The University of New South Wales

Applied Science

1992 Faculty Handbook

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The address of
The University of New South Wales is:

P.O. Box 1, Kensington 2033
New South Wales Australia

Telephone: (02) 697 2222
Telegraph: UNITECH, SYDNEY
Telex: AA26054

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Faculty editor: *Graham Baldwin*

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 4 November 1991, but may be amended without notice by the University Council.

Contents

Calendar of Dates

The academic year is divided into two sessions, each containing 67 days for teaching. There is a recess of approximately six weeks between the two sessions and there are short recesses of one week within each of the sessions

Session 1 commences on the Monday nearest 1 March.

	1992	1993	Faculties other than Medicine
Session 1 (67 teaching days)	2 March to 16 March	1 March to 8 April	
Recess:	17 April to 26 April	9 April to 18 April	
	27 April to 12 June	19 April to 11 June	
Study Recess:	13 June to 18 June	12 June to 17 June	
Examinations	19 June to 7 July	18 June to 6 July	
Midyear Recess:	8 July to 26 July	7 July to 25 July	
Session 2 (67 teaching days)	27 July to 25 September	26 July to 24 September	
Recess:	26 September to 5 October	25 September to 4 October	
	6 October to 6 November	5 October to 5 November	
Study Recess:	7 November to 12 November	6 November to 11 November	
Examinations	13 November to 1 December	12 November to 30 November	

Important Dates for 1992

January

W	1	New Year's Day – Public Holiday
F	10	Last day for acceptance of applications by office of the Admissions Section for transfer to another undergraduate course within the University
M	13	Term 1 begins – Medicine IV
M	20	Term 1 begins– Medicine V
M	27	Australia Day – Public Holiday

February

T	4	Enrolment period begins for new undergraduate students and undergraduate students repeating first year
M	10	Re-enrolment period begins for second and later year undergraduate and graduate students enrolledin formal courses
F	28	Last day for acceptance of enrolment by new and re-enrolling students (Late fee payable thereafter if enrolment approved)

March

M	2	Session 1 begins – all courses except Medicine IV and V
Su	8	Term 1 ends – Medicine IV
M	9	Term 2 begins – Medicine IV
F	13	Last day applications are accepted from students to enrol in Session 1 or whole year subjects
Su	22	Term 1 ends – Medicine V
M	30	Term 2 begins – Medicine V
T	31	HECS Census Date for Session 1

April

F	17	Good Friday – Public Holiday Mid-session Recess begins
M	20	Easter Monday – Public Holiday
S	25	Anzac Day – Public Holiday
Su	26	Term 2 ends – Medicine IV Mid-session Recess ends

May

S	2	May Recess begins – University College, ADFA
M	4	Term 3 begins – Medicine IV
F	8	Term 1 ends – AGSM
T	12	Publication of Provisional Timetable for June examinations
Su	17	May Recess ends – University College, ADFA
W	20	Last day for students to advise of examination clashes
Su	31	Term 2 ends – Medicine V

June

M	1	Term 2 begins – AGSM
T	2	Publication of Timetable for June examination
M	8	Queen's Birthday – Public Holiday
T	9	Term 3 begins – Medicine V
F	12	Session 1 ends
S	13	Study Recess begins College of fine Arts Assessment Week begins
Su	14	Term 3 ends – Medicine IV
M	15	Term 4 begins – Medicine IV
Th	18	Study Recess ends
F	19	Examinations begin Session 1 ends – University College, ADFA
S	20	Midyear Recess begins – University College, ADFA College of Fine Arts Assessment Week ends
M	22	Examinations begin – University College, ADFA

July

T	7	Examinations end
W	8	Midyear Recess begins
S	11	Examinations end – University College, ADFA
Su	19	Midyear Recess ends – University College, ADFA
M	20	Session 2 begins – University College, ADFA
Su	26	Midyear Recess ends
M	27	Session 2 begins

August

F	7	Last day applications are accepted from students to enrol in Session 2 subjects. Term 2 ends – AGSM
Su	9	Term 3 and 4 ends – Medicine IV and V
M	17	Term 4 and 5 begins – Medicine IV and V
M	31	HECS Census Day for Session 2. Term 3 begins – AGSM

September

F	25	Closing date for applications to the Universities Admission Centre
S	26	Mid-session Recess begins September Recess begins – University College, ADFA

October

Su	4	September Recess ends – University College, ADFA
M	5	Labour Day – Public Holiday Mid-session Recess ends
T	6	Publication of provisional timetable for November examinations
W	14	Last day for students to advise of examination clashes
Su	18	Term 4 ends – Medicine V
F	23	Session 2 ends – University College, ADFA
M	26	Examinations begin – University College, ADFA

November

F	6	Session 2 ends Term 3 ends – AGSM
S	7	Study Recess begins College of Fine Arts Assessment Week begins
Su	8	Term 6 ends – Medicine IV
Th	12	Study Recess ends
F	13	Examinations begin Examinations end – University College, ADFA College of Fine Arts Assessment Week ends

December

T	1	Examinations end
F	25	Christmas Day – Public Holiday
S	26	Boxing Day – Public Holiday
M	28	Public Holiday

Introduction

Engineering and science disciplines that are directly concerned with aspects of Australia's resources have been established in the Faculty of Applied Science. Inter-disciplinary and multidisciplinary course options are available to students through the various Schools within the Faculty – Applied Bioscience, Chemical Engineering and Industrial Chemistry, Fibre Science and Technology, Geography, Materials Science and Engineering, Mines, and the Department of Safety Science.

Undergraduate courses available are:

- Applied Geology (including specialization in Mineral and Energy Resources, Engineering Geology, and Geophysics)
- Bioprocess Engineering
- Ceramic Engineering
- Chemical Engineering (including Fuel Engineering) and Mineral Engineering
- Food Science and Technology
- Geography (including Applied Physical Geography, Applied Economic Geography, and Human and Physical Resources)
- Industrial chemistry (including Polymer Science)
- Mineral Engineering
- Mining Engineering
- Metallurgical Engineering
- Petroleum Engineering
- Textile Management
- Textile Technology (including Textile Chemistry, Textile Engineering and Textile Physics)
- Wool and Pastoral Sciences
- Biotechnology, through an honours degree course in the Faculty of Science.

In most schools a variety of options are available, including joint degrees in other faculties (Engineering Science, and Law). Students should discuss their programmes with appropriate staff to ensure that their chosen course of study is appropriate to their aims and aspirations.

In 1991 an independent Department of Safety Science was established in the Faculty. This department specializes in multidisciplinary postgraduate training and research in a wide range of industrial and community safety issues.

The importance of applied science to the University of New South Wales, and to the wider community, is fully recognized and is especially referred to in the University Act of Incorporation. The Faculty of Applied Science is dynamic, with changing activities and programmes to meet the rapid technological developments in the applied sciences. Many of the staff of the Faculty have achieved international recognition for their work, and there is a continuing and wide range of research programmes underway. The staff are enthusiastic, and I hope that you will share their enthusiasm.

Once the term begins, it is essential that you participate fully in your study programme from the first day of the first year. You are also urged to play an active role in the extra-mural activities of the University, especially in the student societies in the Schools.

Explanatory pamphlets and brochures are issued at enrolment and these, together with the Calendar, should be consulted for further information: you should not hesitate to contact the appropriate School offices if you have questions or problems.

G.J.S. Govett

Dean
Faculty of Applied Science

Staff

Comprises Schools of Applied Bioscience, Chemical Engineering and Industrial Chemistry, Fibre Science and Technology, Geography, Materials Science and Engineering, and Mines.

Dean
Professor G.J.S. Govett

Chairman
Associate Professor J.P. Kennedy

Executive Officer
John David Collins, BSc PhD *N.S.W,* Ctext, ATI

Senior Administrative Officer
Graham John Baldwin, BA *A.N.U.*

Project Manager
Otto Zubzanda, Dipling, *T.U. Bratislava,* PhD *N.S.W*

Officer-in-charge, Drawing Office
Narendra Mohan Saha-Chaudhury, BME *Jadavpur,* MIEInd, MIEAust

Electron Microscope Unit of the Faculty of Applied Science

Physical Sciences Electron Microscopist
Paul Munroe, BSc PhD *Birm.*,

Faculty Information

Some People Who Can Help You

If you require advice and information of a general nature contact: Mr. G. Baldwin, Senior Administrative Officer, Room 1013, Applied Science Building. Tel. 697 4469

For information and advice of a specific nature, contact the appropriate school representative below:

Applied Geology Ms L. Bruce, Administrative Assistant, Room 916, Applied Science Building. Tel. 697 4262
Biotechnology Ms R. Lee, Administrative Assistant, Room 110A, Biological Sciences Building. Tel. 697 2050
Chemical Engineering and Industrial Chemistry Miss L. Woodcock, Administrative Officer, Room 316, Applied Science Building. Tel. 697 4318.
Food Science and Technology Mr R. Greenwood, Administrative Officer, Room 115, Building B8A. Tel. 697 4364.
Geography Ms T. Bean, Administrative Assistant, Room 143, Geography and Surveying. Tel. 697 4390.
Materials Science and Engineering Mr. O. Andersen, Administrative Assistant, Room 110B, Materials Science and Engineering Building. Tel. 697 4436.
Mining Engineering Ms S. Fletcher, Administrative Assistant, Room 49A, Main Building. Tel. 697 4516.
Petroleum Engineering Professor V. Pinczewski, Room 115, Petroleum Engineering Building. Tel. 697 5189.
Textile Technology Mr J. Pirie, Administrative Officer, Room 102, Sir Robert Webster Building. Tel. 697 4477.
Wool and Animal Science Assoc. Professor J. Kennedy, Room 256, Sir Robert Webster Building. Tel. 697 4482.
Safety Science Ms B. Littleweed, Administrative Assistant, 30 Botany St, Randwick. Tel. 697 4144.

Faculty of Applied Science Enrolment Procedures

All students re-enrolling in 1992 should obtain a copy of the free leaflet *Re-Enrolling in 1992* available from School Offices and the Admissions Office. This leaflet 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.

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 1992*).

Students With Disabilities

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

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

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

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

The Adviser can be contacted on 697-5418 or at Building F15 (Careers & Counselling Unit).

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 Registrar for approval by the University Council.

Applied Sciences Library Facilities

Although any of the university libraries may meet specific needs, the staff and students of the Faculty of Applied Science are served mainly by the Biomedical Library and the Physical Sciences Library.

The Biomedical Library

The Biomedical Library provides library services for staff and students from the Faculties of Medicine and Biological and Behavioural Sciences, the Schools of Applied Bioscience, Health Services Management, Fibre Science and Technology, and the Department of Safety Science. It is closely associated with the libraries of the teaching hospitals of the University.

The Biomedical Library is located on Levels 2, 3 and 4 of the Mathews Building Annexe and is connected to the other Special Libraries via a link through the undergraduate collection.

Professional staff are available at the Reader Assistance Unit on Level 2 to provide reference services and to assist in the use of the catalogues. Instructional classes in the use of the online catalogue. Instructional classes in the use of the library and in specific subject material can be arranged through the Reader Assistance Unit.

Serials in the Biomedical Library are now shelved in alphabetical order by title and carry the prefix "MB".

Details about Biomedical Library books, serials and audiovisual material can be found in the Library Catalogue, (OPAC).

The Biomedical Library offers the following facilities: computerized literature searches; a wide range of Databases on CD-ROM; remote access to databases on CD-ROM and current contents throughout the campus; access to the Family Medicine Program (MCQ self assessment); interlibrary loans.

Biomedical Librarian — Monica Davis

The Physical Sciences Library

This library, situated on Levels 6 and 7 of the Library tower, caters for the information needs of staff, postgraduate and undergraduate students in the pure and applied sciences, engineering and architecture.

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

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

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

Physical Sciences Librarian — Rhonda Langford

Conditions for the Award of the Degree of Bachelor of Science or Bachelor of Engineering

The courses leading to the award of the degree of Bachelor of Science or Bachelor of Engineering in the Faculty of Applied Science are programmed over four years of full-time study. The normal programs may be varied by the Head of the School in which the student is enrolled. The regulations governing the award of these degrees are as follows:

1. A candidate for the award of the degree of Bachelor of Science or 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 or similar training for such periods as are prescribed.

2. A student may be granted advanced standing by the Professorial Board on the recommendation of Faculty, but in each case must complete the appropriate period of approved industrial training before being eligible for the award of the degree.

3. The degree shall be awarded at Pass or Honours levels. Honours may be awarded in the following categories:Honours Class I; Honours Class II, Division I; Honours Class II, Division II.

4. Students shall be required to conform with the general rules relating to University courses.

Conditions for the Award of the Degree of Bachelor of Science (Technology) or Bachelor of Science (Engineering)

The courses leading to the award of the degree of Bachelor of Science (Technology) or Bachelor of Science (Engineering) in the Faculty of Applied Science are normally programmed over six years of part-time study in the University whilst the student is employed in industry. The normal programs may be varied by the Head of the School in which the student is enrolled. The regulations governing the award of these degrees are as follows:

1. A candidate for the award of the degree of BSc(Tech) or BSc(Eng) shall:
(1) comply with the requirements for admission;
(2) follow the prescribed course of study in the appropriateschool and pass the necessary examinations;
(3) complete an approved program of industrial or similar training for such periods as are prescribed.

2. A student may be granted advanced standing by the Professorial Board on the recommendation of Faculty.

3. The degree of BSc(Tech) and BSc(Eng) shall be awarded at Pass level only but in the case of superior performance throughout the course the degree shall be conferred 'with merit'.

4. Students shall be required to conform with the general rules relating to University courses.

General Education Requirement

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

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

The program requires students to undertake studies in three categories of the program:

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

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

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

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

The key questions addressed by the Program are:

CATEGORY A: The External Context

Course requirement: 56 hours

1. How do we, can we, generate wealth? (Australia and the Development of the World Economy) 28 hours
2. How can we, ought we, distribute wealth, status and power? (Human Inequality) 28 hours
3. What steps should we take, and what policies should we adopt, in science and technology? (Science and Civilization) 56 hours
4. What effects do our wealth generating and techno-scientific activities have on the environment? (Ecosystems, Technology and Human Habitation) 28 hours
5. What are the effects of the new mass media of communication? (Mass Media and Communication) 28 hours
6. What are the key social and cultural influences on Australia today? (Australian Society and Culture) 28 hours

CATEGORY B: The Internal Context of Assumptions And Values

Course requirement: 56 hours

1. How do we define ourselves in relation to the larger human community? (The Self and Society) 56 hours
2. How do our conceptions of human nature and well-being influence both individual and social behaviour? (Changing Conceptions of Human Nature and Well-Being) 28 hours
3. What are the prevailing conceptions of and challenges to human rationality? (The Pursuit of Human Rationality) 28 hours
4. How do language, images and symbols function as means and media of communication (The Use of Language, Images and Symbols) 28 hours
5. What is the impact of the computer on human society and culture? (The Computer: Its Impact, Significance and Uses) 28 hours
6. Which systems of belief and configurations of values are most conducive to the survival and enhancement of the human species and the planet earth? (Beliefs, Values and the Search for Meaning) 28 hours

CATEGORY C: An Introduction To The Design And Responsible Management Of The Human And Planetary Future

The central question to be addressed by students in a systematic and formal way is:

For what purpose or purposes will I use my intellectual skills, my expertise, or my technological prowess?

Will these abilities be used, for example:

(i) in a creative and innovative way?

(ii) to widen the circle of human participation in the benefits they bring?

(iii) to break down the barriers of exclusion and discrimination?

(iv) to enhance the prospects for survival of the human species?

(v) to enhance the capacity of the planet earth to sustain life?

In the Faculty of Applied Science most undergraduates take a Faculty subject APSE0002 "Social Issues in Applied Science" in the 4th year of their course as partial satisfaction of the Category C requirement. Completion of the Category C requirement differs across the Faculty and the details are shown under each School's handbook entry.

Undergraduate Study:

Course Outlines

The Faculty of Applied Science consists of the Schools of Applied Bioscience, Chemical Engineering and Industrial Chemistry, Fibre Science and Technology, Geography, Materials Science and Engineering, Mines and the Centre for Petroleum Engineering. These Schools offer full-time undergraduate courses leading to the degree of Bachelor of Science or Bachelor of Engineering, and some of the Schools also offer part-time courses leading to the award of the degree of Bachelor of Science (Technology).

Full-time Courses

Full-time courses of four years' duration leading to the award of the degree of Bachelor of Science are offered in Applied Geography, Applied Geology, Food Science and Technology, Industrial Chemistry, Textile Technology, Textile Management and Wool and Pastoral Sciences. Four-year courses leading to the award of the degree of Bachelor of Engineering are offered in Ceramic Engineering, Chemical Engineering, Mining Engineering and Petroleum Engineering. A four-year course leading to the award of a Bachelor of Metallurgical Engineering is offered in Metallurgical Engineering and Materials Engineering.

Honours: In all courses the degree may be awarded with Honours. The award of Honours is determined by performance in subjects and in the final-year project. Honours are awarded in Class 1; Class 2 Division 1; and Class 2 Division 2.

Industrial Training Requirements: In the scientific and technological courses close association with industry is maintained on the practical aspects of the professions. This is achieved in most of the courses of the Faculty by expecting students to complete an approved industrial training program prior to graduation. This is normally carried out during the Summer Recess. In the case of Wool and Pastoral Sciences, students are required to complete twenty-four weeks' approved practical work. In Mining Engineering students will undertake a program of practical training of at least 100 days.

Part-time Courses

Six-year part-time courses leading to the award of the degree of Bachelor of Science (Technology) are offered by the Department of Food Science and Technology in the School of Applied Bioscience; in Industrial Chemistry by the School of Chemical Engineering and Industrial Chemistry; and in Metallurgy and Ceramics by the School of Materials Science and Engineering.

The BSc(Tech) degree courses are intended for students who are employed in relevant industries and who wish to prepare for a degree mainly by part-time attendance. As part of the requirements for the award of the BSc(Tech) degree, students are required to complete an approved program of industrial training of not less than one year prior to the award of the degree. Industrial training should normally be completed concurrently with attendance in the course, but with the approval of the Head of School, may be completed after completion of the prescribed course of study.

Students who qualify for the award of the BSc(Tech) degree in the Faculty of Applied Science and who wish to proceed to the award of a BSc or BE degree will normally be required to complete further work which will involve at least one year of full-time attendance.

Holders of the degree of BSc(Tech) or BSc(Eng) will be eligible to proceed to the award of the degree of Master of Science, Master of Engineering or Master of Applied Science, subject to the regulations relating to these degrees.

Transfer is also possible from full-time courses to the part-time BSc(Tech) degree course, but a period of approved industrial experience must be gained before graduation. This requirement will apply to students transferring from BSc and BE degree courses within the Faculty.

Graduate Study:

Course Outlines

Graduate Enrolment Procedures

All students enrolling in graduate courses should obtain a copy of the free leaflet *Re-Enrolling 1992 for Postgraduate Students* available from School Offices and the Admissions Office. This leaflet 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 Study

The Faculty provides facilities for students to proceed to the award of the higher degrees of Doctor of Philosophy, Master of Engineering, Master of Science, Master of Applied Science, Master of Safety Science, Master of Engineering Science (Industrial Safety), and Master of Environmental Studies. Courses leading to the award of a Graduate Diploma are also offered. The degree of Doctor of Science is awarded for a contribution of distinguished merit in the fields of science, engineering or applied science.

The degrees of Doctor of Philosophy, Master of Engineering and Master of Science are all awarded for research and require the preparation and submission of a thesis embodying the results of an original investigation or design. Candidates for the Doctorate of Philosophy are normally involved in at least three years work. The work for the award of a Master's degree may be completed in a minimum of one year, but normally requires two years of study for full-time students, and equivalent time for part-time students.

The Faculty offers courses leading to the award of the degree of Master of Applied Science. The institution of this degree springs from the recognition of the considerable advance of knowledge in the fields of applied science and engineering which has marked recent years and the consequent increased scope for advanced formal instruction in these fields. Students are usually in attendance at the University for one year on a full-time basis or for two years part-time.

The Faculty offers a course leading to the award of the degree of Master of Environmental Studies. This is an interdisciplinary course designed to study the nature of environmental problems and the evaluation methodology. Students are usually in attendance at the University for one year on a full-time basis or for two years part-time.

The Master of Engineering Science course in Industrial Safety is flexible and designed for engineers who manage safety as part of their line management role or for specialist safety engineers who do not require the broad based MSafetySc course. Students are usually in attendance for one year full-time or for two years part-time.

The Master of Safety Science course is a broad based course which gives a grounding in all the disciplines which are essential to safety, together with electives in specialist areas such as ergonomics, occupational hygene, safety management or safety engineering. Students are requird to study for a minimum of eighteen months full-time or three years part-time.

Courses are also offered at the graduate level leading to the award of a Graduate Diploma. Students are required to attend courses of study for one year full-time or two years part-time. The courses available for the Graduate Diploma are Arid Lands Management, Biochemical Engineering, Biotechnology, Corrosion Technology, Ergonomics, Food Technology, Mining

and Mineral Engineering, Remote Sensing, Safety Sensing, Textile Technology and Wool and Pastoral Sciences and Petroleum Engineering.

Candidates may register for all the research degrees subject to adequate research facilities and satisfactory supervision being available in the candidate's particular field of study. Where special conditions can be met the Faculty may grant permission to a candidate to enrol for the degree of Doctor of Philosophy on a part-time basis.

The conditions governing the award of the various higher degrees and graduate diplomas are set out later in this handbook in Conditions for the Award of Higher Degrees.

