment in the case of a full-time candidate or eight academic sessions in the case of a part-time candidate. In the case of a candidate who has had previous research experience the committee may approve remission of up to two sessions for a full-time candidate and four sessions for a part-time candidate.

(11) A full-time candidate for the degree shall present for examination not later than ten academic sessions from the date of enrolment. A part-time candidate for the degree shall present for examination not later than twelve academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

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 Academic Registrar two months notice of intention to submit the thesis.

(3) The thesis shall comply with the following requirements.:

(a) it must be an original and significant contribution to knowledge of the subject;

(b) the greater proportion of the work described must have been completed subsequent to enrolment for the degree;

(c) it must be written in English except that a candidate in the Faculty of Arts may be required by the Committee to write a thesis in an appropriate foreign language;

(d) it must reach a satisfactory standard of expression and presentation;

(e) it must consist of an account of the candidate's own research but in special cases work done conjointly with other persons may be accepted provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may not submit as the main content of the thesis any work or material which has previously been submitted for a university degree or other similar award but may submit any work previously published whether or not such work is related to the thesis.

* 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.

(5) Four copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of theses for higher degrees.

(6) It shall be understood that the University retains the four copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

Examination

**5.** (1) There shall be not fewer than three examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least two of whom shall be external to the University.

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the thesis and shall recommend to the Committee that:

(a) the candidate be awarded the degree without further examination; or

(b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school*; or

(c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or

(d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or

(e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(3) If the performance at the further examination recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to further examination as determined by the Committee within a period specified by it but not exceeding eighteen months.

(4) The Committee shall, after consideration of the examiners' reports and the results of any further examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate be permitted to resubmit the thesis after a further period of study and/or research.

Fees

**6.** A candidate shall pay such fees as may be determined from time to time by the Council.

## Master of Biomedical Engineering (MBiomedE)

**1.** The degree of Master of Biomedical Engineering may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

Qualifications

**2.** (1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Higher Degree Committee of the Faculty of Engineering (hereinafter referred to as the Committee).

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.

Enrolment and Progression

**3.** (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar at least two calendar months before the commencement of the session in which the enrolment is to begin.

(2) A candidate for the degree shall be required to undertake such formal subjects and pass such assessment as prescribed, and shall submit a project report. The program of advanced study, including the preparation of the project report, shall total a minimum of 60 credits. The number of credits allocated for each subject shall be determined by the Committee on the recommendation of the Director of the Centre for Biomedical Engineering (hereinafter referred to as the head of the school).

(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.

* 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) 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 Academic Registrar two months notice of intention to submit a report on the project.

(4) Three copies of the project report shall be presented in a form which complies with the requirements of the University for the preparation and submission of project reports for higher degrees.

(5) It shall be understood that the University retains three copies of the project report submitted for examination and is free to allow the project report to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the project report in whole or in part, in microfilm or other copying medium.

Examination

**5.**(1) There shall be not fewer than two examiners of the project report, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

(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 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 ales 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 b made on the prescribed form which shall be lodged with the Academic Registrar at least one calendar month before the commencement of the session in which enrolment is to begin.

(2) In every case, before permitting a candidate to enrol, the head of the school* in which the candidate intends to enrol shall be satisfied that adequate supervision and facilities are available.

* 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.

(3) An approved candidate shall be enrolled in one of the following categories:

(a) full-time attendance at the University;

(b) part-time attendance at the University;

(c) external - not in regular attendance at the University and using research facilities external to the University.

(4) A candidate shall be required to undertake an original investigation on an approved topic. The candidate may also be required to undergo such examination and perform such other work as may be prescribed by the Committee.

(5) The work shall be carried out under the direction of a supervisor appointed from the full-time members of the University staff.

(6) The progress of a candidate shall be reviewed annually by the Committee following a report by the candidate, the supervisor and the head of the school* in which the candidate is enrolled and as a result of such review the Committee may cancel enrolment or take such other action as it considers appropriate.

(7) No candidate shall be granted the degree until the lapse of three academic sessions in the case of a full-time candidate or four academic sessions in the case of a part-time or external candidate from the date of enrolment. In the case of a candidate who has been awarded the degree of Bachelor with Honours or who had previous research experience the Committee may approve remission of up to one session for a full-time candidate and two sessions for a part-time or external candidate.

(8) A full-time candidate for the degree shall present for examination not later than six academic sessions from the date of enrolment. A part-time or external candidate for the degree shall present, for examination not later than ten academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

Thesis

**4.**(1) On completing the program of study a candidate shall submit a thesis embodying the results of the original investigation.

(2) The candidate shall give in writing two months notice of intention to submit the thesis.

(3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not such work is related to the thesis.

(5) Three copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of higher degree theses.

(6) It shall be understood that the University retains the three copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

Examination

**5.**(1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the merits of the thesis and shall recommend to the Committee that:

(a) the candidate be awarded the degree without further examination; or

(b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school*; or

(c) the candidate be awarded the degree subject to further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or

(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

*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

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***

Qualification

**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.

**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 Academic Registrar not less than six months before the intended date of submission of the thesis. A graduate who intends to apply in this way should, in his or her own interest, seek at an early stage the advice of the appropriate head of school* with regard to the adequacy of the subject matter and its presentation for the degree. A 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 Academic Registrar two months notice of intention to submit the thesis.

(3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not related to the thesis.

(5) Three copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation 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 Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

(2) 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

(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

*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

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.

**6.** A candidate shall pay such fees as may be determined from time to time by the Council.

Fees

**1.** The degree of Master of Engineering Science or Master of Surveying Science may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

**Master of Engineering Science (MEngSc) and Master of Surveying Science (MSurvSc)**

**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).

Qualifications

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.

**3.**(1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Academic Registrar two calendar months before the commencement of the session in which the enrolment is to begin.

Enrolment and Progression

(2) A candidate for the degree shall:

(a) undertake such formal subjects and pass such assessment as prescribed, or

(b) demonstrate ability to undertake research by the submission of a thesis embodying the results of an original investigation of an approved topic, or

(c) undertake an approved combination of the above in which case the thesis component shall be referred to as a project report.

(3) The program of advanced study shall total a minimum of 36 credits. The number of credits allocated for each subject shall be determined by the Committee on the recommendation of the appropriate head of school*. A 9 credit project report shall be submitted for examination in accordance with the requirements of the appropriate head of the school* and shall be assessed as a formal subject.

(4) A candidate's proposed program shall be approved by the appropriate head of school* prior to enrolment. For the purposes of this requirement the appropriate head of school* shall normally be the head of the school* providing supervision of the project report or thesis or, if there is no project report or thesis the major field of study.

(5) The progress of a candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(6) No candidate shall be awarded the degree until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or four sessions in the case of a part-time candidate. The maximum period of candidature shall be four academic sessions from the date of enrolment for a full-time candidate and eight sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee

**4.**(1) A candidate who undertakes an 18 credit project or a 36 credit thesis shall carry out the work on an approved topic under the direction of a supervisor appointed from the full-time academic members of the University staff.

**18 Credit Project Report /36 Credit Thesis**

(2) The candidate shall give in writing to the Academic Registrar two months notice of intention to submit a project report or thesis.

*Or department where a department is not within a school or schools or departments, where the research is being undertaken in more than one school or department.

(3) The 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 Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the 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.

**Examination of 36 Credit Thesis**

**6.**(1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the thesis and shall recommend to the Committee that:

(a) the candidate be awarded the degree without further examination; or

(b) the candidate be awarded the degree without further examination, subject to minor corrections as listed being made to the satisfaction of the head of the school*; or

(c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or

(d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or

(e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(3) If the performance at the further examination recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis an 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. It is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate may resubmit the thesis after a further period of study and/or research.

**Fees**

**7.** A candidate shall pay such fees as may be determined from time to time by the Council.

*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

**Master of Safety Science (MSafetySc)**

**1.** The degree of Master of Safety Science may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

Qualifications

**2.**(1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Higher Degree Committee of the Faculty of Engineering (hereinafter referred to as the Committee).

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.

Enrolment and Progression

**3.**(1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodge with the Academic Registrar at least two calendar months before the commencement of the session in which enrolment is to begin.

(2) A candidate for the degree shall be required to undertake such formal subjects and pass such assessment as prescribed. The program of advanced study shall total a minimum of 54 credits. The number of credits allocate for each subject shall be determined by the Committee on the recommendation of the Course Director (hereinafter referred to as the head of the school).

(3) The progress of a candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(4) No candidate shall be awarded the degree until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or four sessions in the case of a part-time candidate. The maximum period of candidature shall be four academic sessions from the date of enrolment for a full-time candidate and eight sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee

18 Credit Project Report

**4.**(1) The program of advanced study may include an 18 credit project on an approved topic.

(2) The work shall be carried out under the direction of a supervisor appointed from the full-time academic members of the University staff.

(3) The candidate shall give in writing to the Academic Registrar two months notice of intention to submit a report on the project.

(4) Three copies of the project report shall be presented in a form which complies with the requirements of the University for the preparation and submission of project reports for higher degrees.

(5) It shall be understood that the University retains the three copies of the project report submitted for examination and is free to allow the project report to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the project report in whole or in part, in microfilm or other copying medium.

Examination of 18 Credit Project Report

**5.**(1) There shall be not fewer than two examiners of the project report, appointed by the Academic Board on the recommendation of the Committee.

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the project and shall recommend to the Committee that:

(a) the project report be noted as satisfactory; or

(b) the project report be noted as satisfactory subject to minor corrections being made to the satisfaction of the head of the school; or

(c) the project report be noted as unsatisfactory but that the candidate be permitted to resubmit it in a revised form after a further period of study and/or research; or

(d) the project report be noted as unsatisfactory and that the candidate be not permitted to resubmit it.

(3) The Committee shall, after considering the examiners' reports and the candidate's results of assessment in the prescribed formal subject, 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 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 Academic 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.

(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 co[pies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

Examination

**5.**(1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the merits of the thesis and shall recommend to the Committee that:

(a) the candidate be awarded the degree without further examination, or

(b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school; or

(c) the candidate be awarded the degree subject to a further examination on questions posed in the report performance in this further examination being to the satisfaction of the Committee; or

(d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or

(e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(3) If the performance at the further examination recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to a further oral, practical or written examination within a period specified by it but not exceeding eighteen months.

(4) The Committee shall, after consideration of the examiners' reports and the reports of any oral or written or practical examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate may resubmit the thesis after a further period of study and/or research.

Fees

**6.** A candidate shall pay such fees as may be determined from time to time by the Council.

**Master of Surveying *without supervision* (MSurv)**

See Master of Engineering.

**Master of Surveying Science (MSurvSc)**

See Master of Engineering Science.

## Graduate Diploma

**1.** A Graduate Diploma may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

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 Academic 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-tome 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.

# Scholarship and Prizes

The scholarships and prizes listed below are available to students whose courses are listed in this handbook. Each faculty handbook contains in its Scholarships and Prizes section the scholarships and prizes available with that faculty. The General Information section of the Calendar contains a comprehensive list of scholarhips and prizes offered throughout the University.

## Scholarships

## Undergraduate Scholarships

Listed below is an outline only of a number of scholarships available to students. Full information may be obtained from Room G20, located on the Ground Floor of the Chancellery.