Short, intensive graduate and special courses are provided throughout each year designed to keep practising scientists and technologists in touch with the latest developments in their various fields.

Subject Descriptions

Identification of Subjects

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

Each approved subject of the University is identified by a sequence of eight characters, consisting of a four character alphabetical prefix which identifies the organizational unit responsible for administering the subject, and a four digit numeric suffix identifies the subject.

Subject identifiers are approved 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 four character alphabetical prefix.

2. Each subject identifier 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.

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 alphabetical prefixes for each organizational unit are set out on the following pages.

Servicing Subjects are those taught by a school or department outside its own faculty. Their subject descriptions are published in the handbook of the faculty which originates the subject and are also published in the handbook of the faculty in which the subject is taught. The following pages contain descriptions for most of the subjects offered for the courses described in this book, the exception being General Education subjects. For General Education subjects see the Centre for Liberal and General Studies 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
P/T part-time
L Lecture, followed by hours per week
T Laboratory/tutorial, followed by hours per week
wks weeks of duration
hpw hours per week
C credit points or credit units
CR Credit level
DN Distinction
HD High Distinction
X External

Prefix	Organizational unit	Faculty
ABIO	School of Applied Bioscience	Applied Science
ACCT	School of Accounting	Commerce & Economics
ACHM	Department of Chemistry	University College
ACMA	Department of Civil Engineering	University College
ACSC	Department of Computer Science	University College
ADSC	Australian Defence Studies Centre	University College
AECM	Department of Economics & Management	University College
AELE	Department of Electrical Engineering	University College
AENG	Department of English	University College
AERO	Aerospace Engineering	Engineering
AGOC	Department of Geography & Oceanography	University College
AHIS	Department of History	University College
AINT	University College(Interdisciplinary)	University College
AMAT	Department of Mathematics	University College
AMEC	Department of Mechanical Engineering	University College
ANAT	School of Anatomy	Medicine
APHY	Department of Physics	University College
APOL	Department of Politics	University College
APSC	Faculty of Applied Science	Applied Science
APSE	Faculty of Applied Science	Applied Science
ARCH	School of Architecture	Architecture
ARTS	Faculty of Arts and Social Sciences	Arts and Social Sciences
ASIA	Asian Studies	Arts and Social Sciences
ATAX	Board of Studies in Taxation	
AUST	Australian Studies	Arts and Social Sciences
BIOC	School of Biochemistry	Biological & Behavioural Sciences
BIOM	Centre for Biomedical Engineering	Engineering
BIOS	School of Biological Science	Biological & Behavioural Sciences
BIOT	Department of Biotechnology	Applied Science
BLDG	School of Building	Architecture
BSSM	Board of Studies in Science & Mathematics	
CEIC	School of Chemical Engineering & Industrial Chemistry	Applied Science
CHEM	School of Chemistry	Science
CHEN	Department of Chemical Engineering	Applied Science
CHIN	Chinese	Arts and Social Sciences
CIVL	School of Civil Engineering	Engineering
CMED	School of Community Medicine	Medicine
COFA	College of Fine Arts	
COMM	Faculty of Commerce and Economics	Commerce & Economics
COMP	School of Computer Science and Engineering	Engineering
ECOH	Department of Economic History	Commerce & Economics
ECON	School of Economics, Departments of Economics and Econometrics	Commerce & Economics
EDST	School of Education Studies	Professional Studies
ELEC	School of Electrical Engineering	Engineering
ENGL	School of English	Arts and Social Sciences
EURO	European Studies	Arts and Social Sciences
EXPA	School of Arts and Music Education	Professional Studies
FIBR	School of Fibre Science & Technology	Applied Science
FILM	Department of Theatre and Film Studies	Arts and Social Sciences
FINS	School of Banking & Finance	Commerce & Economics
FOOD	Department of Food Science and Technology	Applied Science
FREN	School of French	Arts and Social Sciences
FUEL	Department of Fuel Technology	Applied Science
GENS	Centre for Liberal & General Studies	
GEOG	School of Geography	Applied Science
GEOL	Department of Applied Geology	Applied Science
GERS	Department of German Studies	Arts and Social Sciences
GREK	Modern Greek	Arts and Social Sciences
GSBE	Graduate School of the Built Environment	Architecture
HEAL	School of Health Services Management	Professional Studies
HIST	School of History	Arts and Social Sciences
HOSP	School of Marketing	Commerce & Economics
IDES	Department of Industrial Design	Architecture
INDA	Industrial Arts	Architecture
INDC	Department of Industrial Chemistry	Applied Science
INDO	Indonesian	Arts and Social Sciences
INFS	School of Information Systems	Commerce & Economics
INTD	Interdisciplinary Studies	Arts and Social Sciences
IROB	School of Industrial Relations & Organizational Behaviour	Commerce & Economics
JAPN	Asian Studies Unit	Commerce & Economics
KCME	Key Centre for Mines	Applied Science
LAND	School of Landscape Architecture	Architecture
LAWS	School of Law	Law
LEGT	Department of Legal Studies & Taxation	Commerce & Economics
LING	Linguistics	Arts and Social Sciences
LIBS	School of Librarianship	Professional Studies
MANF	Manufacturing Management	Engineering
MARK	School of Marketing	Commerce & Economics
MATH	School of Mathematics	Science
MATS	School of Materials Science and Engineering	Applied Science
MDCN	School of Medicine	Medicine
MDSG	Medicine Surgery Clinical Studies	Medicine
MECH	School of Mechanical and Manufacturing Engineering	Engineering
MEED	School of Medical Education	Medicine
MFAC	Medical Faculty (Administration)	Medicine

Prefix	Organizational unit	Faculty
MICR	School of Microbiology	Biological & Behavioural Sciences
MINE	Department of Mining Engineering	Applied Science
MNGT	Australian Graduate School of Management	
MSCI	Board of Studies and Mathematics	Board of Studies
MUSI	Department of Music	Arts and Social Sciences
NAVL	Naval Architecture	Engineering
OBST	School of Obstetrics & Gynaecology	Medicine
OCEA	Faculty of Science	Science
OPTM	School of Optometry	Science
PAED	School of Paediatrics	Medicine
PATH	School of Pathology	Medicine
PDCS	Professional Development Centre	Professional Studies
PHIL	School of Philosophy	Arts and Social Sciences
PHPH	School of Physiology & Pharmacology	Medicine
PHYS	School of Physics	Science
PLAN	School of Town Planning	Architecture
POLS	School of Political Science	Arts and Social Sciences
POLY	Department of Polymer Science	Applied Science
PROF	Faculty of Professional Studies	Professional Studies
PSCY	School of Psychiatry	Medicine
PSYC	School of Psychology	Biological & Behavioural Sciences
PTRL	Department of Petroleum Engineering Studies	Applied Science
REMO	Centre for Remote Sensing	Engineering
RUSS	Department of Russian Studies	Arts and Social Sciences
SAFE	Department of Safety Science	Applied Science
SCTS\ HPST	School of Science & Technology Studies	Arts and Social Sciences
SLSP	Department of Social Science & Policy	Arts and Social Sciences
SLST	School of Sport & Leisure Studies	Professional Studies
SOCI	School of Sociology	Arts and Social Sciences
SOCW	School of Social Work	Professional Studies
SPAN	Spanish & Latin American Studies	Arts and Social Sciences
SURG	School of Surgery	Medicine
SURV	School of Surveying	Engineering
TEDG	School of Teacher Education (graduate)	Professional Studies
TEED	School of Teacher Education (undergraduate)	Professional Studies
TESL	TESOL	Arts and Social Sciences
TEXT	Department of Textile Technology	Applied Science
THFI	Department of Theatre and Film Studies	Arts and Social Sciences
THST	Department of Theatre and Film Studies	Arts and Social Sciences
USOM	School of Mines	Applied Science
WOMS	Women Studies	Arts and Social Sciences
WOOL	Department of Wool & Animal Science	Applied Science

School of Applied Bioscience

Head of School
Professor P. P. Gray

Administrative Assistant
Ms R. Lee

The former Schools of Biotechnology and of Food Science and Technology were amalgamated in January 1986 to form the School of Biological Technologies. The School was renamed the School of Applied Bioscience in 1988. The School consists of the Departments of Biotechnology and of Food Science and Technology.

Department of Biotechnology

Biotechnology employs a body of multidisciplinary expertise directed towards the utilization and recycling of natural resources by controlled biological action, usually in a reactor. Its study provides an appreciation of the capabilities of biological systems and the skills required to maximize these capabilities on the industrial scale. Particular attention is given to: the selection of the appropriate systems and their maximization by genetic and or enzyme tailoring; the design of biological reactors and their ancillary equipment; optimization and control of the processes. It is by these means that products are manufactured at ensured standards of quality. The products include certain foods and beverages, baker's yeast, antibiotics, steroids, vaccines, enzymes, amino acids, nucleotides, vitamins, organic acids, alcohols, metals, plant growth regulators and insecticides. Specific mammalian proteins, such as insulin and growth hormone, are also produced by microorganisms which have been genetically engineered to contain the appropriate mammalian gene.

In 1992 the Department of Biotechnology is introducing a new undergraduate course, a BE in Bioprocess Engineering. The course is four years full-time and has been designed to meet the requirements for membership of the Institution of Engineers, Australia.

Students proceeding to the BSc degree course through the Board of Studies in Science and Mathematics and who seek to undertake training in biotechnology may do so by combining such training with a major in another relevant discipline, preferably biochemistry, microbiology or chemistry.

The fourth Honours year includes further formal training as well as research in biotechnology. Alternatively, students with no previous training in biotechnology may undertake the biotechnology honours year, provided they have the necessary background training in biochemistry and microbiology; in such cases the Level III biotechnology units constitute the formal component.

Details of courses majoring in biotechnology are given in the Faculty of Science handbook.

Department of Food Science and Technology

Food Technology is the application of basic science to the management of foods from the time of production until their use by the consumer. It is concerned with optimum food quality

and quantity, with nutritional status and safety, and with means of production, processing, preservation, distribution and utilization.

A study of food science and technology demands an interdisciplinary and integrated approach, one that brings many scientific disciplines into focus. Its basis is in areas of chemistry, biochemistry and microbiology, and its borders merge with those of agriculture, engineering, nutrition and commerce.

The food technologist acquires new knowledge by laboratory and process research, and applies it to the development of acceptable foods by optimum processes and equipment. Foods are studied in terms of their basic constituents and the changes they undergo when subjected to modern processing and distribution. The technologist is equally concerned with the development and selection of raw materials from agricultural, horticultural, animal and marine sources.

There is a demand, both national and international, for professionally trained people who are prepared to accept responsibility for the quality and safety of humans' food supply, who can contribute to the solution of one of the greatest problems of our age, how to make food supplies grow faster than population.

The Department offers a four-year full-time course leading to the award of the degree of Bachelor of Science and six-year part-time course leading to the award of the degree of Bachelor of Science (Technology). Graduates of both courses qualify for membership of the Royal Australian Chemical Institute, the Australian Institute of Food Science and Technology, and the US Institute of Food Technologists.

Graduate Diploma and Master of Applied Science courses in Food Technology of one year full-time or two years part-time are designed for graduates in science or agriculture wishing to familiarize themselves with the principles of food technology. Master of Applied Science courses in Food Microbiology and Food Engineering are also offered.

General Education Electives

For details of the General Education requirements see Faculty Information.

School of Applied Bioscience

Professor of Biotechnology, Head of School and Head of Department of Biotechnology
Peter Philip Gray, BSc *Syd.*, PhD *N.S.W.*, FIEAust, MAmerIChE, MABA

Professor of Food Science and Technology and Head of Department of Food Science and Technology
Geoffrey Moor Wilson, BSc PhD *Liv.*, AAIFST

Professor of Molecular Biology
*John Shine, BSc PhD *A.N.U.*

Professor of Applied Bioscience
Peter Lindsay Rogers, BE *Adel.*, MBA *N.S.W.*, DPhil DSc *Oxf.*

*Conjoint appointment with The Garvan Institute of Medical Research.

Department of Biotechnology

Head of Department of Biotechnology
Professor P. P. Gray

Professor
Peter Lindsay Rogers

Associate Professor
Noel William Dunn, MSc *Melb.*, PhD *Monash*

Senior Lecturers
Stephen Francis Delaney, BSc *Sheff.*, PhD *Liv.*, *MASM*
Pauline Mavis Doran, BE *Qld.*, MSc PhD *CalTech.* MIChE
Robert James Hall, BSc PhD *N.S.W.*
John Colin Madgwick, MSc PhD *N.S.W.*

Lecturer
Stephen Michael Mahler, BSc *Syd.*, PhD *Qld.*

Professional Officers
Russell George Cail, DipBiochem *Bendigo I.T.*, PhD *N.S.W.*
John Alton Ide, BSc *PhD N.S.W.*
Rose Ann Varga, BSc *N.S.W.*

Administrative Assistant
Robin Lee

Department of Food Science and Technology

Head of Department of Food Science and Technology
Professor G. M. Wilson

Associate Professors
Kenneth Alan Buckle, BSc PhD *N.S.W.*, FAIFST, FCIA
Graham Harold Fleet, MSc *Qld.*, PhD *Calif.*, FASM, FAIFST
Heather Greenfield, BSc PhD *Lond.*, FAIFST, MIBiol
Michael Wootton, BSc PhD *N.S.W.*, FAIFST, MAGI, ARACI

Senior Lecturers
Barbara Anne Munce, BSc PhD *N.S.W.*, FAIFST, FCIA, MASM, MIFT
Frances Maud Scriven, BSc PhD *N.S.W.*, AAIFST
Christopher Mo Ching Yuen, BSc DipEd *W.Aust.*, MAppSc PhD *N.S.W.*, AAIFST

Lecturer
Robert Hilton Driscoll, BSc *A.N.U.*, PhD *N.S.W.*, AAIFST

Principal Tutor
Jane Elizabeth Paton, BSc *N.S.W.*

Tutor
Jayashree Arcot, MSc *Madras*, PhD *Hyd.*

Administrative Officer
Richard John Greenwood, BA *N.S.W.*

Professional Officers
Maxwell Robert Bell, BSc MAppSc *N.S.W.*, ASTC
Yvone El-Ghetany, BScAg *Ains Shams*, MSc *N.S.W.*
Zbigniew Suminski, ME(Food Tech) *Olstzyn*

Honorary Visiting Fellow
Kevin Joseph Scott, BSc(Agr) Dip Ed *Syd.*

National Research Fellow
Vacant

Research Fellow
John David Craske, MSc PhD *N.S.W.*, ASTC, FRACI, FTS, AAIFST

Food Industry Development Centre

Director
Peter Michael Cranston, MSc *N.S.W.*, PhD *Macq.*, GradDip *N.S.W.*, *and N.S.W.*, MASM, AAIFST, ARACI

Senior Research Officer
Frances Anne Warnock, BSc *N.S.W.*, GDipEd *Adel.C.A.E.*, GDipND *Flin.*

Administrative Assistant
Joyce Weeks

Course Outlines

Undergraduate Study

3060
Food Science and Technology - Full-time Course

Bachelor of Science
BSc

This course is designed to provide depth and breadth in the relevant physical and biological sciences on which food science and technology is based. Students completing the Year 1 requirements are eligible for selection for admission to Year 2 of the course.

Year 1		Hours per week S1	S2
PHYS1002	Physics 1 *or*		
PHYS1022	Introductory Physics 1	6	6
CHEM1101	Chemistry 1A	6	0
CHEM1201	Chemistry 1B	0	6
MATH1032	Mathematics 1 *or*		
MATH1042	Higher Mathematics 1 *or*		
MATH1011	General Mathematics 1B *and*	6	6
MATH1021	General Mathematics 1C		
BIOS1011	Biology A	6	0
BIOS1021	Biology B	0	6
		24	24
Year 2			
CHEM2011	Physical Chemistry	0	6
CHEM2021	Organic Chemistry	5	1
CHEM2041	Chemical and Spectroscopic Analysis	0	6
MATH2819	Statistics SA	2	2
BIOC2312	Introductory Biochemistry	6	6
MICR2218	Microbiology	8	0
FOOD3210	Introductory Nutrition	3	0
FOOD4210	Introductory Food Engineering	0	3
		24	24
Year 3			
CHEM3929	Food Chemistry	6	0
FOOD1310	Food Preservation	6	0
FOOD1320	Plant Food Science	2	0
FOOD1330	Animal Food Science	3	0
FOOD1340	Quality Evaluation and Control	0	2
FOOD1350	Food Technology Laboratory	0	6
FOOD2310	Food Microbiology	4	0
FOOD3310	Nutrition	0	3
FOOD4310	Food Process Engineering	0	4
FOOD4320	Computer Applications	0	2
BIOT3041	Principles of Biotechnology	3	0
CHEM3926	Analytical Instrumentation	0	3
	General Education Subject/s Category A	0	4
		24	24

Year 4		Hours per week S1	S2
FOOD1400	Project	8	8
FOOD1410	Field Excursions	3	0
FOOD1420	Food Legislation	2	0
FOOD1430	Food Industry Management†	2	0
APSE0002	Social Issues in Applied Science†	2	0
	General Education Subject/s Category B	0	4
		17	12

†These subjects contribute to satisfaction of the Category C General Education requirement.

Plus *three* or more of the following electives to a total of not less than 8.5 hours per week.

CHEM3021	Organic Chemistry	0	6
MANF0400	Production Management	3	3
MANF4610	Operations Research	3	3
MARK2012	Marketing Systems	4	0
MATK2052	Marketing Research	0	4
BIOT3051	Biotechnology Laboratory	0	3
FOOD1440	Food Quality and Product Development	0	6
FOOD1450	Food Processing Wastes	0	3
FOOD1460	Cereal Technology	6	0
FOOD1470	Postharvest Technology of Foods	6	0
FOOD2410	Advanced Food Microbiology	0	6
FOOD2420	Yeast Technology	3	0
FOOD3410	Advanced Nutrition	0	6
FOOD4410	Advanced Food Engineering	3	0
FOOD4420	Food Packaging	3	0

or such other electives, to a total of not less than 8.5 hours per week, as approved by the Head of Department.

During Years 3 and 4 of the course excursions are made to various food industries. Detailed reports of some of these visits are required.

Detailed reports of the students' activities during their periods in industry are required.

3070
Food Science and Technology - Part-time Course

Bachelor of Science (Technology)
BScTech

This course is designed for students who are employed in the food processing industries. It extends over six part-time years of study, and leads to the award of the degree of Bachelor of Science (Technology). Students are required to complete an approved program of industrial training of not less than twelve months prior to the award of the degree. Industrial training should normally be completed concurrently with attendance in the course, but with the approval of the Head of Department may be completed after completion of the prescribed course of study.

The course covers the same subject matter as the first three years of the full-time course. For the first two years students

follow a common course in which general biology is taken, and thereafter specialize in the biological sciences, which are fundamental to the study of food science and technology. The subjects of Stages 4, 5 and 6 may be available only in day-time classes, and substantial day-time release from industry may be required. Students who have completed the requirements of this course and have qualified for the award of the degree of Bachelor of Science (Technology) may proceed to the award of the degree of Bachelor of Science by attending for one full-time year and completing the subjects listed in Year 4 of the full-time course. Students desiring to proceed to the award of a BSc degree must apply to the Head of the Department not later than 31 December of the year in which the sixth stage is completed.

Stages 1 and 2*		**Hours per week** S1	S2
PHYS1002	Physics 1 *or*		
PHYS1022	Introductory Physics 1	6	6
CHEM1101	Chemistry 1A	6	0
CHEM1201	Chemistry 1B	0	6
MATH1032	Mathematics I *or*		
MATH1042	Higher Mathematics 1' *or*	6	6
MATH1011	General Mathematics 1B *and*		
MATH1021	General Mathematics 1C		
BIOS1011	Biology A	6	0
BIOS1021	Biology B	0	6

*Physics and Mathematics are usually taken as Stage 1, the other subjects as Stage 2.
†There are no evening lectures in this subject.

Stage 3			
CHEM2021	Organic Chemistry	5	1
CHEM2041	Chemical and Spectroscopic Analysis	0	6
BIOC2312	Introductory Biochemistry	6	6
		11	13

Stage 4			
CHEM2011	Physical Chemistry	0	6
MATH2819	Statistics SA	2	2
MICR2218	Microbiology	8	0
FOOD3210	Introductory Nutrition	3	0
FOOD4210	Introductory Food Engineering	0	3
		13	11

Stage 5			
CHEM3929	Food Chemistry	6	0
FOOD2310	Food Microbiology	4	0
BIOT3041	Principles of Biotechnology	3	0
FOOD3310	Nutrition	0	3
FOOD4310	Food Process Engineering	0	4
FOOD4320	Computer Applications	0	2
	General Education Subject/s Category A	0	4
		13	13

Stage 6		**Hours per week** S1	S2
FOOD1310	Food Preservation	6	0
FOOD1320	Plant Food Science	2	0
FOOD1330	Animal Food Science	3	0
FOOD1340	Quality Evaluation and Control	0	2
FOOD1350	Food Technology Laboratory	0	6
CHEM3926	Analytical Instrumentation	0	3
	General Education Subject/s Category B	2	2
		13	13

3055
Bioprocess Engineering - Full-Time Course

Bachelor of Engineering
BE

The first two years of the course are similar to the first two years of the Chemical Engineering degree course with the addition of basic training in Biology. The third year of the course contains basic training in Biochemistry, Microbiology as well as the Chemical Engineering units and an introduction to Bioprocess Engineering which will be further developed in the fourth year. The course has been designed so that graduates can find employment in the fermentation, food processing, pharmaceutical, agro-industrial and waste treatment industries.