Unless otherwise indicated in footnotes, applications for the following scholarships should be made to the Academic Registrar by 14 January each year. Please note that not all of these awards are available every year.

| Donor | Value | Year/s of Tenure | Conditions |
|---|---|---|---|
| **General** | | | |
| Bursary Endowment Board* | $200 pa | Minimum period of approved degree/ combined degree course | Merit in HSC and total family income not exceeding $6000 |
| Sam Cracknell Memorial | Up to $3000 pa payable in fortnightly instalments | 1 year | Prior completion of at least 2 years of a degree or diploma course and enrolment in a full-time course during the year of application; academic merit; participation in sport both directly and administratively; and financial need. |
| Girls Realm Guild | Up to $1500 pa | 1 year renewable for the duration of the course subject to satisfactory progress and continued demonstration of need | Available only to female students under 35 years of age who are permanent residents of Australia enrolling in any year of a full-time undergraduate course on the basis of academic merit and financial need. |

*Apply to The Secretary, Bursary Endowment Board, PO Box 460, North Sydney 2060, immediately after sitting for HSC.

## Undergraduate Scholarships (continued)

| Donor | Value | Year/s of Tenure | Conditions |
|---|---|---|---|
| **General (continued)** | | | |
| W.S. and L.B. Robinson** | Up to $4200 pa | 1 year renewable for the duration of the course subject to satisfactory progress | Available only to students who have completed their schooling in Broken Hill or whose parents reside in Broken Hill; for a course related to the mining industry. Includes courses in mining engineering, geology, electrical and mechanical engineering, metallurgical process engineering, chemical engineering and science. |
| Universities Credit Union | $500 pa | 1 year with the possibility of renewal | Prior completion of at least 1 year of any undergraduate degree course. Eligibility limited to members of the Universities Credit Union Ltd of more than one year's standing or members of the family of such members. |
| Alumni Association | Up to $1500 pa | 1 year with the possibility of renewal | 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 overseas students. |

**Applications close 30 September each year.

## Engineering

### Electrical Engineering and Computer Science

| | | | |
|---|---|---|---|
| The Tyree Westinghouse Electrical Company Pty Ltd | Up to $6720 over 4 years | 1 year renewable for the duration of the course, subject to satisfactory progress | Eligibility for admission to the full-time degree course in Electrical Engineering. |
| OTC Ltd-Women in Electrical Engineering | Up to $1500 pa | 1 year | Available to female students enrolled in Year 1 of the electrical Engineering course, leading to the degree of Bachelor of Engineering. Candidates must be residents of Australia. |

### Mechanical and Industrial Engineering

| | | | |
|---|---|---|---|
| James Howden & Co Australia Pty Ltd | Up to $1000 pa | 1 year | Permanent residence in Australia and eligibility for admission to the full-time degree course in Mechanical Engineering. |
| Shell Refining Australia Pty Ltd | Up to $1500 pa | 1 year renewable for the duration of the course, subject to satisfactory progress | Eligibility for admission to Year 2 of the full-time degree course in Mechanical Engineering. |

### Surveying

| | | | |
|---|---|---|---|
| The Institution of Surveyors NSW, Incorporated | Up to $500 pa | 1 year renewable for the duration of the course, subject to satisfactory progress | Permanent residence in Australia and eligibility for admission to the full-time degree course in Surveying. Selection is based on academic merit, personal qualities and financial need. |

## Undergraduate Scholarships (continued)

| Donor | Value | Year/s of Tenure | Conditions |
|---|---|---|---|
| **Surveying (continued)** | | | |
| NSW Department of Lands – Women in Surveying | Up to $2000 pa | 1 year | Available to female students entering Year 1 of the Surveying course, leading to the degree of Bachelor of Surveying. Candidates must be residents of Australia. |

### The UNSW Co-op Program

The University of New South Wales has industry-linked education scholarship programs to the value of $8000 per annum in the following areas: Business Information Technology, Chemical Engineering, Civil Engineering, Electrical and Computer Engineering, Industrial Chemistry, Mechanical and Industrial Engineering, Mining, Mineral Engineering and Applied Geology. Further information can be obtained by writing to The Co-ordinator, UNSW Co-op Programs Industry-Linked Education Office, C/- Vice-Chancellors Division.

## Graduate Scholarships

Application forms and further information are available from the Student Centre, located on the Ground Floor of the Chancellery unless an alternative contact address is provided. Information is also available on additional scholarships which may become available from time to time, mainly from funds provided by organizations sponsoring research projects.

The following publications may also be of assistance: **1.** *Awards for Postgraduate Study in Australia and Awards for Postgraduate Study Overseas*, published by the Graduate Careers Council of Australia. PO Box 28, Parkville, Victoria 3052;* **2.** *Study Abroad*, published by UNESCO;* **3.** *Scholarships Guide for Commonwealth Postgraduate Students*, published by the Association of Commonwealth Universities.*

Details of overseas awards and exchanges administered by the Department of Employment, Education and Training can be obtained from: Awards and Exchanges Section, Department of Employment, Education and Training, PO Box 826, Woden, ACT 2606.

Where possible, the scholarships are listed in order of faculty.

*Available for reference in the University Library.

| Donor | Value | Year/s of Tenure | Conditions |
|---|---|---|---|
| **General** | | | |
| University Postgraduate Research Scholarships | Living allowance of $9000 pa. Other allowances may also be paid. | 1-2 years for a Masters and 3-4 years for a PhD degree | Applicants must be honours graduates or equivalent. Applications to Dean of relevant Faculty. |
| Commonwealth Postgraduate Research Awards | $12,734 to $16,433 | | Applicants must be honours graduates or equivalent or scholars who will graduate with honours in current academic year, and who are domiciled in Australia. Applications to Academic Registrar by 31 October. |
| Commonwealth Postgraduate Course Awards | Living allowance of $10,415 pa. Other allowances may also be paid. | 1-2 years; minimum duration of course | Applicants must be graduates or scholars who will graduate in current academic year, and who have not previously held a Commonwealth Post-graduate Award. Applicants must be domiciled in Australia. Preference is given to applicants with employment experience. Applications to Academic Registrar by 30 September. |

## Graduate Scholarships (continued)

| Donor | Value | Year/s of Tenure | Conditions |
|---|---|---|---|
| **General (continued)** | | | |
| Australian American Educational Foundation Fulbright Award | Travel expenses and $A2000 as establishment allowance. | 1 year, renewable | Applicants must be graduates who are domiciled in Australia and wish to undertake research or study for a higher degree in America. Applications close 30 September with The Secretary, DEET, AAEF Travel Grants, PO Box 826, Woden ACT 2606. |
| Australian Federation of University Women | Amount varies, depending on award | Up to 1 year | Applicants must be female graduates who are members of the Australian Federation of University Women |
| Commonwealth Scholarship and Fellowship Plan | Varies for each country. Generally covers travel, living, tuition fees, books and equipment, approved medical expenses. Marriage allowance may be payable. | Usually 2 years, sometimes 3 | Applicants must be graduates who are Australian citizens and who are not older than 35 years of age. Tenable in Commonwealth countries other than Australia. Applications close with Academic Registrar in September or October each year. |
| The English-Speaking Union (NSW Branch) | $5000 | 1 year | Applicants must be residents of NSW or ACT. Awarded to young graduates to further their studies outside Australia. Applications close mid-April with The Secretary, Ground Floor, Sydney School of Arts, 275c Pitt Street, Sydney NSW 2000. |
| Frank Knox Memorial Fellowships tenable at Harvard University | Stipend of $US7000 pa plus tuition fees | 1, sometimes 2 years | Applicants must be British subjects and Australian citizens, who are graduates or near graduates of an Australian university. Applications close with the Academic Registrar mid October. |
| Robert Gordon Menzies Scholarship to Harvard | Up to $US 15,000 | 1 year | Tenable at Harvard University. Applicants must be Australian citizens and graduates of an Australian tertiary institution. Applications close 31 December with the Registrar, A.N.U., GPO Box 4, Canberra ACT 2601 |
| Gowrie Scholarship Trust Fund | $4000 pa. Under special circumstances this may be increased | 2 years | Applicants must be members of the Forces or children of members of the Forces who were on active service during the 1939-45 War. Applications close with the Academic Registrar by 31 October. |
| Harkness Fellowships of the Commonwealth Fund of New York | Living and travel allowances, tuition and research expenses, health insurance, book and equipment and other allowances for travel and study in the USA | 12 to 21 months | Candidates must be Australian citizens and **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. |

## Graduate Scholarships (continued)

| Donor | Value | Year/s of Tenure | Conditions |
|---|---|---|---|
| **General (continued)** | | | |
| The Packer, Shell and Barclays Scholarships to Cambridge University | Living and travel allowances, tuition expenses. | 1-3 years | Applicants must be Australian citizens who are honours graduates or equivalent, and under 26 years of age. Applications close 15 October with The Secretary, Cambridge Commonwealth Trust, PO Box 252, Cambridge CB2 ITZ, England. |
| The Rhodes Scholarship to Oxford University | Approximately £4200 stg pa | 2 years, may be extended for a third year. | Unmarried Australian citizens aged between 19 and 25 who have an honours degree or equivalent. Applications close in August each year with The Secretary, University of Sydney, NSW 2006. |
| **Engineering** | | | |
| Australian Institute of Nuclear Science and Engineering Studentships | Basic stipend $11,103 pa plus allowances and some University expenses. | 1-3 years | Applicants must be honours graduates in Science or Engineering. At least one quarter of the period of tenure must be spent at the Institute at Lucas Heights, NSW. Applications close late October with the Academic Registrar. |
| Harold G. Conde Memorial Fellowship | $5000 pa | Maximum of 3 years | Applicants should be honours graduates permanently domiciled in Australia. The Fellowship is a supplementary award to be held in conjunction with another scholarship and is for graduate study or research in a field related to the electricity industry. Applications close with the Academic Registrar by 10 April. |
| IBM Research Scholarship in Microelectronics | $12000 pa where only scholarship held. $5000 pa where it supplements another scholarship. | Up to 3 years | To enable a suitable graduate to undertake a research degree in the Joint Microelectronics Research Centre. Applications close 31 October with the Academic Registrar. |
| The Joseph Barling Fellowship | Not less than $8500 | Maximum of 3 years | Candidates should be electrical engineering graduates of the University of New South Wales in special circumstances mechanical and industrial engineering graduates may apply. The Fellowship is for full-time study for the award of the degree of Master of Business Administration or Doctor of Philosophy at the University. Applications close 31 December with the Academic Registrar. |
| Medical Engineering Research Association | Variable | 1-3 years | Awarded for postgraduate study or research in the field of Biomedical Engineering. Applications to The Secretary, MERA, PO Box 218, Lindfield NSW 2070. |
| Water Industry Research Award | $20,830 pa | 2-4 years | Applications close with the Academic Registrar 10 January. |
| Shell Scholarship in Science or Engineering | See under Science | | |

## Graduate Scholarships (continued)

| Donor | Value | Year/s of Tenure | Conditions |
|---|---|---|---|
| **Engineering (continued)** | | | |
| Australian Telecommunications and Electronics Research Board<br><br>Science Research Scholarship of the Royal Commission of the Exhibition of 1851 | See under Science | | |

# Prizes

## Undergraduate University Prizes

The following table summarizes the undergraduate prizes awarded by the University. Prizes which are not specific to any School are listed under General. All other prizes are listed under the Faculty or Schools in which they are awarded.