Year 1		**Hours per week** S1	S2
PHYS1002	Physics 1	6	6
CHEM1002	Chemistry 1	6	6
CHEN1020	Engineering 1 CE†	6	6
MATH1032	Mathematics 1	6	6
	General Education Subject/s Category A	2	2
		26	26

Year 2			
CEIC2010	Instrumental Analysis	3	3
CEIC2020	Computing	1	2
CEIC2030	Applied Thermodynamics and Rate Processes	2.5	0
CEIC2040	Applied Electrochemical and Surface Properties	1.5	0
CHEN2010	Materials & Energy Balances	2	2
CHEN2020	Flow of Fluids	2	2
CHEN2030	Heat Transfer	0	3
CHEN2040	Mass Transfer Fundamentals	0	2
CHEN2051	Chemical Engineering Laboratory 1	3	2
ELEC0802	Electrical Power Engineering	0	3
MATH2021	Mathematics	2	2
MATH2819	Statistics SA	2	2
BIOS1011	Biology A	6	0
	General Education Subject/s Category B	2	2
		27	25

Year 3		Hours per week S1	S2
CHEN3010	Engineering Thermodynamics	4	0
CEIC3010	Reaction Engineering	0	3
CHEN3020	Numerical Methods	0	3
CHEN3070	Process Control	0	2
CHEN3030	Fluids II	2	0
CHEN3040	Separation Processes	2	2
CHEN3050	Particle Mechanics	0	3
CHEN3060	Process Plant Engineering I	4	4
CHEN3080	Chemical Engineering Laboratory II	1.5	1.5
BIOC2312	Principles of Biochemistry	6	6
BIOT3100	Fermentation Processes	0	2
MICR2201	Introduction to Microbiology	6	0
		25.5	26.5

Year 4			
BIOT4063	Research Project	2	10
BIOT4093	Biological Process Engineering	6	6
CHEN4070	Process Dynamics & Control	3	2
CHEN4060	Process Plant Engineering II	4	0
CHEN4030	Safety & Environment†	2	0
CHEN4050	Process Plant Operation	0	3
CHEN4040	Management	2	2
CHEN4080	Design Project†	1	4
CIVIL0616	Structures	3	0
APSE0002	Social Issues in Applied Science†	2	0
		25	27

†These subjects contribute to satisfaction of the Category C General Education Requirement.

Graduate Study

The School of Applied Bioscience conducts formal courses leading to the award of Master of Applied Science degrees in Biotechnology, Food Technology, Food Microbiology and Food Engineering and Graduate Diplomas in Biotechnology and Food Technology.

In addition, the School welcomes enquiries from graduates in Chemistry, Biochemistry, Microbiology, Applied Science, Chemical Engineering, Physiology, Nutrition and Agriculture who are interested in pursuing research in biotechnology or in food science and technology for the award of the degrees of Master of Science and Doctor of Philosophy.

The Head of School provides information on research scholarships, fellowships, grants-in-aid and School research activities. Graduates are advised to consult the Head of School before making a formal application for registration.

Department of Biotechnology

5015
Biotechnology Graduate Diploma Course

Graduate Diploma
GradDip

The graduate diploma course provides the opportunity for graduates with no previous tuition in biotechnology to undertake training in this discipline.

A degree in a science-based course is required for admission. If the degree course has not included a biology component, the candidate is required to undertake some basic biology training as a prerequisite or co-requisite.

Under normal circumstances, students whose previous training has included a substantial component of biotechnology will not be admitted to the course.

The course comprises study of undergraduate and graduate formal subjects, plus extensive laboratory training in biotechnology.

The diploma is awarded after one year's full-time study, consisting of an average of 18 hours per week, or two years part-time study, consisting of an average of 9 hours per week. The program includes the listed obligatory subjects plus sufficient of the listed elective subjects to meet the hours of study required. The electives include subjects necessary for students without previous tuition in biochemistry and/or microbiology, as well as alternatives for those with previous tuition in these disciplines. The choice of electives in each individual case is subject to approval by the Head of School.

		Hours per week S1	S2
Obligatory Subjects			
BIOT3011	Biotechnology A	6	0
BIOT3021	Biotechnology B	0	6
BIOT5013	Practical Biotechnology	6	6
Elective Subjects			
BIOT3031	Microbial Genetics	6	0
BIOT8010	Graduate Seminars	2	2
BIOT7100	Biological Principles	3	0
BIOT7110	Bioengineering Principles	3	0
MICR2011	Microbiology 1	0	6

Other suitable electives from the Department of Food Science and Technology and/or other Schools.

8042
Master of Applied Science (Biotechnology) Graduate Course

Master of Applied Science (Biotechnology) MAppSc(Biotech)

The Department offers a formal graduate course at the masters' level. The course includes advanced treatments of all areas of biotechnology. It is open to graduates with a four-year degree in biotechnology or a related discipline, or who have, in the opinion of the Higher Degree Committee, acquired equivalent qualifications or experience. Intending students are referred to Conditions for the Award of Graduate Degrees set out later in this handbook.

The course consists of lectures, tutorials, practical sessions, case history studies and a supervised project. The minimum period of registration before the award of the degree is two sessions for full-time students and four sessions for part-time students.

An acceptable course would be a program of subjects involving a minimum of 18 hours per week for two sessions full-time or a minimum of 9 hours per week for four sessions part-time. Course details are as follows:

		Hours per week S1	S2
BIOT7051	Applied Genetics	0	5
BIOT7061	Peptide and Protein Technology	0	5
BIOT7071	Biochemical Engineering	0	5
BIOT7081	Environmental Biotechnology	5	0
BIOT7091	Applied Cellular Physiology	5	0
BIOT7100	Biological Principles	3	0
BIOT7110	Bioengineering Principles	3	0
BIOT7043	Biotechnology Project Major	8	8
BIOT7123	Biotechnology Project Minor	4	4

Elective components:

Elective subjects, including some undergraduate subjects, may be selected from those offered by the School of Applied Bioscience, or from those offered by other Schools in the University subject to approval.

Each individual course must be approved by the Higher Degree Committee of the Faculty of Applied Science and would comprise:

1. A major strand of related material comprising approximately 75% of the total program, including a project comprising not less than 15% nor more than 50% of the program.

2. A minor strand of broader based material comprising up to 25% of the total program.

3. Undergraduate units may be included in one or both strands but may not exceed 25% of the non-project component.

4. At least 60% of the non-project component must be taken in the Department of Biotechnology unless otherwise approved by the Head of School. The remainder, subject to approval and availability, may be undertaken elsewhere in the University. Full details of all subjects are listed under Disciplines of the University in the Calendar.

Department of Food Science and Technology

The Department conducts formal courses leading to the award of the Master of Applied Science degrees and of the Graduate Diploma in food technology.

Master of Applied Science Degree Courses

The MAppSc degree courses provide for a comprehensive study of theoretical and applied aspects of the science, technology and engineering of foods. The courses are elective in nature providing an opportunity for graduates to apply their basic skills in areas relevant to these fields of applied science in which the Department has developed special expertise.

Graduate courses are available for Master of Applied Science degree programs in the following areas:

Food Technology Course **8030**
Food Microbiology Course **8031**
Food Engineering Course **8035**

Intending candidates are invited to contact the Head of the Department for advice and recommendation. The basis of an acceptable program would be formal study aggregating at least 36 credits (1 credit equals 1 hour per week) for 2 sessions full-time or 18 credits for 4 sessions or 12 credits for 6 sessions part-time, and which would comprise:

1. A major strand of related material comprising approximately 75% of the total program, including a project comprising not less than 15% nor more than 50% of the program.

2. A minor strand of broader based material comprising up to 25% of the total program.

3. Undergraduate material may be included in one or both strands but may not exceed 25% of the non-project component.

4. At least 60% of the non-project component must be taken in the School of Applied Bioscience unless otherwise approved by the Head of Department. The remainder, subject to approval and availability, may be undertaken elsewhere in the University. Full details of all subjects are listed under Disciplines of the University in the Calendar.

8030
Food Technology Graduate Course

Master of Applied Science
MAppSc

The MAppSc course in Food Technology is particularly relevant to graduates in Agriculture, Applied Science and Science with principal interests in chemistry, biochemistry, microbiology, physiology, nutrition and engineering. This is a formal course consisting of core components (including a project), and an elective component that allows reasonable flexibility and a choice of subjects in food science and technology based on the candidate's background, subject to the availability of staff and resources.

The course comprises:

Core components		**Credits***
FOOD1527	Principles of Food Preservation	6
FOOD1557	Food Technology Laboratory	6
FOOD1707	Seminar	2
FOOD1717	Major Research Project	18
OR		
FOOD1727	Research Project	12
OR		
FOOD1737	Minor Project	6

* These credits may be concentrated in one session.

Elective components
Elective subjects making up the remainder of the credits, including undergraduate subjects, may be selected from those offered by the School of Applied Bioscience, or from those offered by other Schools in the University subject to approval by the Head of Department.

The work involved in the project must be embodied in a report and submitted in accordance with the requirements of the Faculty.

Depending on the candidate's background, enrolment in some of the above subjects may be accompanied by enrolment in related undergraduate subjects as prerequisites or co-requisites. A particular subject may not necessarily be conducted in any one year.

8031
Food Microbiology Graduate Course

Master of Applied Science
MAppSc

The MAppSc course in Food Microbiology is a formal course designed for graduates in Food Science, Food Technology, Microbiology, Biochemistry, Biotechnology or related disciplines who have an interest in microorganisms associated with foods. The course provides advanced training in all aspects of food microbiology as well as fundamental aspects of food science and technology. It consists of lectures, laboratory sessions, seminars and a supervised project, and requires a program of subjects totalling 36 credits (1 credit equals 1 hour per week for one session). 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).

The course comprises:

Compulsory Subjects		Credits*
FOOD1707	Seminar	2
FOOD2517	Food Microbiology	4
FOOD2527	Microbiological Examination of Foods	6
FOOD2537	Microbiological Quality Control	1
FOOD2547	Food Microbiology Project	6

Elective Subjects		Credits*
FOOD1517	Chemistry, Biochemistry and Physics of Foods	3
FOOD1527	Principles of Food Preservation	6
FOOD2507	Introductory Microbiology	3
FOOD2557	Microbial Spoilage of Foods	1
FOOD2567	Foodborne Microorganisms of Public Health Significance	2
FOOD2577	Food and Beverage Fermentations	2
FOOD2587	Microorganisms as Food Processing Aids and Ingredients	1

or other subjects offered by the Departments of Food Science and Technology and of Biotechnology subject to approval by the Head of Department.

* These credits may be concentrated in one session.

8035
Food Engineering Graduate Course

Master of Applied Science
MAppSC

The MAppSc course in Food Engineering is a formal course designed for graduates in Engineering or related disciplines and who have an interest in the processing of biological resources for human consumption. The formal components of the course provide professional training at an advanced level in food engineering and food science. The studies in food engineering are designed to strengthen and broaden the engineering background of candidates and emphasise the use of fundamental principles in solving problems associated with food processing. Problem solving skills in engineering are developed further in a research project devoted to an area of food engineering.

The course comprises:

Core components		Credits*
FOOD1707	Seminar	2
FOOD4527	Advanced Food Engineering	4
FOOD1717	Major Research Project	18
OR		
FOOD1727	Research Project	12
OR		
FOOD1737	Minor Project	6

* These credits may be concentrated in one session.

Elective components
The elective subjects making up the remainder of the credits, including undergraduate subjects, may be selected from those offered by the School of Applied Bioscience, or from those offered by other Schools in the University subject to approval by the Head of Department.

5020
Food Technology Graduate Diploma Course

Graduate Diploma
GradDip

The Graduate Diploma course is designed to provide professional training at an advanced level for graduates in Science, Applied Science or Engineering who have not had previous training in Food Technology.

Requirements are a first degree and, in some cases, the successful completion of assignments or examinations, as directed by the Head of Department.

The course is a blend of formal lectures and laboratory work at the undergraduate and graduate levels. The Graduate Diploma in Food Technology (GradDip) is awarded on the successful completion of one year of full-time study (34 credits), or two years of part-time study (17 credits/year). It involves the following program:

Core components		Credits*
FOOD1527	Principles of Food Preservation	6
FOOD1537	Plant Food Products	2
FOOD1547	Animal Food Products	3
FOOD1557	Food Technology Laboratory	6
FOOD2517	Food Microbiology	4

* These credits may be concentrated in one session.

Elective components
The elective subjects making up the remainder of the credits, including undergraduate subjects, may be selected from those offered by the School of Applied Bioscience, or from those offered by other Schools in the University subject to approval by the Head of Department. In all cases the hours devoted to graduate subjects constitute at least 50% of the total course hours.

Subject Descriptions

Undergraduate Study

APSE0002 Social Issues in Applied Science **S1**

The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

Department of Food Science and Technology

FOOD1310 Food Preservation **S1 L3 T3**

Prerequisites: BIOC2812, CHEM2011, CHEM2021, CHEM2041, FOOD3210, FOOD4210, MICR2218.

Introduction to food preservation; spoilage control by traditional and modern techniques. Technology of food preservation by heat, chilling and freezing, sun drying and dehydration. Use of salt, sugar, acid, chemical preservatives, ionizing radiations, modified atmospheres in food preservation. Chemical and microbial stability of foods. Packaging requirements for preserved foods. Water relations of foods. An integrated program of laboratory and pilot plant exercises designed to illustrate the principles and procedures presented in the lecture course.

FOOD1320 Plant Food Science **S1 L2**

Prerequisites: BIOC2312, CHEM2011, CHEM2021, CHEM2041, FOOD3210, FOOD4210, MICR2218.

Cereals. Structure, composition, properties and uses of cereal grains with emphasis on wheat; processing and technology of wheat and rice. *Sugars.* Sources, types, properties of sugars in foods; sugar milling and refining. *Fruit and vegetables.* Nutrient composition; principles of postharvest physiology, storage and handling. *Lipids.* Sources and composition of fats and oils, methods of extraction and processing. *Non-microbial hazards in foods.* Minerals, proteins, acids, goitrogens, cyanogens, carcinogens; spices and flavours. *Plant protein.* Sources, composition, extraction and uses in foods with emphasis on soybean. *Tea, cocoa and coffee.* Production, composition and processing.

FOOD1330 Animal Food Science **S1 L3**

Prerequisites: BIOC2312, CHEM2011, CHEM2021, CHEM2041, FOOD3210, MICR2218.

Nature and distribution of world animal food resources. *Meat:* Muscle structure, function, slaughter, conversion of muscle to meat; chemical, biochemical factors in postmortem glycolysis; meat microbiology; chilling, freezing, curing, processing of meat and meat-derived products; processing equipment; meat marketing systems; nutritional and sensory properties of meats. *Milk and dairy products.* Chemical, physical properties, microbiology of milk; technology of milk-derived products including cheese, fermented products, butter; frozen, chilled and dried milk-derived foods. *Marine products.* Nature and distribution of world fishery resources; teleostean and elasmobranch species, spoilage mechanisms, quality assessment; preservation by chilling, freezing, salting, drying, smoking, marinading and fermentation; fish meal and fish protein concentrate. *Egg products.* Structure and composition of the avian egg; changes during storage of whole eggs; egg quality assessment; functional properties of egg components; preservation of the intact egg; pulping, freezing and drying of whole egg pulp, yolk and albumen.

FOOD1340 Quality Evaluation and Control **S2 L1 T1**

Prerequisites: FOOD1310, FOOD1320, FOOD1330, FOOD2310, MATH2819.

An introduction to food quality, its nature, assessment and control during handling, processing and storage; the use of objective and sensory methods of assessment; an introduction to HACCP, TTT and PPP concepts.

FOOD1350 Food Technology Laboratory **S2 T6**

Prerequisites: FOOD1310, FOOD1320, FOOD1330, FOOD2310.

A program of exercises integrating elements of the chemical, physical, sensory and microbiological analysis of foods and the impact of processing on these factors. The program is designed to demonstrate the application of laboratory methods to food systems. Ability to carry out test methods and to interpret results will be a major component in student assessment.

FOOD1400 Project **F T8**

Prerequisite: Completion of Year 3 subjects.

The student undertakes an individual project involving a literature survey, an experimental investigation, the preparation of a detailed report on a selected topic in food science and technology, and presentation of seminars on a literature review and experimental results.

FOOD1410 Field Excursions **S1 T3**

Prerequisite: Completion of Year 3 subjects.

Inspection of food processing plants, growing areas and research stations in the Sydney metropolitan area, New South Wales and interstate.

FOOD1420 Food Legislation **S1 L2**

Prerequisite: Completion of Year 3 subjects.

An overview of Federal and State regulations affecting the production and marketing of foods; food imports and exports. Mechanisms for development of food standards. Principles of approval and usage of food additives. Codex standards. Implementation of food regulations.

FOOD1430 Food Industry Management **S1 L2**

Prerequisite: Completion of Year 3 subjects.

An introduction to food industry management, accounting, finance, marketing, industrial relations and communication skills.

FOOD1440 Food Quality and Product Development **S2 L2 T4**

Prerequisite: Completion of Year 3 subjects.

The steps involved in new product development; role of market research and advertising. Costing procedures, new product failure, case studies. Practical exercises in new food product development.

FOOD1450 Food Processing Wastes **S2 L2 T1**

Prerequisite: FOOD1350.

Effects of waste discharges into waterways. Treatment of water for domestic and industrial applications; water re-use; process modifications for effluent reduction. Origin, composition, treatment, disposal and utilisation of wastes from food processing operations. Legal and economic aspects of waste disposal. Inspections of water and waste treatment plants.

FOOD1460 Cereal Technology **S1 L2 T4**

Prerequisite: FOOD1350.

A treatment in greater depth of the following topics dealt with in FOOD1320 Production, storage, marketing and quality of cereal grains; current trends in these areas, technology of bread, biscuit and cake manufacture; chemical, physical and biochemical interactions in wheat flour doughs; flour milling and assessment of flour quality; cereal protein analysis, properties and behaviour; wheat variety identification; meat cereal combinations; cereal enzymes; non-food uses of cereals; preparation and uses of cereal protein, starches and lipids.

FOOD1470 Postharvest Technology of Foods **S1 L2 T4**

Prerequisite: FOOD1350.

Preharvest considerations, postharvest physiology and biochemistry, postharvest factors affecting quality, methods of storage and handling, marketing strategies for selected food commodities.

FOOD2310 Food Microbiology **S1 L2 T2**

Prerequisite: MICR2218.

A lecture and laboratory program on the ecology, biochemistry, isolation, enumeration and identification of bacteria, yeasts, fungi and viruses associated with foods and beverages. *Food spoilage:* specific food microorganism associations; taxonomy and biochemistry of major spoilage species; chemical and physical changes to food properties; control; spoilage of specific commodities. *Food-borne microbial disease;* foods as vectors of disease and food poisoning; statistics and epidemiology; ecology and taxonomy of food-borne pathogenic microorganisms; control and prevention by hygiene, microbiological standards and legislation. *Food fermentation:* microbial ecology and biochemistry of fermentations; fermentations of alcoholic beverages, bakery products, dairy products, meats, vegetables, cocoa beans, soy sauce; production of food ingredients and processing aids by fermentation. *Microbiological examination of foods:* sample preparation and sampling plans; sub-lethal injury; standard methods for determination of total plate counts, indicator organisms, food-borne pathogenic species, principal spoilage species. *Microbiological quality control:* specifications and standards; decision criteria; hazard analysis and critical control point (HACCP) concept.

FOOD2410 Advanced Food Microbiology **S2 L2 T4**

Prerequisite: FOOD2310.

An advanced theoretical and practical treatment of the ecology, taxonomy, biochemistry and analytical technology of bacteria, yeasts, fungi and viruses associated with food spoilage, food-borne disease and food fermentations. Emphasis on: new developments in food microbiology; economic consequences of microorganisms in foods; exploitation of microorganisms in novel processes for the production of food ingredients and processing aids; new technologies for the detection of microorganisms in foods, including enzyme immunoassay, DNA-probes, bioluminescence, impedance, epifluorescent-filtration methods; practical problems associated with the microbiological analysis of foods and interpretation of data.

FOOD2420 Yeast Technology **S1 L2 T1**

Prerequisite: FOOD2310.

The ecological, taxonomic and biochemical fundamentals of yeasts. The role of yeasts in alcoholic fermentations: beer, wine, cider, distilled spirits. Baker's yeast production and the role of yeasts in baking. Yeast fermented foods. The spoilage of foods by yeasts. Yeasts and yeast extracts as food for animals and humans. Yeast enzymes in the food industry.

FOOD3210 Introductory Nutrition **S1 L2 T1**

Co-or prerequisite: BIOC2312.

Role of nutrients in human structure and function. Effects of diet on growth and body size. Food habits, beliefs and choice; dietary patterns. Assessment of nutritional status; anthropometry, dietary intake studies, use of dietary recommendations, food groups, tables of food composition.

FOOD3310 Nutrition **S2 L2 T1**

Prerequisite: FOOD3210.

Nutritional needs of vulnerable groups: infants, pregnant and lactating women, the aged. Dietary intolerance, disorders related to the affluent diet including coronary heart disease, dental caries, diabetes, hypertension and cancer. Problems of undernutrition including protein, energy, mineral and vitamin deficiencies. Physiological and nutritional aspects of dietary fibre, alcohol and food intolerance. Measurement of nutrient intake using computer systems, on individual and group basis.

FOOD4210 Introductory Food Engineering **S2 L2 T1**

Prerequisites: PHYS1002 or PHYS1022 and MATH1032 or MATH1011 and MATH1021.