Information regarding the establishment of new prizes may be obtained from the Examinations Section located on the Ground Floor or the Chancellery.

| Donor/Name of Prize | Value $ | Awarded for |
|---|---|---|
| **General** | | |
| The Sydney Technical College Union Award | $400.00 and Bronze Medal | Leadership in student affairs combined with marked academic proficiency by a graduand. |
| The University of New South Wales Alumni Association Prize | Statuette | Achievement for community benefit by a student in the final or graduating year. |
| **Faculty of Engineering** | | |
| The Institution of Engineers Australia Award | $200.00 and medal. | The best performance by a final or equivalent year student in 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 | $130.00 | The best performance in Year 1 or part-time equivalent of a Bachelor degree offered by the Faculty of Engineering. |
| **School of Civil Engineering** | | |
| The GAA Engineering Award | $500.00 | The best essay on a topic relating to galvanising by a student proceeding to the degree of Bachelor of Engineering (Civil) |
| The Association of Consulting Structural Engineers of New South Wales Prize | $225.00 | Best performance in 8.4430 Structural Design 4 in the Bachelor of Engineering course in Civil Engineering |
| The Association of Consulting Structural Engineers of New South Wales Prize | $175.00 | The best performance in 8.3440 Structural Design 3 in the Bachelor of Engineering Course in Civil Engineering |
| The Australian Conservation Foundation Prize | $50.00 | The best performance in the subjects which develop environmental management concepts for the Civil Engineer |
| The Australian Institute of Traffic Planning and Management Prize | $150.00 | The best performance in 8.4510 Transport Engineering major in the Bachelor of Engineering course in Civil Engineering |
| The Australian Welding Institute Prize | Books to the value of $60.00 | The best design which incorporates a welding process for students in Years 2 to 4 of the Bachelor of Engineering in Civil Engineering |
| The Baulderstone Hornibrook Prize | $500.00 | The best performance in Engineering Construction and Management in the Bachelor of Engineering Course in Civil Engineering |
| The Crawford Munro Memorial Prize | $150.00 | The best performance in 8.3640 Engineering Hydrology in the Bachelor of Engineering Course in Civil Engineering |

## Undergraduate University Prizes (continued)

| Donor/Name of Prize | Value $ | Awarded for |
|---|---|---|
| **School of Civil Engineering (continued)** | | |
| The Hardie's Pipeline Award | $250.00 and plaque | The best performance in 8.3630 Water Supply and Wastewater disposal in the Bachelor of Engineering course in Civil Engineering |
| The James Hardie Co Pty Ltd Prize | $225.00 | The best performance in 8.2610 Hydraulics 1 in the Bachelor of Engineering course in Civil Engineering |
| The Jeffery and Katauskas Prize | $500.00 | The best performance in 8.4310 Materials Major in the Bachelor of Engineering course. |
| **School of Electrical Engineering and Computer Science** | | |
| The Austral Crane Prize | $37.50 | The best performance in Year 3 of the Bachelor of Engineering course in Electrical Engineering. |
| The Austral Crane Prize | $37.50 | The best performance in a Power or Control elective in the Bachelor of Engineering course in Electrical Engineering |
| The Electricity Supply Engineers' Association of New South Wales Prize | $100.00 | 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 course in Electrical Engineeering. |
| The IBM Prize | $200.00 | The best performance in 6.611 Computing 1 |
| The Institution of Electrical Engineers Prize | $100.00 | The best performance in Year 3 studies of the Bachelor of Engineering course in Electrical Engineering |
| The J. Douglas Maclurcan Prize | $60.00 book order | Outstanding performance in the field of Control Systems in the final year of the Bachelor of Engineering course in Electrical Engineering |
| The Logica Pty Limited Prize | $1000.00 | The best performance by a graduand in a Computer Science Honours degree course. |
| **School of Mechanical and Industrial Engineering** | | |
| The Ansett Airlines of Australia Prize | $200.00 and Bronze Medal | The best overall performance in the Bachelor of Engineering course in Aeronautical Engineering |
| The Atlas Copco Prize | $125.00 | The best overall performance in the Bachelor of Engineering course in Mechanical Engineering. |
| The Austral Crane Prize | $75.00 | The best overall performance in full-time Year 3 of the Bachelor of Engineering course in Mechanical Engineering |
| The Australian Institute of Refrigeration, Air Conditioning and Heating Prize | Student membership of the Institute for one year, and Design Aid and Data book | The best performance in a subject selected by the Head of School |
| The Babcock Australia Limited Prize | $100.00 | The best performance in a subject selected by the Head of School |
| The Carrier Air Conditioning Pty Limited Prize | $250.00 | The best performance in a subject selected by the Head of School |
| The Computer-based Engineering Design Prize | $100.00 | The best undergraduate or postgraduate thesis making a contribution to computer-based Engineering design in the School of Mechanical and Industrial Engineering |

## Undergraduate University Prizes continued)

| Donor/Name of Prize | Value $ | Awarded for |
|---|---|---|
| **School of Mechanical and Industrial Engineering (continued)** | | |
| The David Carment Memorial Prize | $500.00 and Bronze Medal | The best overall performance in the final year of the Bachelor of Engineering course in Naval Architecture |
| The Electricity Commission of NSW Award | $250.00 | The best performance in 5.641 Thermal Power Plants |
| The Harbin Polytechnical Alumni Association Prize | $100.00 | The best performance in a subject selected by the Head of School |
| The Hawker de Havilland Ltd Prize | $500.00 | The best thesis in the Bachelor of Engineering course in Aeronautical Engineering |
| The Hawker de Havilland Victoria Limited Prize | $300.00 and Silver Medal | The best overall performance in the final year of the Bachelor of Engineering Course in Aeronautical Engineering |
| The Jeremy Hirschhorn Prize in Mechanical Engineering | $100.00 | The best performance in a subject selected by the Head of School |
| The John Harrison Prize | $100.00 | The best performance in Mechanics of Machines in Year 3 of the Bachelor of Engineering course in Mechanical Engineering |
| The Royal Institution of Naval Architects (Australian Division) Prize | $200.00 | The best ship design by a student in the final year of the Bachelor of Engineering course in Naval Architecture |
| The Shell Refining (Australia) Pty Ltd Prize | $100.00 | The best overall performance by a student in Year 1 of the Bachelor of Engineering course in Mechanical Engineering |
| The Shell Refining (Australia) Pty Ltd Prize | $100.00 | The best undergraduate thesis by a student in the final year of the Bachelor of Engineering course in Mechanical Engineering |
| The Shell Refining (Australia) Pty Ltd Prize | $100.00 | The best performance in the subject 18.603 Management/Economics by a student in the Bachelor of Engineering course. |
| The Staedtler (Pacific) Pty Ltd Prize | Products to the value of $100.00 | The best overall performance by a student in Year 2 of the Bachelor of Engineering course in Mechanical Engineering |
| **School of Mechanical and Industrial Engineering – Department of Industrial Engineering** | | |
| The Austral Crane Prize | $75.00 | The best overall performance in Year 3 of the Bachelor of Engineering course in Industrial Engineering |
| The R.E. Jeffries Memorial Prize | $500.00 | The best overall performance in the final year of the Bachelor of Engineering Degree course in Industrial Engineering |
| The Shell Refining (Australia) Pty Ltd Prize | $100.00 | The best performance in a subject selected by the Head of School |
| The TRW Products Limited Prize | $100.00 | The best performance in a subject selected by the Head of School |