Units and dimensions; system conversions; material, momentum and energy balances; steady state and transient heat transfer; insulation; heat exchangers; solid and fluid rheology; viscosity; pumps; mixing.

FOOD4310 Food Process Engineering **S2 L2 T2**

Prerequisite: FOOD4210.

Refrigeration; freezing; chilling and thawing; evaporation; dehydration; extraction; distillation; extrusion; comminution; filtration and separation; process control; packaging.

FOOD4320 Computer Applications **SS L1 T1**

Prerequisite: MATH2819.

Introduction to VAX/VMS, VM/CMS, MS-DOS and other control languages; the use of statistical, graphics and other

program packages to solve problems in food science and technology.

FOOD4410 Advanced Food Engineering **S1 L2 T1**

Prerequisites: FOOD4310, FOOD4320.

Physical properties and measurement of food texture; numerical techniques, integrated food processing operations and process control; economics of process development; recent developments in food engineering.

FOOD4420 Food Packaging **S1 L2 T1**

Pre- or co-requisite: FOOD1310.

Chemical and physical properties of packaging materials; interaction between package and food, selection of packaging materials and systems, evaluation of packaging materials and systems, package design criteria; printing; computers in packaging; modified atmosphere and smart films.

Department of Biotechnology

Biotechnology is a Department within the School of Applied Bioscience.

APSE0002 Social Issues in Applied Science **S1**

The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

BIOT3011 Biotechnology A **S1 L3 T3**

Prerequisites: BIOC2312 and MICR2218.

The basic principles involved in the operation of microbial processes on an industrial scale. Includes: the selection, maintenance and improvement of microorganisms; the influence of physical and chemical factors on the microbial environment; the control of environmental factors; the effects of operational patterns on batch and continuous flow cultivation; aeration and agitation; scale-up of microbial processes; air and media sterilization; the harvesting, purification and standardization of products; the principles involved in microbial processes for chemical, pharmaceutical and food production, microbial waste treatment and environmental control. The laboratory component includes manipulation of microorganisms, laboratory-scale fermenter operation, microbial enzyme isolation, visits to industrial fermentation plants and industrial seminars.

BIOT3021 Biotechnology B **S2 L2 T4**

Prerequisite: BIOT3011.

Application of principles of biotechnology to the analysis and design of microbial processes of industrial relevance (antibiotics, microbial enzymes, single cell protein from carbohydrates and hydrocarbons, fermented foods and beverages, amino acids and vitamins, microbial polysaccharides, activated sludge and photosynthetic processes for waste treatment, microbial leaching of low-grade minerals). Emphasis on quantitative approach: mass and heat balance calculations, kinetic and thermodynamic analysis, detailed equipment design and specification, process design and layout, process simulation, plant location, application of optimization techniques. The economics of microbial processes are considered and comparison made with alternative modes of production or treatment. The economics of agroindustry in Australia using microbial processes. Marketing of fermentation products, clinical trials required, legal constraints, patent rights. Technical and economic feasibility studies, and a design project.

BIOT3031 Microbial Genetics **S1 L2 T4**

Prerequisites: BIOS2011, BIOS2021, BIOC2312 and MICR2011.
Excluded: MICR3021.

This unit is suitable for students majoring in Microbiology, Biochemistry, Biotechnology or Genetics. It deals with major aspects of the genetics of bacteriophage, bacteria and yeast. Topics include plasmids and transposible genetic elements, gene transfer, mutagenesis and DNA repair, mutants, bacteriophage genetics, gene cloning (vectors, recombinant DNA techniques) and genetics of nitrogen fixation.

BIOT3041 Principles of Biotechnology **S1 L3**

Prerequisites: BIOC2312 and MICR2218

Lecture component of BIOT3011 Biotechnology A.

BIOT3051 Biotechnology Laboratory **S1 T3**

Prerequisite: BIOT3041.

Laboratory component of BIOT3011 Biotechnology A.

BIOT3061 Modern Techniques in Biotechnology S2 L2 T4

Prerequisite: BIOC2312.

Recent developments in biotechnology have resulted in techniques which are widely applied in industrial, clinical, veterinary, agricultural and research laboratories. Many of these techniques have resulted from the development of monoclonal antibodies and the development of gene probes. The course includes: antibody structure; production of monoclonal antibodies, cell fusion, hybridoma selection, culture techniques, purification; analytical techniques employing monoclonal antibodies (RIA, ELISA); therapeutic application of antibodies, immunotoxins; gene probes; restriction fragment length polymorphisms (RFLP); gene probes for disease detection, identification of bacteria and viruses; forensic application of DNA fingerprinting. Tutorial and practical work to complement the lectures.

BIOT3100 Fermentation Processes **S2 T2**

Factors governing the use of microorganisms in industrial processes, including the selection, maintenance and improvement of microorganisms, the control of environmental factors, batch and continuous flow operational patterns, product recovery, process optimization and waste disposal. Demonstrations of the operation and control of fermenter systems and of microbial process simulation.

BIOT4063 Research Project **S1 T3 S2 T9**

BIOT4073/BIOT4083 Biotechnology Honours

Advanced formal training in selected areas of biotechnology and participation in one of the school's research projects.

BIOT4093 Biological Process Engineering **F L2 T4**

Prerequisite: MICR2201.

Structure of Metabolism: Growth of an undifferentiated organism as a physico-chemical process leading to quantification of growth processes. Structure and function of a

single cell. The structure of metabolic processes. Energy metabolism balances. Small metabolite production. Macro-molecule production. Coordination and control of cellular processes. *Industrial Bio-processes:* A review of bio-process industries. The selection, screening and maintenance of commercial cultures. The optimization of bio-processes. Batch and continuous fermentations. Enzyme engineering, single cell protein. Biodeterioration and microbiological stability. Sanitation. Fermentation practice. *Microbial Dynamics and Energetics:* Principles used in the quantification of complex systems. Quantification of biomass and the growth process. Balanced growth. The Monod model and further extensions of the model. Uncoupling of growth processes. Quantification of product formation. Distributed, segregated, unstructured and structured models. Stochastic models. Overall energetics of growth processes. Entropy and free energy relationships in complex reaction sequences. Principles and requirements of driven reactions. The energetics of cell processes and the prediction of yields and metabolic heat evolution.

Graduate Study

Department of Food Science and Technology

Food Science and Technology is a Department within the School of Applied Bioscience.

FOOD1507 Introductory Food Science **S1 L1 S2 T1**

An introduction to the history of food preservation and human nutrition. Current world food patterns, organizations and trade. Food development programs, regional and international agencies and activities. Parameters of food quality; food choice and social behaviour, food and society. Students present a seminar on aspects of food science in Session 2.

FOOD1517 Chemistry, Biochemistry and Physics of Foods **S1 or S2 L2 T1**

An introduction to the chemical, physical and biochemical properties of foods. Food proteins, lipids, carbohydrates, nucleic acids, vitamins, minerals, pigments. Food enzymes, main classes and factors affecting their activity. Food rheology and texture. Heat transfer in foods. Effect of processing upon the properties of foods. Basic techniques for the analysis of food components and properties.

FOOD1527 Principles of Food Preservation **S1 L3 T3**

Spoilage control by traditional and modern techniques. Technology of food preservation by heat, chilling and freezing, sun drying and dehydration, salt, sugar, acid, chemical preservatives, ionizing radiations, modified atmospheres. Chemical and microbial stability of foods. Packaging requirements for preserved foods. An integrated program of laboratory and pilot plant exercises designed to illustrate the principles and procedures presented in the lecture course.

FOOD1537 Plant Food Products **S1 L2**

Cereals: structure, composition, properties and uses of cereal grains with emphasis on wheat; processing and technology of wheat and rice. *Sugars:* sources, types, properties of sugars in foods; sugar milling and refining. *Fruit and vegetables:* nutrient composition; principles of postharvest physiology, storage and handling. *Lipids:* sources and composition of fats and oils, methods of extraction and processing. *Non-microbial hazards in foods:* minerals, proteins, acids, goitrogens, cyanogens, carcinogens; spices and flavours. *Plant protein:* sources, composition, extraction and uses in foods with emphasis on soybean. *Tea, cocoa and coffee:* production, composition and processing.

FOOD1547 Animal Food Products **S1 L3**

Nature and distribution of world animal food resources. *Meat:* muscle structure, function, slaughter, conversion of muscle to meat; chemical, biochemical factors in postmortem glycolysis; meat microbiology; chilling, freezing, curing, processing of meat and meat-derived products; processing equipment; meat marketing systems; nutritional and sensory properties of meats. *Milk and dairy products:* chemical, physical properties, microbiology of milk; technology of milk-derived products including cheeze, fermented products, butter, frozen, chilled and dried milk-derived foods. *Marine products:* nature and distribution of world fishery resources; teleostean and elasmobranch species, spoilage mechanisms, quality assessment; preservation by chilling, freezing, salting, drying, smoking, marinading and fermentation; fish meal and fish protein concentrate. *Egg products:* structure and composition of the avian egg; changes during storage of whole eggs; egg quality assessment; functional properties of egg components; preservation of the intact egg; pulping, freezing and drying of whole egg pulp, yolk and albumen.

FOOD1557 Food Technology Laboratory **S2 T6**

Prerequisites: FOOD1527, FOOD1537, FOOD1547 or their equivalent.

A program of laboratory and pilot plant exercises integrating elements of the chemical, physical, sensory and microbiological analysis of foods and the impact of processing on these factors. The program is designed to demonstrate the application of laboratory methods to food systems.

FOOD1607 Dairy Technology **S2 L1 T1**

Prerequisite: FOOD1547 or equivalent.

A detailed review of trends in dairy industries at the national and international levels. The microbiology and biochemistry of dairy products with particular reference to the technology of milk, butter and cheese production. The development of new dairy products, the use of dairy products in other foods. Emphasis is placed upon the use and development of new technologies in the broad areas of dairy product processing.

FOOD1617 Oenology **S1 L2**

History of wine production, statistics and classification. Viticulture. Grape composition. Technology and biochemistry of production of table wines, sparkling wines, vermouths, sherries; quality control procedures. Legal, cultural, climatic factors in French, Spanish, Portuguese, Italian, German, Californian and Australian wine production. Principles of sensory testing and evaluation of wines.

FOOD1627 Technology of Cereal Products **S2 L2**

Prerequisite: FOOD1537 or equivalent.

World production of cereals: cultivation, diseases, harvesting and storage of cereal crops. Grain morphology and components, cereal quality, quality and yield improvements by breeding. Milling of wheat, flour types, flour testing, suitability for different purposes, flour component interactions in doughs, flour bleaches and dough improvers, baking technology. The use of non-wheat flours in bread and baked goods. Pasta products and breakfast cereals. Nutritional aspects of cereals. Starch-gluten separation, starch syrups. Malting, brewing, distilling and industrial alcohol production from cereals. Preparation, properties and uses of modified starches.

FOOD1637 Marine Products **S2 L2**

Prerequisite: FOOD1547 or equivalent.

World fisheries, oceanographic factors and fish populations. Biochemistry and microbiology of growth, culture, harvesting and postharvest handling. Cultivation of fish, molluscs, crustacea, modern and traditional methods. Biochemistry and microbiology of marine products in relation to freezing and preservation by the use of heat, chemicals and fermentation.

Quality control parameters and fish inspection. Role of marine products in world nutrition. Possibilities for further exploitation of marine resources.

FOOD1647 Food Additives and Toxicology **S1 L2**

Functions, modes of action of food additives, consequences of use, ethical and legislative considerations. National, State and international attitudes and standards. Principles of toxicological testing, the evaluation of results.

FOOD1657 Postharvest Physiology and Handling of Fruit and Vegetables **S1 L1 T5**

Pre or co-requisite: FOOD1537 or equivalent.

Biochemistry and physiology of metabolism in fresh fruit and vegetables; respiration measurements as an index of metabolism, maturation and senescence; concept of climacteric and nonclimacteric produce; physiological and metabolic changes occurring during ripening. Effect of temperature on metabolism; constraints of high and low temperatures; role of humidity control and water loss in quality maintenance; use of atmosphere control to delay senescence and ripening. Physiological disorders of stored produce; microorganisms of importance to postharvest tissue; physical and chemical methods of control; postharvest disinfestation and quarantine measures. Examination of current commercial storage and marketing operations.

FOOD1667 Postharvest Storage of Foods **S1 L2 T4**

Prerequisite: FOOD1557 or equivalent.

Preharvest considerations, postharvest physiology and biochemistry, postharvest factors affecting quality, methods of storage and handling, marketing strategies for selected food commodities.

FOOD1701 Seminar **F T1**

Students present material arising from literature and/or laboratory assignments and/or plant investigations in the food and related industries. Critical assessments are made of the results of research in food science and technology.

FOOD1717 Major Research Project **F T9**

A detailed investigation of a selected topic in food science and technology including submission of a project report.

FOOD1727 Research Project **F T6**

An investigation of an aspect of food science and technology and submission of a project report.

FOOD1737 Minor Project **F T3**

A study of an aspect of food science and technology and submission of a project report.

FOOD1747 Special Topics in Food Science and Technology **S1 or S2 T6**

An individually supervised program of investigation in specialised aspects of food science and technology not otherwise offered. Embraces a literature review, laboratory work and/or industrial liaison as may be appropriate. Available only to appropriately qualified students.

FOOD1757 Special Topics in Food Science and Technology **S1 or S2 T3**

A similar but shorter investigation to that outlined in FOOD1747.

FOOD1767 Reading Assignment **SS T1**

A reading assignment in an area supporting candidates' major disciplines or commodity interests. Presentation of a seminar may be required.

FOOD2507 Introductory Microbiology **S1 L2T2**

This subject is designed as a prerequisite to FOOD2517 for students with very limited or no background in basic microbiology. It covers the fundamentals of microbial taxonomy, ecology, cytology and biochemistry and the basic technologies of microbial culture, isolation, enumeration and identification.

FOOD2517 Food Microbiology **S1 L2 T2**

Prerequisite: FOOD2507 or other introductory microbiology subject.

A lecture and laboratory program on the ecology, biochemistry, isolation, enumeration and identification of bacteria, yeasts, fungi and viruses associated with foods and beverages. *Food spoilage:* specific food/microorganism associations; taxonomy and biochemistry of major spoilage species; chemical and physical changes to food properties; control of spoilage of specific commodities. *Foodborne microbial disease:* foods as vectors of disease and food poisoning; statistics and epidemiology; ecology and taxonomy of food-borne pathogenic microorganisms; control and prevention by hygiene, microbiological standards and legislation. *Food fermentation:* microbial ecology and biochemistry of fermentations; fermentation of alcoholic beverages, bakery products, dairy products, meats, vegetables, cocoa beans, soy sauce; production of food ingredients and processing aids by fermentation. *Microbiological examination of foods:* sample preparation and sampling plans; sub-lethal injury; standard methods for determination of total plate counts, indicator organisms, foodborne pathogenic species, principal spoilage species. *Microbiological quality control:* specifications and standards; decision criteria; hazard analysis and critical control point (HACCP) concept.

FOOD2527 Microbiological Examination of Foods **S2 L2 T4**

Prerequisite: FOOD2517 or equivalent.

Detailed lecture and laboratory consideration of standard methods and new methods and technologies for the bacteria, yeasts and fungi in analysis of foods. Rapid cultural methods; immunoassay, DNA-probe, impedance, bioluminescence, image analysis-epifluorescence (DEFT), Petrifilm, computer identification of microorganisms. Measurement of sanitation effectiveness. Sampling considerations. Interpretation of microbiological data in reference to specifications, standards, spoilage and public health risk. Detection and enumeration of specific microorganisms using new technologies.

FOOD2537 Microbiological Quality Control **S1 L1 T1**

Prerequisite: FOOD2507 or equivalent
Co-requisite: FOOD2527.

A theoretical and practical consideration of: food hygiene; cleaning and sanitation programs; HACCP; microbiological specifications and standards; food legislation; food inspection; setting up and management of a laboratory for the microbiological analysis of foods.

FOOD2547 Food Microbiology Project **FT3**

Prerequisite: FOOD2517.

A study of an aspect of food microbiology and submission of a project report.

FOOD2557 Microbial Spoilage of Foods **S2 L1**

Prerequisite: FOOD2517.

Consideration of: major microbial groups responsible for spoilage - yeasts, moulds, lactic acid bacteria, acetic acid bacteria, psychrotrophs, lipolytics, proteolytics; specific commodity groups - meat, dairy and fish products, fruits, vegetables; impact of processing technologies on food spoilage and extension of shelf-life; biochemical basis of spoilage defects, taints.

FOOD2567 Foodborne Microorganisms of Public Health Significance **S2L2**

Prerequisite: FOOD2517.
Co-requisite: FOOD2527.

An advanced treatment of the ecology, epidemiology, properties, pathogenicity, methods of analysis, economic significance and control of pathogenic microorganisms in foods. *Salmonella, Shigella, Escherichia coli., Vibrio* sp., *Staphylococcus aureus, Bacillus* sp., *Clostridium perfringens, Clostridium botulinum, Yersinia, Listeria, Campylobacter, Aeromonas, Klebsiella*, viruses, fungi.

FOOD2577 Food and Beverage Fermentations **S2L2**

Prerequisite: FOOD2517.

A detailed treatment of the microbial ecology, biochemistry, processing technology and quality parameters of fermented foods and beverages; cheese, yogurt, novel dairy products; meat sausages; bread, biscuit/cracker doughs; soybean products, soy sauce, tempe; traditional fermented products of Asia and Africa; vegetables; cocoa beans; alcoholic beverages, beer, wine, champagne, distilled spirit.

FOOD2587 Microorganisms as Food Processing Aids and Ingredients **S2L1**

Prerequisite: FOOD2517.

This subject interfaces with biotechnology and considers the use of microorganisms as primary sources of processing aids and ingredients for food processing. The microbial production of vitamins, flavouring agents, amino acids, enzymes, pigments, thickening agents, fats and oils, modified proteins, organic acids. Use of microbial species as biocontrol agents to extend shelf-life, as agents to improve the nutritive and therapeutic value of foods, immobilized cell and cell reactor technologies for conducting food and beverage bioconversions.

FOOD3507 Introductory Nutrition **S1 L2 T1**

Role of nutrients in human structure and function. Effects of diet on growth and body size. Food habits, beliefs and choice; dietary patterns. Assessment of nutritional status; anthropometry, dietary intake studies, use of dietary recommendations, food groups, tables of food composition.

FOOD3517 Nutrition **S2 L2 T1**

Prerequisite: FOOD3507 or equivalent.

Nutritional needs of vulnerable groups: infants, pregnant and lactating women, the aged. Dietary intolerance, disorders related to the affluent diet including coronary heart disease, dental caries, diabetes, hypertension and cancer. Problems of undernutrition including protein, energy, mineral and vitamin deficiencies. Physiological and nutritional aspects of dietary fibre, alcohol and food intolerance. Measurement of nutrient intake using computer systems, on individual and group basis.

FOOD3527 Advanced Nutrition **S2 L3 T3**

Prerequisite: FOOD3517 or equivalent.

Nutrition topics in relation to food and nutrition policy; the food industry and community nutrition in developing and industrialised countries; food enrichment, food allergies, supplementary feeding programs and nutrition education. Principles of the nutrient evaluation of foods. Practical sessions and computing using nutrient data bases.

FOOD4507 Food Engineering Principles **S2 L2 T1**

Prerequisites: First year mathematics and physics or equivalents.

Units and dimensions; system conversions; material, energy and momentum balance; steady state and transient heat transfer; insulation; heat exchangers; solid and fluid rheology; viscosity; pumps; mixing.

FOOD4517 Unit Operations in Food Engineering **S2 L2 T2**

Prerequisite: FOOD4507 or equivalent.

Refrigeration; freezing; chilling and thawing; evaporation; dehydration; extraction; distillation; extrusion; comminution; filtration and separation; process control; packaging.

FOOD4527 Advanced Food Engineering **S2 L2 T2**

Prerequisites: FOOD4517, FOOD4537 or their equivalent

Mathematical representation of heat and mass transfer and fluid mechanics in food processing. Numerical techniques and computer modelling; design of integrated food processing operations and process control; economics of process development and control; recent advances in food engineering.

FOOD4537 Computing in Food Science **S2 L1 T1**

Prerequisite: An introductory statistics subject or equivalent

Introduction to VAX/VMS, VM/CMS, MS-DOS and other control languages; the use of statistical, graphics and other program packages to solve problems in food science and technology.

FOOD4547 Technology of Food Drying **S2 L2 T1**

Psychrometry. Derivation and application of psychrometric equations for air-water systems. Principles of drying. Calculation of mass and energy balances around drying equipment. Calculation of drying time. Commercial drying equipment. Principles of liquid food evaporation.

FOOD4557 Food Engineering Laboratory **S2 T3**

Co-requisite: FOOD4527

Laboratory and pilot plant exercises illustrating the principles and procedures involved in food processing and food quality assessment.

FOOD4567 Food Engineering Field Work **S1 T3**

Inspection of food processing factories, agricultural and food research establishments and food producing areas.

FOOD4577 Principles of Food Packaging **S1 or S2 L2 T1**

Co-requisite: FOOD1527

History of food packaging; chemical and physical properties of package materials; interaction between food and package; evaluation of packaging materials and systems; selection of packaging materials and systems; design criteria; printing; computers in packaging; modified atmosphere and smart films.

Department of Biotechnology

Biotechnology is a Department within the School of Applied Bioscience.

General

Units are offered separately subject to specified prerequisites as well as the restrictions on those units designed as bridging materials.

BIOT8010 Graduate Seminars **F T2**

BIOT7010 Reading List in Biotechnology (Microbiology) **S1 or S2 T3**

BIOT7020 Reading List in Biotechnology (Biochemistry) **S1 or S2 T3**

BIOT5013 Practical Biotechnology **F T6**

Illustration, demonstration and operation of laboratory-scale and pilot-scale equipment. Visits to appropriate industries. Experimental project or critical review.

BIOT7043 Biotechnology Project (Major) **F T8**

An experimental or technical investigation or design project in the general field of biotechnology.

BIOT7051 Applied Genetics **S2 L2 T3**

Isolation of commercially useful microorganisms. Mutagenesis and the isolation of mutants of the following types: auxotrophs; catabolic mutants; feedback inhibition and repression resistance; constitutive; catabolite repression resistance; resistance to antimicrobial agents and to viruses; extended enzyme substrate specificity; altered enzyme properties; changes in promoter and attenuator activity.

Techniques of genetic exchange: transformation; conjugation; transduction; cell fusion; sexual and parasexual cycles. The use of these techniques in strain construction. Recombinant-DNA technology: plasmid and virus technology; cloning vectors for use in microorganisms, plant and animal cells. Strain construction using rec-DNA techniques. Properties of expression, excretion and genetic stability of constructs.

BIOT7061 Peptide and Protein Technology **S2 L2 T3**

Industrial scale production of enzymes, peptide hormones, antibodies including monoclonal antibodies, vaccines; regulation of synthesis by environmental control and genetic manipulation; recovery and down-stream processing techniques; immobilization by entrapment and binding.

Applications of proteins in medical therapy and diagnosis and as analytical tools including ELISA and affinity chromatography: applications of enzymes in the food and beverage industries.

BIOT7071 Biochemical Engineering **S2 L2 T3**

Design of bioreactors; range of biocatalysts from free enzymes to immobilized cells; heat and mass transfer, scale-up, economic feasibility studies as applied to bioprocesses; design of equipment and facilities for sterile operation and to meet recDNA guidelines; downstream processing, design and operation; instrumentation and control; use of computer-linked systems; mathematical simulation.

Detailed examples of bioprocesses including: amino acid production, single cell protein and liquid fuels, secondary metabolite production, growth and product formation of animal and plant tissue cultures. Patent and commercial aspects of bioprocesses.

BIOT7081 Environmental Biotechnology **S1 L2 T3**

Environmental Biotechnology examines the way microbes decompose chemically complex materials. Applications include the use of bacteria and fungi to detoxify wastes, converting them to usable substances. Prevention of biodeterioration of valuable materials is also an important area of study. Lectures cover biodegradation of minerals, metals, cellulosics, aromatics, hydrocarbons and waste-water treatment. Students present research reviews and conduct experimental projects.

BIOT7091 Applied Cellular Physiology **S1 L2 T3**

Elemental and molecular composition of cells; formulation of growth media; stoichiometry of growth processes and product formation; metabolic regulation; stringent response; mechanisms of metabolite uptake and product release; maintenance energy; thermodynamics of cellular growth and activities. Effect of mutation on cellular physiology; recombinant-DNA products. Fermentation processes: inoculum preparation, physiology of selected processes.

BIOT7100 Biological Principles **S1 L3**

A study of the characteristics of living systems. Biological molecules: carbohydrates, lipids, proteins and nucleic acids. Cell structure and function: prokaryotic and eukaryotic cells. Basic biochemistry: thermodynamics and catalysis of metabolism; catabolic and anabolic processes; properties of enzymes; DNA replication; protein synthesis. Comparative metabolism of viruses, bacteria, fungi, plants and animals. Metabolic regulation. Modes of nutrition and nutrient cycles. Reproduction and genetics: eukaryotic and prokaryotic systems; sexual and

asexual reproduction; bacterial genetics; recombinant DNA technology. Basic plant biology; plant structure and function; transport. Invertebrate zoology, evolution and animal behaviour. Microorganisms of commercial significance. Biodeterioration and biodegradation.

BIOT7110 Bioengineering Principles **S1 L3**

A subject designed to provide an introductory course for students in the MAppSc Biotech program who have not previously undertaken any bioengineering studies.

Steady state and differential balances as a basis for quantification of complex real systems. Concepts in rate processes and kinetic analysis with application to biological systems. Experimental determination of rate data. Correlation of simple lumped rate processes and simultaneous distributed processes and the concepts involved in dimensionless numbers.

Lamina and turbulent flow. The structure of homogeneous and boundary layer turbulence flow in pipes and channels. Mixing theory. Process vessel reactor models.

Fluid viscosity, Newtonian and non-Newtonian fluids, convective and molecular transport processes. Heat and mass transport, film coefficients. Film, boundary layer, penetration and surface renewal theories.

Quantification of complex systems. Empirical and mechanistic models in biological systems.

BIOT7123 Biotechnology Project Minor **F T4**

A small experimental or design project, or an extensive literature review and analysis of a selected topic in biotechnology.

School of Chemical Engineering and Industrial Chemistry

Head of School
Professor D.L. Trimm
Administrative Officer
Ms L.A. Woodcock

The School contains the Departments of Chemical Engineering and Industrial Chemistry and the Centre for Petroleum Engineering which service three degree courses, and the Departments of Fuel Technology and Polymer Science which offer professional electives in these degree courses. A professional elective in Biological Process Engineering is also available from the Department of Biotechnology.

Chemical engineering is the application of the principles of the physical sciences, together with the principles of economics and human relations, to fields in which matter undergoes a change in state, energy content or composition. The chemical engineer is generally responsible for the design, construction and operation of plant and equipment used in the chemical processing industries.

Fuel engineering is primarily concerned with the practical and economic applications of scientific knowledge and engineering experience to the production, processing and utilization of fuels and energy.

Industrial Chemistry is the discipline in which the scientific work of the research chemist is translated into the activities of the chemical industry. The thermodynamic feasibility of a reaction in inorganic or organic chemistry, the conditions under which the reaction might proceed, the kinetics of the reaction and the means whereby the reaction might be controlled to produce the desired product are the fundamentals of the course.

Petroleum Engineering is a specialised engineering discipline which prepares graduates for a career in the oil and natural gas industries and its related operations. Petroleum engineers apply physical, mathematical and engineering principles to identify and solve problems associated with exploration, exploitation, drilling, production, processing, transportation and all the related economic and management problems associated with recovery of hydrocarbons from deep beneath the earth's surface.

For the award of Honours in the Chemical Engineering, Industrial Chemistry and Petroleum Engineering degree courses, students need to have distinguished themselves in the formal work, in other assignments as directed by the Head of the School, and in the final year project, for which a thesis is required.

It is compulsory that, before completion of the course, students in Chemical Engineering and Petroleum Engineering must obtain a minimum of twelve weeks' professionally oriented or industrial experience.

It is compulsory that, before graduation, students in the full-time courses in Industrial Chemistry obtain a minimum of twelve weeks' professionally oriented or industrial experience. Students in the part-time courses in Industrial Chemistry must complete an approved program of industrial experience of not less than twelve months prior to the award of the degree.

Staff

Professor of Chemical Technology and Head of School
David Lawrence Trimm, BSc PhD *Exe.*, DIC *Lond.*, CPEng, FRACI, MIChemE

Professors of Chemical Engineering
Anthony Gordon Fane, BSc PhD DIC *Lond.*, CPEng, FIChemE
Christopher Joseph Dalzell Fell, BSc *N.S.W.*, PhD *Camb.*, CPEng, FTS, FIChemE, FIEAust, MAmerIChE
Mark Sebastian Wainwright, MAppSc *Adel.*, PhD *McM.*, FRACI, FIE Aust

Professor of Petroleum Engineering
Val Wolf Pinczewski, BE *N'cle.(N.S.W.)*, PhD *N.S.W.*, CPEng, MIChemE

Associate Professors
Robert Paul Burford, BSc PhD *Adel.*,FPRI, MAmerIChE, FRACI
Michael Paul Brungs, BSc PhD *N.S.W.*, FSGT
Neil Russell Foster, BSc PhD *N.S.W.*, MAIE, MAmeriChE, ARACI
John Kingsford Haken, MSc PhD *N.S.W., ASTC, FRACI*
Brian David Henry, MSc *N.S.W.*, PhD *Lough.*, CPEng, FIChemE, FIEAust
Maria Skyllas-Kazacos, BSc PhD *N.S.W.*, ARACI, MES
Judy Agnes Raper, BE PhD *N.S.W.*, CPEng, MIChemE
Geoffrey David Sergeant, BSc PhD *Wales*, CEng, FInstE, FAIE

Senior Lecturers
Phillip Thomas Crisp, BSc PhD *Syd.*, ARACI, AssocAIDH
Rodney Phillip Chaplin, BSc PhD *Adel.*, ARACI
Douglas Christopher Dixon, BE MEngSc *Syd.*, PhD *N.S.W.*, MIEAust
John Clifford Jones, BSc PhD *Leeds*, ARACI, CChem
Heinz A. Preisig, BSc *H.T.L.*, MSc PhD *Arkansas*
John Frank Stubington, BE *Qld.*, PhD *Camb.*, CEng, FAIE, MIChemE
Tam Tran, BSc PhD *N.S.W.*, MAME, IChE, ARACI, MAIME
Robert Marsden Wood, BSc *Leeds*, PhD *Camb.*, CPEng, FIChemE

Lecturers
Adesoji Adediran Adesina, BSc *Lagos*, MASc PhD *Waterloo*
Brace H. Boyden, MSc PhD *Arkansas*
Henry Edward Curry-Hyde, BSc *Natal*, PhD *N.S.W.*
Gerda Ingrid Kuschel, BE PhD *Auck.* GradMIChemE, MTMS-AIME
Richard William Schofield, BE PhD *N.S.W.*
Diane Elizabeth Wiley, BAppSc DDIAE DipEd *Arm. C.A.E.*, ARACI

Tutor
Anthony John Papagelis, BE *N.S.W.*

Administrative Officer
Lesley Anne Woodcock

Professional Officers
Robert Edmund Brand, BSc BE *N.S.W.*, ASTC, ARACI
Stephen Joseph Clough, BSc *Syd.*, MAppSc *N.S.W.*, CChem, ARACI, MAIE
Van Bong Dang, BSc MAppSc *Gunma*, MSc *N.S.W.*, AIE
Barry William Edenborough, BE PhD *N.S.W.*
Raul Hector Martinez, BE *T.U., Buenos Aries*, MIE Aust.
Katia Simeonova Nasev, BE *Higher Inst. Chem. Tech., Sofia*, Grad IEAust
John McEwan Starling, BE *N.S.W.*

Computer Systems Officer
Ross James Smith, BSc PhD *N.S.W.*

Department of Chemical Engineering

Head
Professor A. G. Fane

Department of Fuel Technology

Head
Associate Professor G. D. Sergeant

Department of Industrial Chemistry

Head
Associate Professor Michael Paul Brungs

Department of Polymer Science

Head
Associate Professor R. P. Burford

Centre for Petroleum Engineering Studies

Director
Professor V. W. Pinczewski

Senior Lecturer
Henry Alfred Salisch, BSc *Quito Poly. Inst.*, MSc *Oklahoma*, MS *Venezuela Central*

Lecturer
I. Taggart, BMath *N'cle.(N.S.W.)*
S Rahman, BSc *Chitt.*, MSc *Strath.*, PhD *Clausthal*

Visiting Professors
M Rasin Tek, PhD *Mich.*
Charles S Aldrich, BSE *Texas*, MSE *Colorado Sch. of Mines*

Visiting Lecturers
Guy Allinson, BSc *Leeds.*, DipSocSci *Birm.*
Barry Walsh, BE PhD *Syd.*

Administrative Assistant
Vacant

Centre for Membrane and Separation Technology

Director, Chemical Engineering
Professor A. G. Fane

Centre for Particle and Catalyst Technologies

Director
Associate Professor J. A. Raper

Course Outlines

Undergraduate Study

3040
Chemical Engineering - Full-time Course

Bachelor of Engineering
BE

This course extends over four years and students study full-time during the day for twenty-eight weeks of each year (excluding examination and recess periods).

Successful completion of the BE degree course is accepted by the Institution of Chemical Engineers, the Institution of Engineers, Australia, and Royal Australian Chemical Institute as sufficient academic qualification for corporate membership.

Various course patterns involving full-time or part-time study may be approved by the Head of School. Evening classes are only available in most Year 1 subjects.

Year 1		Hours per week S1	S2
PHYS1002	Physics 1	6	6
CHEM1002	Chemistry 1	6	6
CHEN1020	Engineering 1 CE†	6	6
MATH1032	Mathematics 1	6	6
	General Education Subject Category A	0	2
		24	26

Year 2			
CHEM2828	Organic and Inorganic Chemistry (for Chemical Engineers)	4	0
CEIC2010	Instrumental Analysis	3	3
CEIC2020	Computing	1	2
CEIC2030	Applied Thermodynamics and Rate Processes	2.5	0
CEIC2040	Applied Electrochemical and Surface Processes	1.5	0
CHEN2010	Material and Energy Balances	2	2
CHEN2020	Flow of Fluids	2	2
CHEN2030	Heat Transfer	0	3
CHEN2040	Mass Transfer Fundamentals	0	2
CHEN2051	Chemical Engineering Laboratory 1	3	2
ELEC0802	Electrical Power Engineering	0	3
MATH2021	Mathematics	2	2
MATH2819	Statistics SA	2	2
	General Education Subject/s	2	2
		25	25

Year 3		Hours per week S1	S2
CHEN3010	Engineering Thermodynamics	4	0
CEIC3010	Reaction Engineering	0	3
CHEN3020	Numerical Methods	0	3
CHEN3070	Process Control	0	2
CHEN3030	Fluids 2	2	0
CHEN3040	Separation Processes 1	2	2
CHEN3050	Particle Mechanics	0	3
CHEN3060	Process Plant Engineering 1	4	4
CHEN3080	Chemical Engineering Laboratory 2	1.5	1.5
CHEN3090	Chemical Engineering Applications*	4	4
CIVL0616	Structures	3	0
MATH3021	Mathematics	2	2
	General Education Subject	2	0
		24.5	24.5

(*Students taking the Fuel and Energy Engineering or Minerals Engineering Electives follow a modified program described below under 'Professional Electives in Course 3040').

Year 4			
CHEN4090	Research Project*	2	10
CHEN4070	Process Dynamics and Control	3	2
CHEN4020	Advanced Reaction Engineering*	2	0
CHEN4010	Separation Processes 2	2	0
CHEN4060	Process Plant Engineering 2	4	0
CHEN4030	Safety and Environmental*†	2	0
CHEN4050	Process Plant Operation*	0	3
CHEN4040	Management	2	2
CHEN4080	Design Project†	1	4
CHEN4100	Professional Electives*	3	3
APSE0002	Social Issues in Applied Science†	2	0
		23	24

(*Students taking the Fuel and Energy Engineering or Minerals Engineering Electives follow a modified Program described below under "Professional Electives in Course 3040").

†These subjects contribute towards satisfaction of the Category C General Education Requirement.

Professional Electives in Course 3040 Chemical Engineering

Fuel and Energy Engineering

The Department of Fuel Technology offers a coherent professional elective in Fuel and Energy Engineering designed for those students interested in the application of fuel and energy technologies in industry, commerce, government, education or research and development. The Department is the only one of its kind in Australia and has a long history of teaching and research in the fuels and energy area. The elective covers the broad areas of properties, constitution, processing, conversion and utilization of fuels. Topics include combustion science and engineering; radiation and flames; design and performance evaluation of fuel using plant such as furnaces, boilers and heat recovery appliances; coal and oil conversion processes; energy

management and conservation; and progress in fuel science and fuel processing.

Students choosing this professional elective should take FUEL3010 Fuel and Energy Engineering 1 in Year 3 and FUEL4010 Fuel and Energy Engineering 2 and FUEL4090 Fuel and Energy Engineering Project in Year 4. Part-time students should take these subjects at equivalent stages of the part-time degree. (See BE Chemical Engineering 3040 Degree structure for the subjects that the Fuel and Energy Engineering courses replace).

This elective may qualify graduates for membership of the Australian Institute of Energy and the Institute of Energy UK.

Year 3	Hours per week S1	S2
FUEL3010	4	4
Year 4		
FUEL4010	9	4

Minerals Engineering

Jointly by the School of Chemical Engineering and Industrial Chemistry and the School of Mines, the Minerals elective is offered to students who wish to obtain a basic training in preparation for a career in the mineral industry. The elective covers the areas of secondary treatment of mineral sources, from physical mineral processing to pyrometallurgy and hydrometallurgy. Topics include engineering principles and current plant practices in comminution, beneficiation, extraction, purification, product recovery and other pyrometallurgical operations currently used in the coal, heavy minerals, iron and steel, non-ferrous, base and precious metal industries. Progress in mineral science and technology, mineral plant design and process evaluation are also parts of the elective. Students choosing this elective should take the required subjects listed in the table below for Years 3 and 4 in lieu of the following subjects: CHEN3090 Chemical Engineering Applications, CHEN4090 Research Project, CHEN4020 Advanced Reaction Engineering, CHEN4030 Safety and Environmental, CHEN4050 Process Plant Operation, CHEN4100 Professional Electives. This elective may qualify graduates for membership of the Australian Institute of Mining and Metallurgy.

Year 3:		S1	S2
MINE0130	Principles of Mining	0	2
GEOL5410	Mineralogy for Mineral Engineering	2	0
MINE3101	Mineral Process Engineering	2	2
Year 4:			
MINE4101	Mineral Processing Practices	2	0
MATS9650	Pyrometallurgical Processes	2	0
MINP4010	Hydrometallurgical Processes	2	0
MINP4020	Hydrometallurgy Practices	3	0
MINP4030	Hydrometallurgical Process Engineering	0	2
MINE4401	Mine Waste Disposal & the Environment	0	2
MINE4402	Mineral Engineering Project	4	8

3100
Industrial Chemistry - Full-time Course

Bachelor of Science
BSc

Industrial Chemistry is a four-year professional (prescribed) science course that is concerned with the application of science and technology to the chemical industry.

Successful completion of the course is accepted by the Royal Australian Chemical Institute as sufficient academic qualification for full corporate membership.

Various course patterns involving full-time and part-time study may be approved by the Head of School.

Year 1		Hours per week S1	S2
PHYS1002	Physics 1	6	6
CHEM1002	Chemistry 1	6	6
MATH1032	Mathematics 1	6	6
INDC1020	Engineering 1 IC†	6	6
		24	24
Year 2			
PHYS2920	Electronics	3	0
CHEM2031	Inorganic Chemistry	0	6
CHEM2021	Organic Chemistry	2	4
MATH2021	Mathematics	2	2
MATH2819	Statistics SA	2	2
CEIC2010	Instrumental Analysis	3	3
INDC2010	Mass and Energy Balances	2	0
INDC2020	Introduction to Fluid Flow	2	1
INDC2030	Heat Transfer and Temperature Measurement	0	2
INDC2050	Physical Processes Laboratory	2	0
CEIC2020	Computing	1	2
CEIC2030	Applied Thermodynamics and Rate Processes	2.5	0
CEIC2040	Applied Electrochemical and Surface Processes	1.5	0
	General Education Subject Category A	0	2
		23.5	23.5
Year 3			
CHEM3829	Organic Chemistry	6	0
CEIC3010	Reaction Engineering	0	3
INDC3090	Chemistry of Industrial Processes	3	3
INDC3041	Corrosion in the Chemical Industry	0	3
INDC3010	Thermodynamics	3	0
INDC3060	Unit Operations	2	0
INDC3021	Numerical Methods	0	2
INDC3031	Experimental Design	2	1
INDC3070	Instrumentation and Process Control 1	0	3
INDC3050	Chemistry of High Temperature Materials	0	2
INDC3080	Instrumental Analysis 2	4	0
POLY3010	Polymer Science	2	4
	General Education Subject/s	2	2
		24	23

Year 4		Hours per week S1	S2
CEIC4010	Process Economics 1	1	0
CEIC4020	Process Economics 2	0	1
BIOT3100	Fermentation Processes	0	2
INDC4040	Management	0	2
INDC4020	Applied Kinetics	2	0
INDC4010	Applied Thermodynamics	2	0
INDC4070	Laboratory Automation Science	4	0
INDC4080	Seminars	2	2
INDC4090	Project	8	16
INDC4120	Chemistry of the Industrial Environment†	3	0
POLY4010	Advanced Polymer Science	2	0
APSE0002	Social Issues in Applied Science†	2	0
		26	25

†These subjects contribute towards satisfaction of the Category C General Education requirement.

3110
Industrial Chemistry - Part-time Course

Bachelor of Science (Technology)
BSc (Tech)

This course requires an approved program of 12 months of industrial training prior to the award of the degree.

Stages 1 and 2*		Hours per week S1	S2
PHYS1002	Physics 1	6	6
CHEM1002	Chemistry 1	6	6
INDC1020	Engineering 1 IC	6	6
MATH1032	Mathematics 1	6	6
		24	24

*Physics and Mathematics are usually taken in Stage 1 and the other subjects in Stage 2.