# Graduate University Prizes

The following table summarizes the graduate prizes awarded by the University.

| Donor/name of Prize | Value $ | Awarded for |
|---|---|---|
| **Faculty of Engineering – Centre for Safety Science** | | |
| The Grace Bros Safety Science Merit Award | $250.00 | The best performance in 47.330G The Accident Phenomenon in the Graduate Diploma in Safety Science Course. |
| The Grace Bros Safety Science Merit Award | $250.00 | The best performance in 47.330G The Accident Phenomenon in the Master of Safety Science course. |
| The Manufacturers Mutual Insurance Prize for Ergonomics Principles | $200.00 | The best performance in 47.061G Principles of Ergonomics by a student in the Masters Degree or Graduate Diploma courses in Safety Science |
| The Manufacturers Mutual Insurance Prize for Occupational Disease | $150.00 | The best performance in 80.701G Occupational Disease by a student in the Masters Degree or Graduate Diploma courses in Safety Science |
| The Manufacturers Mutual Insurance Prize for Occupational Health | $150.00 | The best performance in 80.702G Occupational Health Control by a student in the Masters Degree or Graduate Diploma courses in Safety Science |
| The National Safety Council Prize | $100.00 | The best performance in 47.052G Introduction to Safety Engineering in the Masters Degree or Graduate Diploma in Safety Science. |
| The Safety Institute of Australia (NSW Division) Bill Lessels' Memorial Prize for Master of Safety Science | Books to the value of $150.00 | The best overall performance by a student in the Master of Safety Science course. |
| The Safety Institute of Australia (NSW Division) Bill Lessels' Memorial Prize for Graduate Diploma in Safety Science | Books to the value of $150.00 | The best overall performance by a student in the Graduate Diploma of Safety Science course. |
| **School of Civil Engineering** | | |
| The Institute of Advanced Motorists Prize | $50.00 | The best performance in Traffic Planning and Control |
| The Maunsells Project Report Prize | $500.00 | The best performance in 8.909X or 8.909G Project Report (9 credits)OR 8.918X or 8.918G Project Report (18 credits) OR 46.512X or 46.512G Project Report (9 credits) OR 46.513X or 46.513G Project Report (18 credits) by a student in the Master of Engineering Science or Master of Applied Science courses |
| The Maunsells Waste Management Prize | $500.00 | The best aggregate performance in 8.872X or 8.872G Management of Waste, 8.873X or 8.873G Waste & Waste-Water Analysis & Environmental Requirements, 8.874X and 8.874G Waste Management Science,25.715X |
| **School of Mechanical and Industrial Engineering** | | |
| The Computer-based Engineering Design Prize | $100.00 | The best undergraduate or postgraduate thesis making a contribution to computer-based Engineering design in the School of Mechanical and Industrial Engineering |

## Student's Timetable

| Time | Monday | | Tuesday | | Wednesday | | Thursday | | Friday | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Session 1 | Session 2 | Session 1 | Session 2 | Session 1 | Session 2 | Session 1 | Session 2 | Session 1 | Session 2 |
| 9-10 | | | | | | | | | | |
| 10-11 | | | | | | | | | | |
| 11-12 | | | | | | | | | | |
| 12-1 | | | | | | | | | | |
| 1-2 | | | | | | | | | | |
| 2-3 | | | | | | | | | | |
| 3-4 | | | | | | | | | | |
| 4-5 | | | | | | | | | | |
| 5-6 | | | | | | | | | | |
| 6-7 | | | | | | | | | | |
| 7-8 | | | | | | | | | | |
| 8-9 | | | | | | | | | | |