Stage 3			
CHEM2011	Physical Chemistry	6	0
MATH2021	Mathematics	2	2
MATH2819	Statistics SA	2	2
CEIC2010	Instrumental Analysis	3	3
	General Education Subject/s Category A	2	2
		15	9

Stage 4			
PHYS2920	Electronics	3	0
CHEM2021	Organic Chemistry	6	0
CHEM2031	Inorganic Chemistry	0	6
INDC2020	Introduction to Fluid Flow	2	0
INDC2010	Mass and Energy Balances	2	0
INDC2030	Heat Transfer and Temperature Measurement	0	2
CEIC2020	Computing	1	1
		14.5	9.5

Stage 5		Hours per week S1	S2
INDC3041	Corrosion in the Chemical Industry	0	3
INDC3010	Thermodynamics	3	0
CEIC3010	Reaction Engineering	0	3
INDC3060	Unit Operations	2	0
INDC3021	Numerical Methods	0	2
INDC3031	Experimental Design	2	1
INDC3050	Chemistry of High Temperature Materials	0	2
INDC3080	Instrumental Analysis 2	4	0
	General Education Subject/s Category B	2	2
		13	13

Stage 6			
CHEM3829	Organic Chemistry	6	0
INDC3090	Chemistry of Industrial Processes	3	3
INDC3070	Instrumentation and Process Control 1	0	3
POLY3010	Polymer Science	2	4
		11	10

Centre for Petroleum Engineering Studies

The Centre of Petroleum Engineering has a four-year course leading to the award of a Bachelor of Engineering in Petroleum Engineering.

Entry is normally into Year 1 of the program. The first two years of the Petroleum Engineering Course are identical to the first two years of the Chemical Engineering Course. The University has approved an arrangement whereby, upon recommendation of the Head of School, students who satisfy the requirements of the first two years of the Chemical Engineering, Mechanical Engineering, Civil Engineering or Mining Engineering degree courses at the University may be admitted into the final two years of the BE degree course in Petroleum Engineering. Such students would complete an appropriately modified Year 3 program as approved by the Head of School.

The University has also approved an arrangement whereby, upon the recommendation of the Head of School, students who satisfy the requirements of the first two years of the Chemical, Mechanical, Civil or Mining Engineering full-time degree courses at any other Australian tertiary institution may be admitted to the final two years of the Petroleum Engineering course. Such students will be required to undertake an appropriately modified Year 3 program as approved by the Head of School. Acceptance into the course will be on the basis of academic merit.

3045
Petroleum Engineering - Full-time Course

Bachelor of Engineering
BE

Year 3		Hours per week S1	S2
CIVL0616	Structures	3	0
MATH3021	Mathematics	2	2
PTRL3001	Reservoir Rock Properties and Fluid Flow in Porous Media	2	0
PTRL3006	Drilling Fluids and Cementing	0	3
PTRL3007	Reservoir Engineering 1	0	2
PTRL3002	Rock and Fluid Properties Laboratory	0	3
PTRL3008	Petroleum Production Economics	1	0
PTRL3003	Petroleum Thermodynamics	2	0
PTRL3004	Drilling and Production Laboratory	0	3
PTRL3105	Formation Evaluation 1	2	2
PTRL3009	Fundamentals of Drilling Engineering	2	0
GEOL5301	Introduction to Petroleum Geology	2	0
GEOL5302	Geology of Petroleum Accumulations	0	2
CHEN3040	Separation Processes	2	2
CHEN3061	Process Plant Engineering 1	4	3
INDC3070	Instrumentation and Process Control 1	0	3
APSE0002	Social Issues in Applied Science†	2	0
		24	25
Year 4			
PTRL4007	Reservoir Engineering 2	0	2
PTRL4006	Well Completion and Production Operations	0	3
PTRL4105	Formation Evaluation 2	2	2
PTRL4008	Oil and Gas Law and Regulation	0	2
PTRL4001	Reservoir Simulation	0	2
PTRL4002	Advanced Recovery Methods	0	2
PTRL4109	Petroleum Engineering Project	6	2
PTRL4003	Well Pressure Testing	2	0
PTRL4004	Advanced Drilling Engineering	3	0
CHEN4060	Process Plant Engineering II	4	0
CHEN4070	Process Dynamics and Control	3	2
CHEN4030	Safety and Environmental†	2	0
GEOL5401	Petroleum Production Geology	2	0
CHEN4080	Design Project†	1	4
		25	21

†These subjects contribute towards satisfaction of the Category C General Education requirement.

Graduate Study

Formal courses in the School of Chemical Engineering and Industrial Chemistry lead to the award of the Master of Applied Science or the Graduate Diploma.

Master of Applied Science Degree Courses

The MAppSc degree courses involve a project which must integrate and apply the principles treated in the course. It may take the form of a design feasibility study or an experimental investigation. Evidence of initiative and of a high level of ability and understanding is required in the student's approach, and the results must be embodied in a report and submitted in accordance with the University's requirements.

The following graduate courses are available to Master of Applied Science degree course candidates. Candidates may specialize in the following areas:

Chemical Engineering and Industrial Chemistry	Course **8015**
Fuel Technology	Course **8060**
and	
Petroleum Engineering	Course being arranged

The MAppSc degree courses provide for a comprehensive study of theoretical and practical aspects of many advanced topics. The courses are formal and elective in nature and provide an opportunity for graduates to apply their basic skills in fields in which the School has developed special expertise.

The courses specializing in Chemical Engineering and Industrial Chemistry, Fuel Technology and Petroleum Engineering are primarily intended for graduates in Applied Science, Engineering, or Science with principal interests in Chemistry, Mathematics and/or Physics. They are designed to allow the maximum flexibility consistent with the standing of the award.

Intending candidates are invited to submit proposed study programs to the Head of the School for advice and recommendation. Each individual course must be approved by the Higher Degree Committee of the Faculty of Applied Science. An acceptable course would be a program of formal study aggregating approximately 18 hours weekly for two sessions full-time or 9 hours weekly for four sessions part-time, and which could comprise:

1. A major strand of course material making up 75% of the total program. This includes a project constituting not less than 15% and not more than 30% of the program;

2. A minor strand of broader-based supporting material making up to 25% of the total program; and

3. Undergraduate material, which may be included in one or both strands but may not exceed 25% of the total program.

Approximately 60% of the program (including the project) must be undertaken in the School of Chemical Engineering and Industrial Chemistry. The remainder, subject to approval and availability, may be undertaken in other Schools within the University. Full details of all subjects are listed under Disciplines of the University in the Calendar.

Courses will be run in any year only if sufficient applications are received. A minimum number of 5 registrations is usually required.

8015
Chemical Engineering and Industrial Chemistry Graduate Course

Master of Applied Science
MAppSc

This course is designed to allow students to select areas of specialization appropriate to their needs. The areas of specialization include Industrial Chemistry, Chemical Engineering and Industrial Pollution Control. Students are asked to consult the area supervisors in the School to develop a program of study which complies with regulations for the Master of Applied Science degree. Students may undertake a Major Project (CEIC5000) amounting to six hours per week for a year or take a Minor Project (CEIC5010) of three hours per week for a year and select an extra elective subject.

8060
Fuel Technology Graduate Course

Master of Applied Science
MAppSc

This is a formal course leading to the award of the degree of Master of Applied Science. It is a two-year part-time course designed to provide professional training and specialization in fuel science or fuel and energy engineering for graduates in science, applied science or engineering who have not had substantial previous formal education in these subjects. The course may be offered over 1 year full time with a sufficiently high enrolment.

The course is based on the general formula for a MAppSc degree program, whereby the subject FUEL3010 can comprise the undergraduate component, the project (30% or 15% of the program) is CEIC5000 or CEIC5010 and the remainder of the hours can be taken from the units offered in the FUEL58.. and FUEL59.. series of subjects. There are also compulsory seminar and laboratory practice subjects.

The course allows reasonable flexibility with a choice of subjects, and units within subjects, subject to the availability of staff. Provision is made for subjects outside those offered by the Department to be incorporated in the program at either graduate or undergraduate level.

Centre for Petroleum Engineering

The Centre offers courses that cover the areas of Reservoir Engineering, Production Engineering and Formation Evaluation. Suggested course outlines are available from the Director of the Centre.

5031
Petroleum Engineering Graduate Diploma Course

Graduate Diploma in Engineering (Petroleum) GradDip

The oil industry traditionally employs personnel who, although working as Petroleum Engineers, have no formal qualifications in petroleum engineering. The Diploma Program in Petroleum Engineering is designed to provide these people with a means of obtaining formal qualifications in a short intensive full-time study program over one academic year.

The course work, carried out under the guidance and supervision of academic staff of the Centre, and in close co-operation with the oil industry, will incorporate a significant percentage of practical work in major areas of petroleum engineering. At the end of the formal course, satisfactory completion of a two-months practical assignment in the oil industry will be required, for the diploma to be awarded.

Candidates for the program must hold a Bachelors Engineering or Science Degree and some relevant field experience in the industry. Acceptance into the program is at the discretion of the Director of Centre for Petroleum Engineering.

The one year (two session) program course consists of the following subjects:

Session 1		**Hours Per Week**
PTRL5001	Reservoir Rock Properties	2
PTRL5003	Well Pressure Testing	2
PTRL5005	Petroleum Thermodynamics	2
PTRL5008	Petroleum Production Economics	1
PTRL5009	Fundamentals of Drilling Engineering	2
PTRL5105	Formation Evaluation	2
PTRL5109	Petroleum Engineering Project	4
GEOL5301	Introduction to Petroleum Geology	2
		17

Session 2		**Hours Per Week**
PTRL5002	Rock and Fluid Properties	3
PTRL5004	Reservoir Simulation Fundamentals	2
PTRL5006	Well Completion and Production Operations	3
PTRL5007	Reservoir Engineering	2
PTRL5012	Drilling Fluids and Cementing	3
PTRL5105	Formation Evaluation	2
PTRL5109	Petroleum Engineering Project	2
GEOL5302	Geology of Petroleum Accumulations	2
PTRL5010	Practical Assignment*	
		19

*Two months practical assignment taken at end of formal course.

Subject Descriptions

Undergraduate Study

Centre for Petroleum Engineering

APSE0002 Social Issues in Applied Science **S1**

The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

PTRL3001 Fundamentals of Fluid Flow In Porous Media **S1 L2**

Steady state single phase flow in porous media. Darcy's law for linear and radial systems. Flow in series and parallel. Radial diffusivity equation. Ei-function solution. Principle of superposition.

PTRL3002 Rock and Fluid Properties Laboratory **S2 T3**

Prerequisite: PTRL3001. Co-requisite: PTRL3006.

An integrated reservoir engineering and formation evaluation laboratory incorporating experiments in porosity, permeability, capillary pressure and resistivity of reservoir rocks and PVT properties of crude oil.

PTRL3003 Petroleum Thermodynamics **S1 L2**

Thermodynamic theory for phase behaviour of complex hydrocarbon mixtures at high temperature and pressure. Kinetic theory of gases, theory of liquids and liquid mixtures. Equations of State. Principle of corresponding states. Introduction to commercial phase behaviour and thermodynamic property evaluation packages used in the petroleum industry.

PTRL 3004 Drilling and Production Laboratory **S2 T3**

The program includes measurement and control of the basic properties of drilling fluid (density, viscosity, filtration, lubricity and electro-chemical properties) and cement slurry (density, viscosity, filtration, thickening time and mechanical properties). The program also includes a workshop on log interpretation.

PTRL3006 Drilling Fluids and Cementing **S2 L3**

Introduction to the basic functions and properties of drilling fluids and cement slurries. Composition and related properties of drilling fluids and cement slurries. Types of equipment and methods used in cementing operations. Drilling fluid displacement and replacement of cement slurries. Drilling hydraulics.

PTRL3007 Reservoir Engineering I **S2 L2**

Prerequisite: PTRL3001.

Multiphase fluid distribution. Relative permeability and capillary pressure. Capillary-gravity equilibrium. Multiphase flow. Reservoir material balance equations. Calculation of water influx from material balance. Recovery factor and the Buckley-Leverett equation.

PTRL3008 Petroleum Production Economics **S1 L1**

Basic elements of profitability analysis. Depreciation, financial statements, interest, time value of money. The financial plant, outside share, planning and scheduling, pricing and costs. Profitability. Criteria, applications of present value profiles, risk and risk adjustment.

PTRL3009 Fundamentals of Drilling Engineering **S1 L2**

Rotary drilling rig components. Drilling fluid circulating system. Bottom-hole assemblies, well control and blowout prevention equipment and methods. Special marine equipment and drilling cost analysis.

PTRL3105 Formation Evaluation 1 **F L2**

Formation evaluation concepts. Data integration. Basic parameters and relationships. Environmental corrections. Log quality control. General Purpose well logs. Fluid and formation resistivities. Porosity, lithology and permeability studies with logs. Shaly sand log interpretation. Well site and computer processed analysis. Case study in an Australian oil field.

PTRL4001 Reservoir Simulation Fundamentals **S2 L2**

Prerequisites: PTRL4007, MATH3021.

Development of reservoir simulation equations and their solution by finite-difference methods. Standard black oil models and their application to predicting reservoir behaviour. Hands-on use of commercial reservoir simulators: input data preparation, simulator operation, interpretation of simulator output.

PTRL4002 Advanced Recovery Methods **S2 L2**

Prerequisites: PTRL4007.

A comprehensive review of secondary and tertiary oil recovery methods. Secondary water and gas flooding. Mechanisms of miscible and partially miscible displacements of oil and water related to enhanced oil recovery. Influence of phase behaviour on fluid displacement efficiency in surfactant, alcohol, hydrocarbon-miscible, and carbon dioxide flooding processes. Compositional numerical reservoir simulators. Field applications of EOR technologies.

PTRL4003 Well Pressure Testing **S1 L2**

Theory of transient well testing. Practical aspects of design and performance of field tests. Analysis of transients pressure data, effects of boundaries, reservoir hetrogeniety, multiphase flow. Study of production, DST and formation interval tests. Pulse testing and multi-well tests. Computer assisted well test analysis techniques.

PTRL4004 Advanced Drilling Engineering **S1 L3**

Drilling methods and elements of rock mechanics. Rotary drill bits. Prediction of formation pore pressure and fracture

gradient. Casing design. Directional drilling and deviation control. Coring practices. Fishing operations.

PTRL4006 Well Completion and Production Operations **S2 L3**

Prerequisite: PTRL3007.

Reservoir considerations in well completion. Well completion designs. Basic types, function and operation of subsurface equipment. Perforating. Sand control. Hydraulic fracturing and acid treatment. Control of formation damage. Artificial lift methods. Gathering, separation and distribution of oil and natural gas.

PTRL4007 Reservoir Engineering 2 **S2 L2**

Prerequisite: PTRL3007.

Waterflooding, prediction of water influx. PtD and QtD solutions. Prediction of reservoir performance with water influx. Reservoir wettability and its effect on reservoir performance.

PTRL4008 Oil and Gas Law and Regulation **S1 L2**

Introduction to government legislation and control. Jurisdiction over onshore and offshore petroleum resources. The basic title system. Allocation of permits and licences. Expenditure commitments. Rental and royalty payments. Pipeline licences. Discretionary government controls, Aboriginal land rights. Environmental acts and regulations.

PTRL4105 Formation Evaluation 2 **F L2**

Prerequisite: PTRL3105.

Well logging in complex lithologies. Secondary porosity environment. Special Purpose logging. The dipmeter. Formation and fluid sampling. Cementing quality monitoring. Well completions. Gun perforating. Logging in cased holes. Two case studies in Australian oilfields.

PTRL4109 Petroleum Engineering Project **S1 T6 S2 T2**

A major design or research project on a problem relevant to petroleum engineering and concluding in the submission of an individual thesis. Projects of relevance to the research efforts in the School plus approved topics of particular interest to industry.

Chemical Engineering and Industrial Chemistry

General

Students are expected to possess a calculator having exponential capabilities (ln x and exp x or 'x to the y'), and this will normally be allowed to be used in examinations. However, it should be noted that calculators with very much greater capabilities than the above might not be allowed in examinations, because they could give the user an unfair advantage over other candidates. Further information may be obtained from the Head of the School.

Students of both Chemical Engineering and Industrial Chemistry are expected to have a copy of Perry J. H. ed. *Chemical Engineers' Handbook* 6th ed. McGraw-Hill. This book is used extensively for most subjects and units. Certain subjects and units do not have specified textbooks and in these cases reference books are used or printed notes supplied.

APSE0002 Social Issues in Applied Science **S1**

The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

CEIC2010 Instrumental Analysis **F L1 T2**

Prerequisites: PHYS1002, CHEM1002, MATH1032, CHEN1020 or INDC1020.

Data treatment, error analysis and propagation of errors. Basic principles of volumetric analysis. Solubility and pH calculations. Electronic analysis - potentiometric, voltametric and coulometric. Spectrophotometric analysis - UV/visible, atomic emission, atomic absorbtion, X ray diffraction and fluoresence. Chromatographic analysis, gas chromatography, high performance liquid chromatography, and ion chromatography.

CEIC2020 Computing **S1 L1 S2 L1 T1**

Prerequisites: MATH1032, CHEM1002, PHYS1002, CHEN1020 or INDC1020.

Computing for technical applications. Operating systems: VAX computers, the VMS operating system and the EDT editor. The FORTRAN language Elementary numerical methods; library subprograms; structures of program modules for technical calculations. The BASIC language.

CEIC2030 Applied Thermodynamics and Rate Processes **S1 L1.5 T1**

Prerequisites: PHYS1002, CHEM1002 or CHEM1102 and CHEM1201, MATH1032.

Distinction between thermodynamic and kinetic control of processes. Definitions of classical thermodynamics. Open and closed systems. Pressure-volume-temperature properties of industrially important fluids. Applications of thermochemistry in industry. Conversion of heat into work. Concept of lost work. Heat engines and refrigeration cycles. General properties of solutions. Maximum conversion of reactants in batch and flow reactors. Reactor design and chemical kinetics. Reaction rates in industrial batch and flow reactors. The effect of temperature and concentration. The interaction of mass and heat transfer with chemical reactor rates. Laboratory kinetic measurements and their reluctance to reactor design.

CEIC2040 Applied Electrochemical and Surface Processes **S1 L1.5**

Prerequisites: PHYS1002, CHEM1102 and CHEM1201, MATH1032.

Electrochemical principles in the context of important industrial electrochemical processes and engineering. Electrolytes, their properties and applications. Industrial electrochemical processes, electrodes and cells. Surface phenomena. Gas-liquid, gas-solid, liquid-solid interfaces. Physical and chemical adsorption. Electrokinetic (zeta) potentials. The colloidal state. Sols, gels and emulsions in industrial processes.

CEIC4010 Process Economics 1 **S1 L1**

Consists of the segment Process Economics CHEN3060 Process Plant Engineering 1

CEIC4020 Process Plant Economics 2 **S2 L1**

Consists of the segment Process Economics 2 from CHEN4060 Process Plant Engineering 2

CEIC3010 Reaction Engineering **S2 L2 T1**

Prerequisites: CHEM2011, CEIC2020, CHEN2010 or INDC2010, CHEN2020 or INDC2020, CHEN2030 or INDC2030.

Introduction to reactor design: ideal batch, steady state mixed flow, steady state plug flow, size comparisons of ideal reactors, optimization of operating conditions. *Multiple reactor systems:* reactors series and parallel, mixed flow reactors of different sizes in series, recycle reactors, autocatalytic reactions. *Multiple reactions:* reactor design for reaction in parallel and reactions in series, series-parallel reactions. *Temperature effects:* heat of reaction, equilibrium constants, optimum temperature progression, adiabatic and non-adiabatic operation, product distribution and temperature. *Kinetics of rate processes:* Significance of the rate laws and models for distributed and lumped parameter systems. Experimental measurement and correlation of process rates.

CEIC4200 Industrial Experience

Students in the four-year courses must obtain a minimum of twelve weeks professionally oriented or industrial experience prior to the award of the degree.

CEIC4210 Industrial Experience

Students in the BSc (Tech) course in Industrial Chemistry must complete an approved program of industrial experience of not less than twelve months prior to the award of the degree.

CHEN1010 Introduction to Chemical Engineering **F L1 T1**

Introduction to the processing industry and chemical engineering practice. The role and responsibilities of the chemical engineer. Introduction to materials of construction for the processing industries. Application of process calculations in chemical process operations. Conventions in methods of analysis and measurement. The chemical equation and stoichoimetry. Introduction to material balancing. Process calculations associated with gases, vapours and liquids.

CHEN1020 Engineering 1 CE **S1 L2 T4 S2 L3 T3**

This subject is comprised of:

CHEN1010 Introduction to Chemical Engineering F L1 T1

MECH0130 Engineering Drawing and Descriptive Geometry S1 L1 T3

MECH0330 Engineering Mechanics S2 L2 T2.

Each subject is described elsewhere in this handbook. Prospective students should note the following: It is not necessary to pass each of the three component subjects individually; however, for a student who does not pass all components separately the composite mark for the whole subject is not calculated by a simple averaging process. For a component subject in which a passing mark is not obtained, heavier weighting is applied; the lower the mark the heavier the weighting. The details of the calculation method are explained in the first week of the course. A student who is repeating the subject after failure must repeat all three components. No exemptions will be granted for components that were passed at an earlier attempt.

CHEN2010 Material and Energy Balances **F L1 T1**

Prerequisites: CHEM1020, CHEN1020, MATH1032, PHYS1002.

Material Balances: Revision of material balances. Problems involving bypass, recycle and purge. Problems involving staged operations. Differential material balances. *Energy Balances:* Thermodynamic background. First law; phase rule; reference states. General equation and its integro/differential form. Open and closed systems. Shaft work and enthalpy. Application of energy balances to constant composition systems; enthalpy data; heat capacity data; phase change. Application to varying composition systems: Mixing; Heat of solution; Enthalpy concentration diagrams. Reactions. Heats of formation and combustion. Integrated Material and Energy balance problems. Students not taking CHEN1010 will be required to complete a 28-hour bridging course offered by the School early in Session 1.

CHEN2020 Flow of Fluids **F L1 T1**

Prerequisites: PHYS1002, CHEN1020, CHEM1002, MATH1032.

Units and dimensions. Fundamental concepts of Fluids. Simplification of the Navier-Stokes Equation: Fluid statics, continuity, Bernoulli's equation, momentum and energy equations. Flow in closed conduits, including laminar and turbulent flow and losses due to friction. Flow in open channels; hydraulic jump. Pumps and pumping; blowers and compressors, pipes and fittings. Measurement in Fluid Mechanics; viscosity, pressure, velocity, flowrate. Compressible flow.

CHEN2030 Heat Transfer **S2 L2 T1**

Prerequisites: PHYS1002, CHEN1020, CHEM1002, MATH1032.

Conduction: Steady state, one dimensional heat flow. Resistance concept, series and parallel. Unsteady state conduction. *Convection:* Laminar and turbulent flow. Analogies between Momentum and Heat Transfer. Correlations for flow in and across tubes and other surfaces. Free convection. *Radiation:* Black and grey bodies. Shape factors, reciprocity. Radiation from gases. *Heat Transfer with phase change:* Nucleate and film boiling. Condensation and effect of presence of inerts. Applications: Introduction to Heat Exchangers. Log mean temperature difference. Effectiveness - NTU relationships. Extended surfaces.

CHEN2040 Mass Transfer Fundamentals **S2 L1 T1**

Prerequisites: PHYS1002, CHEM1002, CHEN1020, MATH1032.

An introduction to the significance of mass transfer to the chemical engineer. Topics to be covered include: mechanisms of mass transfer, mass transfer driving forces, molecular diffusion, mass transfer models, phase equilibrium. Discussion of application of mass transfer in the chemical process industries.

CHEN2051 Chemical Engineering Laboratory I **S1 T3 S2 T2**

Prerequisites: PHYS1002, CHEM1002, CHEN1020, MATH1032.

An introduction to laboratory work in chemical engineering including information retrieval techniques. Experiments designed to demonstrate physical processes in industrial situations.

CHEN3010 Engineering Thermodynamics **S1 L2 T1 S2 L1**

Co or Prerequisites: CHEM2011, CHEN2010, CHEN2020.

Review of first law of thermodynamics; thermochemistry; second law of thermodynamics. Auxiliary functions and conditions of equilibrium. Thermodynamic properties of fluids; thermodynamic properties of homogeneous mixtures. Chemical reaction equilibria; calculation of equilibrium compositions for single reactions. Phase equilibria; the phase rule, equilibrium. Engineering applications of thermodynamics. Heat engines, refrigeration.

CHEN3020 Numerical Methods **S1 L1 S2 L1 T1**

Prerequisites: CEIC2020, MATH2021, MATH2819.

Basic concepts of numerical methods. Solution of single and multiple, linear and non-linear, non-differential equations. Numerical solutions of ordinary differential equations. Optimization techniques: single and multiple dimensional search, linear programming, dynamic programming. Use of subroutine libraries. Application to process industry problems.

CHEN3030 Fluids 2 **F L1**

Prerequisites: CEIC2020, CHEN2020, MATH2021.

Single and Two-phase flow. Derivation of Navier Strokes Equation and solutions for inviscid flow, boundary layer flow, non-Newtonian flow.

CHEN3040 Separation Processes **F L1 T1**

Prerequisites: CHEM2011, CHEN2010, CHEN2020, CHEN2030, CHEN2040, CHEN2050.

Stagewise Processes: Phase equilibrium. Absorption. Binary distillation. Liquid-liquid extraction. *Design of Mass Transfer Equipment:* Equipment design for absorption, distillation, liquid-liquid extraction and adsorption processes. Unit design for stagewise and differential contact. Design of equipment for membrane and other surface separation processes. *Simultaneous Heat and Mass Transfer:* Psychrometry. Cooling Towers. Drying.

CHEN3050 Particle Mechanics **S2 L2 T1**

Prerequisites: CEIC2020, CHEN2020, MATH2021, MATH2819.

Particle characterisation: Size analysis, sphericity, surface area, density. *Fluid-particle interactions:* drag coefficient, effect of Reynolds number. Terminal velocity, effect of shape, concentration. Drops and bubbles. Particle-particle interactions including flocculation. Flow through porous media. Darcy, Carman-Kozeny, Ergun equations. *Applications of fluid-particle systems:* Sedimentation and thickening. Elutriation. Cyclones. Packed beds. Single phase flow. Two phase flow in trickle beds. *Filtration:* constant pressure theory, specific resistance, equipment, filter aids, centrifugal. *Fluidisation:* minimum fluidisation velocity, two phase theory, bubble properties, applications. Spouting. Pneumatic and hydraulic conveying. *Solids Handling:* Properties of granular solids and powders affecting storage and movement. Stockpiles, silos and hoppers: Feeders, conveyor belts and elevators.

CHEN3060 Process Plant Engineering 1 **F L3 T1**

Prerequisites: CHEN2010, CHEN2020, CHEN2030, ELEC0802, MATH2021.

Processing Engineering I: All activities required from the conception of the idea to produce a product through to the finalisation of the process flow diagram including process selection and evaluation, process design, process simulation, process representation, process acquisition and licensing. *Project Engineering I:* Outline of scope of a process plant including plant location and layout, processing facilities and offsites including utility system design, statutory regulations, facilities for storage, processing and transport of materials within the plant including design of piping systems. *Process Equipment Design:* Materials of construction. Procedures for the selection, design, specification and representation of process equipment. Pressure vessel and heat exchanger design. Engineering standards and procedures. *Materials and Containment:* The use and selection of metals, plastics, refractories, ceramics and glass in construction of chemical plants. Corrosion, strength of materials, use of codes and standards. *Process Economics I:* Capital and operating costs of a process plant. Fixed and variable costs. Break-even analysis. Cost estimation methods.

CHEN3070 Process Control **F L1**

Prerequisites: CEIC2010, CEIC2020, MATH2021.

Unsteady state modelling of simple processes: linearisation, transfer function, concept of input-output models. Lumped parameter versus distributed parameter systems. *Process identification:* transient, frequency, pulse and correlation analysis. *Control system hardware:* transducers, valves, measuring devices for flow, pressure, temperature.

CHEN3080 Chemical Engineering Laboratory 2 **F T1.5**

Prerequisites: CHEM2828, CHEM2011, CEIC2010, CEIC2020, CHEN2010, CHEN2020, CHEN2030, CHEN2050, MATH2021, MATH2819.

An integrated chemical engineering laboratory incorporating experiments in fluid flow, heat transfer, mass transfer, thermodynamics and kinetics, instrumentation and process dynamics and control. The objectives of this laboratory are: to demonstrate, reinforce and extend the principles of chemical engineering which are covered elsewhere in the course; to introduce various laboratory techniques which are used in the experimental investigation of chemical engineering problems; to develop an interest in experimentation, and to develop a proficiency in technical report writing.

CHEN3090 Chemical Engineering Applications **F L2 T2**

Prerequisites: CHEM2011, CEIC2020, CHEN2010, CHEN2020, CHEN2030, MATH2021, MATH2819.

Application of chemical engineering principles to biochemical engineering, fuel engineering, solids handling, alumina and aluminium industries and polymer technology. Integrated problems illustrating skills in process analysis.

CHEN4010 Multicomponent Separation Processes **S2 L1 T1**

Prerequisite: CHEN3010, CHEN3020, CHEN3040, MATH3021.

Separation of multicomponent systems by stagewise operations. Multicomponent separations using modern computer techniques. Phase equilibrium relationships for liquid-vapour and liquid-liquid systems. Azeotropic and extractive distillation.

CHEN4020 Advanced Reaction Engineering **S1 L1 T1**

Prerequisites: CEIC3010, CHEN3020, CHEN3030, CHEN3040, MATH3021.

Heterogeneous Systems: Kinetics of uncatalysed gas-solid and liquid-solid reactions. Kinetic models for catalytic reactions. Inter and intra-particle diffusional effects in fluid-solid systems. Design of fixed bed catalytic reactors in adiabatic and non-adiabatic and non-isothermal operation. Trickle bed reactors. Slurry reactors for batch and continuous operation. Laboratory reactors for determining kinetic parameters in heterogeneous systems.

CHEN4030 Safety and Environmental **S1 L2**

Prerequisites: CHEN3030, CHEN3040, CHEN3050, CHEN3060.

Safety: Techniques for assessing safety of existing and proposed plants. Systems reliability, HAZOP and HAZAN. Pressure and explosion relief. Laboratory Safety. *Pollution Control:* Water pollution I design and operation strategies; treatment operations; economic aspects. Air pollution-effluent dispersions: types of gas cleaning units, choice of gas cleaning equipment. Noise pollution and pollution control legislation.

CHEN4040 Management **F L2**

Prerequisite: CHEN3060.

This course will consider (i) the management of operating plant and (ii) project management of process plant projects. (i) Plant Management: company types, structure and organisation. Company financing and operation. Personnel management. Cost accounting. Company law, industrial relations and trade union practices. (ii) Project management: role and responsibilities of project management. Project organisation. Planning and scheduling. Cost control. Project scheduling. Project trending and performance.

CHEN4050 Process Plant Operation **S1 L1 T2**

Prerequisite: All 3rd year subjects.

Practical studies of the operation of computer controlled chemical plant. Process diagnostics. Troubleshooting.

CHEN4060 Process Plant Engineering 2 **S1 L2 T2**

Prerequisites: CHEN3060, CHEN3070.

Process Engineering II: Process Synthesis and analysis techniques for process sequence selection. Heat exchanger networks. Optimum energy utilisation methods. Process simulation for steady and unsteady state. *Project Engineering II:* All activities required from the finalisation of the process flow diagram for a process plant through the development of P and ID's, plant design and engineering, construction, commissioning and operation. Project management and process contracting. *Economics II:* Project economic evaluation. Discounted cash flow methods. Project financing. Sensitivity analysis and uncertainty. Financial and cost accounting methods.

CHEN4070 Process Dynamics and Control **S1 L2 T1 S2 L1 T1**

Prerequisites: CEIC3010, CHEN3020, CHEN3070, MATH3021.

Common types of feedback controllers; translating control problems into block diagrams. Closed loop relationships and response; stability analysis for SISO systems; feedback controller tuning. Open and closed loop dynamic behaviour of systems of different order and how best to control these systems. Effect of dead time on control; introduction to dead time compensation. Introduction to cascade, feed forward and ratio control. Application of digital computers to real time control; interfacing computers with processes; distributed control systems; data acquisition and process monitoring; digital implementation of control algorithms. Introduction to multivariable control.

CHEN4080 Design Project **S1 T1 S2 T4**

Prerequisite: All 3rd year subjects.

This project will cover the engineering of a small process plant or part thereof requiring the application of material covered within the undergraduate course. The minimum requirements of this project are as specified by the relevant engineering institution's accreditation standards.

CHEN4090 Research Project **F T6**

Prerequisites: All Year 3 subjects.

The experimental investigation of some aspect of chemical engineering.

CHEN4100 Professional Electives **F L2 T2**

Prerequisite: All 3rd year subjects.

To be chosen from offerings in:

Advances in Computer-Aided Process Engineering

Polymer Engineering

Advanced Chemical Engineering Processes

Environmental Management for Chemical Engineers

Biochemical Engineering

Mineral Engineering

Advanced Process Control

which will be offered by the relevant Schools or Departments.

INDC1010 Industrial Chemistry I **F L1 T1**

Prerequisites: PHYS1002, MATH1032.

Introduction to the chemical industry. The role of the industrial chemist in society. The ethical responsibility of the industrial chemist. Introduction to materials for the chemical industry. Information retrieval. Communication skills. Factory visits.

Application of process calculations in chemical process operations. Conventions in methods of analysis and measurement. The chemical equation and stoichiometry. Introduction to materials balancing. Process calculations associated with gases, vapours and liquids.

INDC1020 Engineering 1 IC **S1 L2 T4 S2 L3 T3**

This subject is comprised of:

INDC1010 Industrial Chemistry 1 **F L1 T1**

MECH0130 Engineering Drawing and Descriptive Geometry **S1 L1 T3**

MECH0330 Engineering Mechanics **S2 L2 T2**

Each subject is described elsewhere in this handbook. Prospective students should note the following. It is not necessary to pass each of the three component subjects individually; however, for a student who does not pass all components separately the composite mark for the whole subject is not calculated by a simple averaging process. For a component subject in which a passing mark is not obtained, heavier weighting is applied; the lower the mark the heavier the weighting. The details of the calculation method are explained in the first week of the course. A student who is repeating the subject after failure must repeat all three components. No exemptions will be granted for components that were passed at an earlier attempt.

INDC2010 Mass and Energy Balances **S1 L1 T1**

Prerequisites: CHEM1002, INDC1020, MATH1032, PHYS1002.

Material Balances: Revision of material balances. Problems involving bypass, recycle and purge. Problems involving staged operations. Differential material balances. Energy Balances: Thermodynamic background. First law; phase rule; reference states. General equation and its integral differential form. Open and closed systems. Application of energy balances to constant composition systems; enthalpy data; heat capacity data; phase change. Application to varying composition systems; Mixing; Heat of solution; Enthalpy concentration diagrams. Reactions. Heats of formation and combustion.

Students not taking INDC1010 will be required to complete a 28 hour bridging course offered by the School early in Session 1.

INDC2020 Introduction to Fluid Flow **S1 L1 T1**

Prerequisites: PHYS1002, MATH1032, CHEM1002, INDC1020.

Fundamental concepts of Fluids. Simplification of the Navier-Stokes Equation, continuity, Bernoulli's equation, momentum and energy equations. Flow in closed conduits, including laminar and turbulent flow, and losses due to friction. Measurement in Fluid Mechanics; viscosity, pressure, velocity, flowrate.

INDC2030 Heat Transfer and Temperature Measurement **S2 L1 T1**

Prerequisites: PHYS1002, MATH1032, CHEM1002, INDC1020.

The course will deal with conduction, convection and radiation. Conduction will cover Fourier's Law and the thermal resistance concept. Convection will deal with passage of fluid over a surface and the importance of the Reynolds number in calculating the convection heat transfer coefficient. Radiation will deal with blackbody radiation and Stefan's Law. Applications to industrial heat transfer equipment will be discussed.Temperature measurement devices and circuits. Pyrometry.

INDC2050 Physical Processes Laboratory **S1 T2**

Prerequisites: PHYS1002 (or CHEM1002), CHEM1102, CHEM1201, MATH1032.

An integrated industrial chemistry laboratory incorporating a series of experiments designed to demonstrate the principles of physical processes and instrumentation in industrial situations.

INDC3010 Thermodynamics **S1 L2 T1**

Co- or prerequisites: CHEM2011, INDC2010.

Review of first law of thermodynamics; thermochemistry; second law of thermodynamics. Auxiliary functions and conditions of equilibrium. Thermodynamic properties of fluids; thermodynamic properties of homegeneous mixtures. Chemical reaction equilibria; calculation of equilibrium compositions for single reactions. Phase equilibria; the phase rule, equilibrium.

INDC3021 Numerical Methods **S2 L1 T1**

Prerequisite: CEIC2020.

Basic concepts of numerical methods. Solution of single and multiple, linear and non-linear, non-differential equations. Numerical solutions of ordinary differential equations.

INDC3031 Experimental Design **S1 L1 T1**

Prerequisite: MATH2819.

Regression analysis. Statistical design of experiments. Two level factorial designs. Screening experiments. Optimisation of process variables. Spread sheet and database utilisation. Basic programming. Industrial applications.

INDC3041 Corrosion in the Chemical Industry **S2 L2 T1**

Prerequisite: CHEM2011.

Selection of materials for chemical plant. Strength and corrosion resistance of less common materials of fabrication. Chemical and electrical aspects of corrosion and their application to corrosion problems encountered in the chemical process industries. Electrochemical kinetics. Design factors for corrosion prevention. Methods of corrosion prevention.

INDC3050 Chemistry of High Temperature Materials **S2 L2**

Prerequisite: CHEM2011.

Chemical aspects of high temperature materials; thermodynamics and kinetics of reactions in the solid state; phase equilibria in condensed systems; gas-solid and liquid-solid reactions.

INDC3060 Unit Operations **S1 L2**

Prerequisites: INDC2010, CHEM2011.

Selected aspects of unit operations for industrial chemistry students such as distillation, liquid-liquid extraction, gas absorption, filtration evaporation and crystallization.

INDC3070 Instrumentation and Process Control 1 **S2 L2 T1**

Prerequisites: MATH2021, CEIC2010, CEIC2020, CHEM2041.

Analog Computation: theory and application of basic analog computing elements; magnitude and time scaling; solution of

linear differential equations. *Instrumentation:* theory and application of transducers and transmitters for measurement of process variables. *Process Dynamics:* behaviour of linear, lumped paramater dynamics systems; first, second and higher order and integrating systems. *Process Control:* closed loop, block diagrams, controllers and controller tuning.

INDC3080 Instrumental Analysis 2 **S1 L2 T2**

Prerequisite: CEIC2010

Theory and application of advanced instrumental techniques including: high performance liquid chromatography, infra-red spectroscopy, particle size analysis, surface area analysis, thermal analysis (TGA, DSC/DTA, DMA), ion chromatography, capillary gas chromatography.

INDC3090 Chemistry of Industrial Processes **F L1 T2**

Prerequisite: CHEM2011. Co-or prerequisites CHEM2021, CHEM2031.

The production of inorganic industrial chemicals from the standpoint of the application of the basic principles of inorganic and physical chemistry (acid industries, alkali industries, industrial gases electric furnace products, superphosphates, aluminum and glass); a study of some sections of the organic industrial chemical industry - cellulose, industrial alcohols, formaldehyde, phenol, urea, phenolic and urea resins, acetic acid, polymers based on enthylene and acetylene, elastomers. Students are required to attend factory inspections at local and country centres as required. Laboratory: A small research project designed to illustrate practical applications of the principles of Industrial Chemistry.

INDC4010 Applied Thermodynamics **S1 L1 T1**

Prerequisites: INDC3010, INDC3050.

Calculation of thermodynamic properties for non-ideal liquid and solid solutions. Development of statistical models for real solutions of industrial importance. Thermodynamics of interfaces. Phase equilibria in binary and ternary systems. A study of chemical equilibria in multicomponents, polyphase systems including appropriate computational methods.

INDC4020 Applied Kinetics **S1 L1 T1**

Prerequisites: INDC3020, CEIC3010.

Adsorption theory, kinetics of catalytic and non-catalytic fluid-solid reactions, rates of surface reaction, kinetics of heterogenous reactions affected by diffusion, catalyst characterization.

INDC4040 Management

A series of lectures designed to introduce the students to appropriate management techniques. Topics will include: business strategies, leadership total quality management, safety managment.

INDC4070 Laboratory Automation Science **S1 L1.5 T2.5**

Prerequisite: INDC3070.

The application of computers, eg microcomputers, to real-time data acquisition and process control in chemical laboratories and selected processes of interest to industrial chemists. Introduction to real-time digital operations and data manipulation. Organization of a process control computer. Hardware considerations. The process computer interface. Sequential and programmable logic control of batch processes. Data acquisition and process monitoring techniques. Digital process control PID controller tuning. Graphics in process monitoring and control. Direct Digital Control.

INDC4080 Seminar **F T2**

Students are required to deliver two lecturettes on selected topics, one related to some aspect of chemical technology, and the other to their research project. The intention is to develop skill in oral expression, as well as ability in critical evaluation and logical presentation. Opportunity is taken, where appropriate, to arrange for guest lecturers.

INDC4090 Project (Industrial Chemistry) **S1 T8 S2 T16**

An experimental or technical investigation related to some aspect of industrial chemistry. Prerequisites and/or co-requisites will be determined depending on the nature of the project.

INDC4100 Industrial Electrochemistry **S1 or S2 L2**

Prerequisites: INDC3090, INDC3020.

Fundamentals of electrodes, the Butler-Volmer equation, current/potential laws in relationship to reaction mechanism. Electrocatalysis, gas evolution and co-deposition. Technological aspects of electrochemistry; energy conversion systems, storage systems and plating. Industrial processes ! cell design and side reactions, gas bubble effect, current distribution and mass transfer effects. Developments in electrode technology, diaphragms and cell construction.

INDC4110 Water Chemistry **S1 or S2 L2**

Prerequisite: CEIC2010.

Introduction to stability diagrams for aqueous systems. Characteristics of waters and wastewaters. Treatment of process water and boiler water. Water reclamation and wastewater treatment.

INDC4120 Chemistry of the Industrial Environment **S1 L2 T1**

Prerequisites: CHEM1101, CHEM1201.

Soil chemistry. Occupational diseases. Smogs and acid rain. Toxic elements and compounds. Toxic waste disposal. Industrial accidents. Atmospheric structure and chemistry. Greenhouse warming. The Ozone hole. Nuclear energy. Alternative energy sources. Water analysis. Air analysis. Occupational health.

Servicing Subjects

These are subjects taught within courses offered by other faculties.

CEIC0010 Mass Transfer and Material Balances FL1T1

Prerequisites: CHEM1101, CHEM1201, CIVL2505.

Fundamentals of Mass Transfer: diffusion, mechanisms of mass transfer, models for mass transfer at fixed and free interfaces. Calculation of mass transfer rates at surfaces with simple geometry. Mass transfer in dispersions.Material balances: applications of process calculations in chemical process operations, conventions in methods of analysis and measurement. The chemical equation and stoichiometry. Process calculations associated with gases, vapours and liquids. Problems involving bypass, recycle and purge. Differential material balances.