# The University of New South Wales Kensington Campus

**Theatres**

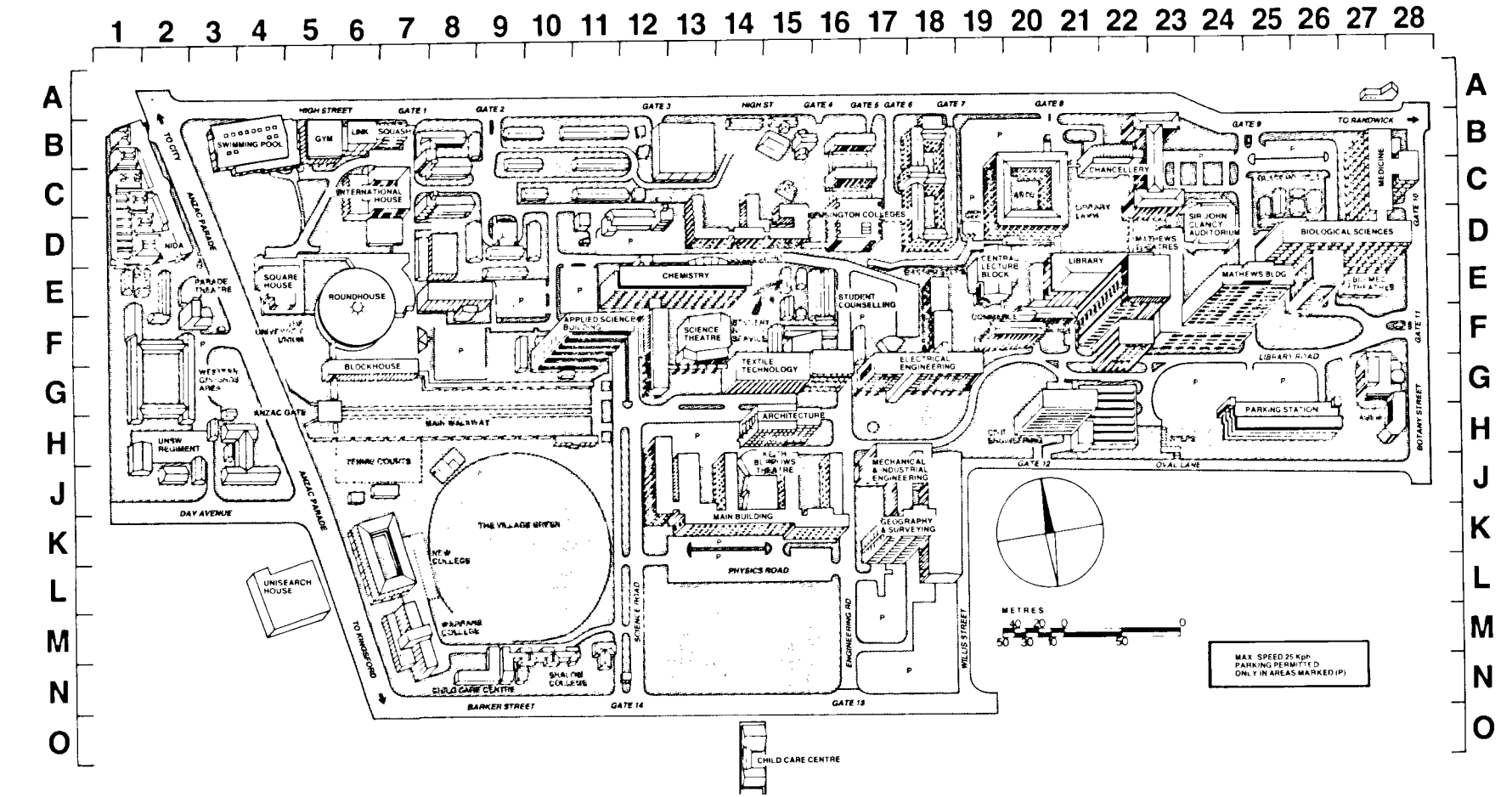
Biomedical Theatres **E27**
Central Lecture Block **E19**
Classroom Block (Western Grounds) **H3**
Rex Vowels Theatre **F17**
Keith Burrows Theatre **J14**
Main Building (Physics) Theatrette **K14**
Mathews Theatres **D23**
Parade Theatre **E3**
Science Theatre **F13**
Sir John Clancy Auditorium **C24**

**Buildings**

Affiliated Residential Colleges
*New (Anglican)* **L6**
*Shalom (Jewish)* **N9**
*Warrane* **M7**
Applied Science **F10**
Architecture **H14**
Arts (Morven Brown) **C20**
Banks **F22**
Barker Street Gatehouse **N11**
Basser College **C18**
Biological Sciences **D26**
Central Store **B13**
Chancellery **C22**
Chemistry
*Dalton* **F12**
*Robert Heffron* **E12**
Civil Engineering **H20**
Commerce and Economics (John Goodsell) **F20**
Dalton (Chemistry) **F12**
Electrical Engineering **G17**
Geography and Surveying **K17**
Goldstein College **D16**
Golf House **A27**
Gymnasium **B5**
House at Pooh Corner **N8**
International House **C6**
Io Myers Studio **D9**
John Goodsell (Commerce and Economics) **F20**
Kanga's House **O14**
Kensington Colleges **C17** (Office)
*Basser* **C18**
*Goldstein* **D16**
*Philip Baxter* **D14**
Link **B6**
Maintenance Workshop **B13**
Materials Science and Engineering **E8**
Mathews **F23**
Mechanical and Industrial Engineering **J17**
Medicine (Administration) **B27**
Menzies Library **E21**
Morven Brown (Arts) **C20**
New College (Anglican) **L6**
Newton **J12**
NIDA **D2**
Parking Station **H25**
Philip Baxter College **D14**
Robert Heffron (Chemistry) **E12**
Sam Cracknell Pavilion **H8**
Shalom College (Jewish) **N9**
Sir Robert Webster (Textile Technology) **G14**
Squash Courts **B7**
Swimming Pool **B4**
Unisearch House **L5**
University Regiment **J2**
University Union (Roundhouse) – Stage I **E6**
University Union (Blockhouse) – Stage II **G6**
University Union (Squarehouse) – Stage III **E4**
Wallace Wurth School of Medicine **C27**
Warrane College **M7**

**General**

Academic Staff Office **C22**
Accounting **F20**
Admissions **C22**
Adviser for Prospective Students **F15**
Anatomy **C27**
Applied Economic Research **G14**
Applied Geology **F10**
Applied Science (Faculty Office) **F10**
Architecture (including Faculty Office) **H14**
Arts (Faculty Office) **C20**
Audio Visual Unit **F20**
Australian Graduate School of Management **G27**
Banking and Finance **F20**
Biochemistry **D26**
Biological and Behavioural Sciences (Faculty Office) **D26**
Biomedical Engineering **A28**
Biomedical Library **F23**
Biotechnology **D26**
Bookshop **G17**
Building **H14**
Careers and Employment **F15**
Cashier's Office **C22**
Chaplains **E15**
Chemical Engineering and Industrial Chemistry **F10**
Chemistry **E12**
Child Care Centres **N8, O14**
Civil Engineering **H20**
Commerce and Economics (Faculty Office) **F20**
Community Medicine **D26**
Computing Services Department **F21, D26**
Continuing Education Support Unit **F23**
Counselling and Careers Service **F15**
Economics **F20**
Education **G2**
Education Testing Centre **E15**
Electrical Engineering and Computer Science **G17**
Energy Research, Development and Information Centre **F10**
Engineering (Faculty Office) **K17**
English **C20**
Ethics Committees Secretariat **B8**
Examinations **C22**
Fees Office **C22**
Food Science and Technology **F10**
French **C20**
General Staff Office **C22**
Geography **K17**
German Studies **C20**
Graduate Office and Alumni Centre **E4**
Graduate School of the Built Environment **H14**
Groundwater Management and Hydrogeology **F10**
Health Administration **C22**
History **C20**
Industrial Arts **H14**
Industrial Relations and Organizational Behaviour **F20**
Information Systems **F20**
Kanga's House **O14**
Kindergarten (House at Pooh Corner) **N8**
Landscape Architecture **K15**
Law (Faculty Office) **F21**
Law Library **F21**
Legal Studies and Taxation **F20**
Liberal and General Studies **C20**
Librarianship **F23**
Library **E21**
Lost Property **C22**
Marine Science **D26**
Marketing **F20**
Materials Science and Engineering **E8**
Mathematics **F23**
Mechanical and Industrial Engineering **J17**
Medical Education **C27**
Medicine (Faculty Office) **B27**
Microbiology **D26**
Mineral Processing and Extractive Metallurgy **E8**
Mining Engineering **K15**
Music **B11**
National Institute of Dramatic Art **D2**
Off-campus Housing **C22**
Optometry **J12**
Pathology **C27**
Patrol and Cleaning Services **C22**
Petroleum Engineering **D12**
Philosophy **C20**
Physics **K15**
Physiology and Pharmacology **C27**
Political Science **C20**
Printing Unit **C22**
Psychology **F23**
Public Affairs Unit **C22**
Publications Section **C22**
Remote Sensing **K17**
Russian Studies **C20**
Safety Science **J17**
Science and Mathematics Course Office **D26**
Science and Technology Studies **C20**
Social Work **G2**
Sociology **C20**
Spanish and Latin American Studies **C20**
Sport and Recreation Centre **B6**
Student Health **E15**
Student Records **C22**
Students' Union **E4** and **C21**
Surveying **K17**
Tertiary Education Research Centre **E15**
Textile Technology **G14**
Theatre Studies **B10**
Town Planning **K15**
Union Shop (Upper Campus) **D19**
University Archives **E21**
University Press **A28**
University Union (Blockhouse) **G6**
Waste Management **H20**
WHO Regional Training Centre **C27**
Wool and Animal Science **B8**


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
A B C D E F G H J K L M N O
HIGH STREET
GATE 1
GATE 2
GATE 3
HIGH ST
GATE 4
GATE 5
GATE 6
GATE 7
GATE 8
GATE 9
TO RANDWICK
TO CITY
ANZAC PARADE
SWIMMING POOL
GYM
SQUASH
INTERNATIONAL HOUSE
NIDA
PARADE THEATRE
SQUARE HOUSE
ROUNDHOUSE
BLOCKHOUSE
ANZAC GATE
MAIN WALKWAY
TENNIS COURTS
DAY AVENUE
UNSW REGIMENT
THE VILLAGE GREEN
NEW COLLEGE
BASHAM COLLEGE
SHALOM COLLEGE
CHILD CARE CENTRE
UNISEARCH HOUSE
TO KINGSFORD
BARKER STREET
GATE 14
GATE 15
SCIENCE ROAD
CHEMISTRY
APPLIED SCIENCE BUILDING
SCIENCE THEATRE
KENSINGTON COLLEGES
STUDENT COUNSELLING
TEXTILE TECHNOLOGY
ELECTRICAL ENGINEERING
ARCHITECTURE
KEITH BURROWS THEATRE
MAIN BUILDING
MECHANICAL & INDUSTRIAL ENGINEERING
GEOGRAPHY & SURVEYING
PHYSICS ROAD
ENGINEERING RD
WILLIS STREET
CHANCELLERY
LIBRARY LAWN
CENTRAL LECTURE BLOCK
LIBRARY
SIR JOHN CLANCY AUDITORIUM
MATHEWS THEATRES
MATHEWS BLDG
BIOLOGICAL SCIENCES
MEDICINE
GATE 10
GATE 11
LIBRARY ROAD
PARKING STATION
GATE 12
OVAL LANE
BOTANY STREET
METRES
MAX. SPEED 25 Kph
PARKING PERMITTED
ONLY IN AREAS MARKED (P)
CHILD CARE CENTRE

This Handbook has been specifically designed as a source of reference for you and will prove useful for consultation throughout the year.

For fuller details about the University – its organization, staff membership, description of disciplines, scholarships, prizes, and so on, you should consult the Calendar.

The Calendar and Handbooks also contain a summary list of higher degrees as well as the conditions for their award applicable to each volume.

For detailed information about courses, subjects and requirements of a particular faculty you should consult the relevant Faculty Handbook.

Separate Handbooks are published for the Faculties of Applied Science, Architecture, Arts, Commerce and Economics, Engineering, Law, Medicine, Professional Studies, Science (including Biological and Behavioural Sciences and the Board of Studies in Science and Mathematics), and the Australian Graduate School of Management (AGSM).

The Calendar and Handbooks, which vary in cost, are available from the Cashier's Office.