CEIC0020 Fluid/Solid Separation SS L1.5 T.5

Particle Characterisation: Size analysis, sphericity, surface area, density. Fluid-particle Interactions: Drag coefficient, effect of Reynolds number. Terminal velocity, effect of shape, concentration. Drops and bubbles. Particle-particle interactions including flocculation. Flow through porous media. Darcy, Carmen-Kozeny, Ergun equations. Applications of Fluid-Particle Systems: Sedimentation and thickening, elutriation, cyclones, filtration, constant pressure filtration, specific resistance, equipment, filter aids, centrifugal separations.

CEIC0030 Environmental Protection in the Process Industries SS L3 T3

Prerequisites: CEIC0010, INDC3070. INDC4120.

Selection of 3 topics from:

Environmental Pollutants

The characteristics of pollutants in air and water. Consequences of pollutions by aqueous, gaseous and solid wastes; case histories. Standards and regulations; legislative aspects. Measurement, analysis and sampling - modern techniques of environmental chemical analysis.

Pollution Control Techniques

Water - primary, secondary and tertiary treatment. Air - removal of particles, chemicals and odours. Solid - disposal procedures. Noise - reduction techniques.

Water Pollution Control Engineering

Screening. Settling tank design. Coagulation and flocculation (colloid chemistry, double-layer theory and flocculation theory). Clarifier design. Filtration technologies - deep bed filtration. Biological treatment plant design - trickling filters - activated sludge processes (and variants) -anaerobic digesters. Sludge processing and disposal.

Air Pollution Control

Case histories, statistics. Single component failure, failure rate data. Reliability theory, series, parallel and redundant systems. Hazard and operability studies. Quantitative risk assessment - hazard identification - failure frequency - consequence calculations (preliminary methods). Laboratory safety.

Laboratory for Environmental Analysis

14 hour laboratory unit developing techniques in modern environmental analysis.

Advanced Environmental Protection

This comprises a series of elective strands which build upon the core subject as follows:

a.1 Advanced treatment methods (water)
a.2 Advanced treatment methods (air)
a.3 Hazardous wastes
a.4 Computer-aided risk assessment
a.5 Advanced laboratory
a.6 Occupational Health Laboratory

POLY0010 Polymer Materials S1 2 S2 4

The structure and synthesis of commercially important polymers including thermoplastics, fibres, rubbers and composites. The effect of chemical and molecular structure upon properties. Degradation. Mechanical properties including time dependent behaviour. Fabrication processes. Polymer selection for various applications.

Department of Fuel Technology

FUEL0010 Fuel Engineering F L2 T1
(Mining and Mineral Processing Engineers)

Properties and classification of fuels. Basic principles of combustion. Introduction to thermal design and configuration of furnaces, kilns, boilers, fuel using equipment. Fuel processing.

FUEL0020 Fuels and Energy S2 L3 T1

A servicing subject for students in Electrical Engineering which covers the topics, sources and properties of fuels and energy, energy use patterns, principles of combustion, combustion calculations, the technology of boilers and other fuel plant, thermodynamic cycles, new and emerging energy technologies, including solar, wind and nuclear energy.

FUEL0030 Fuel Science for Industrial Chemists S1 or S2 L2

Combustion science, mechanisms of major oxidation reactions, flames, mechanism of formation of carbon, NOx and SOx. Measurements of gas flow, gas composition, temperature in flames and furnaces. H-t relationships and their application.

FUEL0040 Fuel Engineering for Ceramic Engineers F L1

An introduction to combustion technology, combustion calculations, burner design, furnace, kiln and boiler thermal design.

FUEL0050 Fuel and Energy Engineering for Process Metallurgy S1 L1 S2 L2

An introduction to combustion technology, fuel plant technology and fuel processing.

FUEL3010 Fuel and Energy Engineering 1 F L3 T1

Sources, properties and classification of fuels and energy sources. Introduction to combustion engineering and science, the thermal design of furnaces, boilers and other fuel using plant, radiation. Basic principles of fuel processing,oil refining, gasification, liquefaction, carbonisation etc. Laboratory work on the properties of petroleum products, coal and gaseous fuels.

FUEL4010 Fuel and Energy Engineering 2 **S1 L5 T4 S2 L2 T2**

Combustion engineering. Furnace and fuel plant design. Energy management. Technologies for the efficient use of fuel. Properties and evaluation of fuels for their application. Laboratory work on burners, furnaces, combustion, efficiency, etc.

FUEL4090 Fuel and Energy Research Project **F T6**

Investigation of some aspect of fuel engineering.

Department of Polymer Science

POLY3010 Polymer Science **F L2 T1**

Prerequisites: CHEM2011, CHEM2021, MATH2021, MATH2819. Co- or prerequisites: INDC3090.

Polymerization chemistry and processes. Step and radical chain polymerization. Step and radical chain polymerization. Ionic (including stereoregular) polymerization. Methods including bulk, suspension, emulsion, solution and gas phase polymerization. Industrially important polymers and their manufacture. Principles of analysis. Molecular weight distribution. Thermodynamics of polymer solutions. Polymer chain conformation. Viscoelasticity. Mechanical behaviour. Polymer morphology. Thermal behaviour and analysis. Chemistry and physics of elastomers. Elements of polymer compounding and fabrication. New polymers.

POLY4010 Advanced Polymer Science **S1 or S2 L2**

Prerequisite: POLY3010

Selected topics from basic texts and the original literature covering polymer analysis: physics of glassy polymers, viscoelasticity, polymer rheology, polymer morphology fracture and environmental stress cracking, rubber elasticity, anionic cationic and Ziegler-Natta catalysis in polymer chemistry, emulsion polymerization, silicon polymers and polymers for high temperature service.

Graduate Study

Centre for Petroleum Engineering Studies

PTRL5001 Reservoir Rock Properties and Fluid Flow in Porous Media **S1 L2**

Steady state single phase flow in porous media. Darcy's law for linear and radial systems. Flow in series and parallel. Radial diffusivity equation. Ei-function solution. Principle of superposition.

PTRL5002 Rock and Fluids Property Laboratory **S2 L3**

Drilling and mud chemistry and rheology. The design of drilling fluids and their applications. Measurement of basic properties. Analysis and evaluation of petrophysical parameters.

PTRL5003 Well Pressure Testing **S1 L2**

Theory of transient well testing. Practical aspects of design and performance of field test instrumentation. Pressure build-up tests. Pressure draw-down tests. Fall-off tests. Multirate tests. Gas well testing. Flow-after-flow. Isochronal and Isochronal modified. Interference testing. Pulse testing. Drillstem tests.

PTRL5004 Reservoir Simulation Fundamentals **S2 L2**

Formulation of reservoir simulation equations. Explicit and implicit solution procedures. Cartesian and radial geometry. Single dimensional, two-phase flow. Description and use of commercial reservoir simulation software. Planning and execution of reservoir simulation projects. Effective use of reservoir simulation as a management and development tool.

PTRL5005 Petroleum Thermodynamics **S1 L2**

Thermodynamic theory for phase behaviour of complex hydrocarbon mixtures at high temperature and pressure. Kinetic theory of gases, theory of liquids and liquid mixtures. Equations of State. Principle of corresponding states. Introduction to commercial phase behaviour and thermodynamic property evaluation packages used in the petroleum industry.

PTRL5006 Well Completion and Production Operations **S2 L3**

Rotary drilling hydraulics. Factors affecting rate of penetration. Directional drilling. Fishing operations. Coring. Formation damage. Casing design. Cementing. Gun perforating. Acidizing. Fracturing. Surfactants for remedial treatment. Sand control.

PTRL5007 Reservoir Engineering **S2 L2**

Basics of phase behaviour, equation of state modelling of gas-liquid systems, reservoir material balances. Identification of major recovery drive mechanisms. Water influx calculations. Well productivity.

PTRL5008 Petroleum Production Economics **S1 L1**

Need for economic reservoir analysis. Cash flow. Time value of money. Profitability of a venture. Valuation of oil and gas properties. Analysis of risk and uncertainty.

PTRL5009 Fundamentals of Drilling Engineering **S1 L2**

Rotary drilling rig components. Drilling fluid circulating system. Bottom-hole assemblies, well control and blowout prevention equipment and methods. Special marine equipment and drilling cost analysis.

PTRL5010 Practical Assignment

A work experience assignment involving the equivalent of 280 hours work over a two month period in the oil industry. Suitable work assignments are arranged through the Centre for Petroleum Engineering in co-operation with industry. Students are required to complete a comprehensive report describing the work carried out. Assessment is based on the report submitted by the student and a student evaluation report by the student's immediate supervisor in the workplace.

PTRL5012 Drilling Fluids and Cementing **S2 L3**

Introduction to the basic functions and properties of drilling fluids and cement slurries. Composition and related properties of drilling fluids and cement slurries. Types of equipment and methods used in cementing operations. Drilling fluid displacement and replacement of cement slurries. Drilling hydraulics.

PTRL5105 Formation Evaluation **F L2**

Theoretical/practical course in log analysis and its relation to other sources of subsurface data. Petrophysical data integration. Study of basic formation parameters and their well log responses. Data handling by computer. Evaluation of results. Case histories of Australian reservoirs.

PTRL5109 Petroleum Engineering Project **S1 L4 S2 L2**

An applied research project on a field problem of relevance to the research effort of the Centre and of practical interest to the oil industry. To be submitted as an individual thesis. Topic must be approved by the Director of the Centre.

Chemical Engineering and Industrial Chemistry

General

Graduate subjects will only be offered if class numbers exceed 5. Some subjects will only be offered every alternate year. Contact School for further details.

CEIC5630 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.

CEIC5700 Process Principles

Material and energy balances and their application in chemical combustion processes. Introduction to rate process theory. Applications of equilibria. Principles of analysis.

CEIC5810 Advanced Process Dynamics

Distributed-Parameter Linear Systems: Selected distributed parameter and mathematically similar systems. Methods of analysis and features of their response. Feedback systems containing deadtime. Heat exchangers. Distillation columns. *Non-linear Systems:* Selected non-linear systems, eg chemical reactors, flow systems, radiant heat transfer. Numerical solutions. Phase plane analysis. Limit cycles.

CEIC5820 Process Optimization

Multivariable analytical and numerical optimization in free and constrained parameter space. Optimization of functions of a continuous variable. Dynamic programming. Applications of these techniques to specific chemical engineering problems.

CEIC5840 System Simulation and Control

This is a participatory course in which case studies, discussion of recent papers, development of digital simulation programs and analog computer laboratory work play an important part. Topics are selected from the following areas:

Unit 1 System Simulation

Numerical methods for digital simulation; programming languages and packages for system modelling of distributed parameter systems; use of analog computers in systems simulation. Application of these techniques to the study of process plant and equipment, environmental systems, and similar areas.

Unit 2 Advanced Process Control

System identification and parameter estimation; control of multiloop systems; non-linear systems; digital control and data-logging, sequencing control.

CEIC5850 Interphase Mass Transfer

Advanced theories of mass transfer. The effect of interfacial instability and methods for predicting its presence. Theoretical prediction of mass transfer in dispersed systems. Multicomponent mass transfer.

CEIC5860 Fluid Particle Interactions

Fundamentals. Particle drag in an infinite laminar fluid, effect of turbulence and acceleration. Drag and rotation in shear flow. Multiparticular systems with homo- and heterogeneously sized particles. Co-current systems. Limiting particle transport velocity. Instabilities, various criteria. Transport line feed systems, transport line driers and reactor. Design of co-current fluid-particle systems. Gas-fluidized beds. Gross behaviour, bubblephase theories, instability theories, grid-bed geometry and resistance relationships, elutriation, residence-time and size-distribution studies. Heat and mass transfer; design of catalytic and non-catalytic fluidized reactors.

CEIC5890 Graduate Colloquia

Colloquia on research developments in the School of Chemical Engineering and Industrial Chemistry. Students are required to participate actively in the colloquia and give at least one dissertation based on their own investigations.

CEIC5900 Specialist Lectures

CEIC5910 Advanced Thermodynamics

Equilibrium: liquid-liquid, liquid-solid and liquid-vapour phase equilibria for high pressure and multicomponent system; chemical reaction equilibrium for complex systems. *Molecular theory and statistical thermodynamics:* partiton functions, monatomic and diatomic gases; Chapman-Enskog theory, evaluation of thermodynamic potentials and virial coefficients. *Compressible flow:* flow of compressible fluids in ducts including supersonic flow, shock waves and stagnation properties.

CEIC5920 Computer-aided Design

A workshop type of course with considerable time devoted to discussion, seminars, writing and running of programs. *Programming:* methods, conventions, and standards; program design, flow-charting, co-ordination and documentation. *Design:* individual plant units and components, flowsheets, optimization and economic analysis. Physical property estimation. *Simulation:* continuous change and discrete change systems.

CEIC5930 Safety in Laboratories **S1**

Storage of hazardous materials. Disposal of hazardous materials. Air pollution and ventilation. Electrical and mechanical aspects of machinery. General laboratory safety. Microbiological safety precautions. Toxicology. Carcinogens and safety. Ionizing and non-ionizing apparatus. Protective clothing. Precautions against hearing loss. Chemistry and physics of flames. Fire precautions in the laboratories. Fire fighting training.

INDC5310 Catalysts and Applied Reaction Kinetics **S1 or S2 L2 T4**

Methods of catalyst preparation and characterization; adsorption theories; general mechanisms for gas-phase reactions catalyzed by solids; poisoning and catalyst decay; effectiveness factors; techniques in catalytic research; special topics in reaction kinetics including gas-solid non-catalytic reactions, polymer kinetics, electrochemical reaction kinetics and electrocatalysis; industrial catalytic processes; application of statistical methods to the solution of complex chemical data.

INDC5500 Instrumental Analysis for Industry **F L1 T2**

Role of analysis in process optimization. Accuracies of analytical methods compared to needs for equality control. Frequency of analysis in relationship to control and analytical costs. Importance of speed of analysis for information feed-back. Case studies for selected processes in relation to selecting the analytical method.

INDC5610 Electrochemical Techniques for Control and Analysis **S1 or S2 L2 T4**

In-depth study of selected electroanalytical methods with respect to theoretical principles, instrumentation and practical utilization. The importance of adsorption and reaction mechanism on accuracies and application. Steady state and

rapid scan voltammetry, stripping voltammetry, chronopotentiometry, chronocoulometry, classical coulometry and potentiometry. Instrument design and modification for specific needs.

Department of Fuel Technology

One Session Unit (SU) is equal to 1 hour per week for session of 14 weeks.

FUEL5800 Fuel Seminar

1 (SU) to be given in Session 2, compulsory in MAppSc degree course in Fuel Engineering. Content bias to choice of subjects.

FUEL5820 Fuel Constitution

Unit 1 1 (SU) Coal constitution and pyrolytic behaviour.
Unit 2 1 (SU) Constitution and classification of oils.
Unit 3 2 (SU) Advanced fuel constitution.

FUEL5830 Fuel Processing

Unit 1 2 (SU) Carbonization and gasification processes.
Unit 2 1 (SU) Liquid fuels from coals.
Unit 3 1 (SU) Chemicals from coals.

FUEL5840 Fuel Plant Engineering

Unit 1 1 (SU) Furnace design and heat recovery.
Unit 2 1 (SU) Process heat transfer and efficient use of steam.
Unit 3 2 (SU) Furnaces and boiler control system.
Unit 4 2 (SU) Fuel plant heat transfer.

FUEL5850 Combustion and Energy Systems

Unit 1 1 (SU) Combustion technology.
Unit 2 1 (SU) Fuel impurities, removal of and deposits from.
Unit 3 1 (SU) Efficiency in energy utilization.
Unit 4 1 (SU) Combined cycles and integrated systems.

FUEL5860 Unit Operations in Waste Management C3

Unit 1 (3 SU) The unit operations and processes associated with modern waste management practices, ie the origin, nature, characterization, handling, transportation, size reduction and storage of various waste materials; reduction at source and disposal by composting, landfill, incineration and chemical processing; recovery and re-use of marketable products. Case histories.

FUEL5881 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 afterburner design.

FUEL5870 Fuel Technology Practice

Compulsory in MAppSc (Fuel) (4 SU). Content bias towards choice of G subjects.

FUEL5910 Atmospheric Pollution and Control (Theory) S1 or S2 L3

Causes, properties, dispersion, measurement and monitoring control and legislation of air pollution in ambient and industrial environments.

FUEL5911 Atmospheric Pollution and Control (Theory) S1 or S2 L3

Causes, properties, dispersion, measurement and monitoring, control and legislation of air pollution in ambient and industrial environments.

FUEL5920 Practical Aspects of Air Pollution Measurement and Control S1 or S2 T3

Prerequisite: FUEL5910 or equivalent.

Laboratory and tutorial programs in the measurement and analysis of ambient and industrial air pollutants. Computation tutorials in advanced dispersion models, aerosol dynamics and control equipment design parameters.

CEIC5000 Major Project

A substantial project on some aspects of chemical engineering, industrial chemistry, polymer science, fuel technology or biological process engineering.

CEIC5010 Minor Project

A minor investigation on some aspect of chemical engineering, industrial chemistry, polymer science, fuel technology or biological process engineering.

Department of Polymer Science

CEIC5000 Major Project

A substantial project on some aspects of chemical engineering, industrial chemistry, polymer science, fuel technology or biological process engineering.

CEIC5010 Minor Project

A minor investigation on some aspect of chemical engineering, industrial chemistry, polymer science, fuel technology or biological process engineering.

POLY5000 Polymer Science F L3 T3

Polymer Processes: Classification of polymers, methods of polymerization; bulk, solution, emulsion, suspension, high pressure; processes; step growth, chain growth; the chemistry and applications of polymer systems including polyesters, polyamides, phenolic condensation resins, vinyl polymers, synthetic elastomers. Natural polymers. *Mechanism and Kinetics:* Step growth polymerization, kinetics, structure effects; chain growth polymerization. Free radical polymerization, chemistry and properties of free radicals and

initiators; kinetics of propagation and termination reactions; co-polymerization; monomer radical structure and reactivity. Cationic and anionic polymerization; stereoregular polymers. *Polymer Characterization:* Molecular weight; averages and distributions; thermodynamics of polymer solutions; theta temperature; fractionation methods; measurement of number-average molecular weight and weight-average molecular weight. *Polymer Physics:* Principles of operation of conven tional polymer processing equipment; safety procedures; polymer compound design; stress strain behaviour of polymers in tension, compression, shear and flexure; elementary rheological behaviour of polymers; rubber elasticity; thermal characteristics of polymers.

POLY5100 Analytical Characterization of Polymers **S1 or S2 L3 T3**

Composition of formulated polymeric material. Group reactions, specific and colour reactions. Instrumental characterization of polymers, and co-polymers and associated additives, eg plasticizers, anti-oxidants, etc by UV and IR spectrophotometry and pyrolysis gas chromatography. Analysis of films by transmission and reflectance spectrophotometric methods. Thermal analysis.

POLY5300 Polymer Engineering **S1 or S2 L4 T2**

Natural and synthetic elastomers; vulcanization, theory and method. Cross-linked thermoplastics. Extrusion. Press, injection and transfer moulding. Adhesives. Heat sealing and welding. Latices. Films. Cellular polymers. Fibre reinforced plastics. Mould design. Physical testing-standards and air conditioning; basic principles; testing machines, thermal, electrical and optical properties; accelerated ageing; preparation of standard test compounds; creep; dynamic mechanical tests; rubber in shear; abrasion; flammability. Polymer engineering applications and design data.

POLY5400 Polymer Physics **S1 or S2 L4 T2**

Chain dimensions. Diffusion and viscosity. Segmental motion and the glass temperature Tg: factors affecting Tg. Crystallinity, thermodynamic and kinetic parameters. Viscoelastic behaviour of polymers; creep, Maxwell fluid and Kelvin-Voigt solid models, Boltzmann superposition principle; stress relaxation, relaxation and retardation time spectra, WLF curves; dynamic behaviour, elastic hysteresis, damping. Stress strain behaviour in polymers. Chemical stress relaxation in elastomeric networks. Fracture mechanisms and impact strength of polymers. Kinetic theory of rubber elasticity.

School of Fibre Science and Technology

Head of School
Professor R. E. Griffith

The School of Fibre Science and Technology was established in 1986 to bring together the University's activities in Wool and Pastoral Sciences and Textile Technology. The objectives of the School include the provision of comprehensive education of undergraduate and postgraduate students in the science and technology of: (i) production and marketing of wool fibre and other ruminant animal products, with special emphasis on wool fibre; (ii) production and marketing of other textile fibres; (iii) processing of textile fibres and their manufacture into consumer and industrial products; and (iv) performance and properties of textile and related fibre products.

These objectives are achieved by providing an undergraduate course in Wool and Pastoral Sciences which emphasises the plant and animal sciences relevant to production in the sheep industry, as well as preparation of wool for market, specification of wool, marketing of wool and the relationship between wool production and wool processing; and by providing undergraduate courses in Textile Technology (in which there are options in Textile Chemistry, Textile Engineering and Textile Physics) and Textile Management. While Wool and Pastoral Sciences mainly deals with wool and similar fibres such as cashmere and mohair produced by goats, as well as more general features of animal production, Textile Technology covers all fibres and all aspects of their utilization in consumer and industrial products.

Rapidly advancing developments in the primary and secondary fibre industries make close collaboration between workers from the production and processing sides essential. Many of these developments have been stimulated by objective measurement of fibre properties - a special area of expertise of the Department of Wool and Animal Science; and the objective specification of textile products in which the Department of Textile Technology is a world leader. In the sheep industry these developments have major implications for systems of wool production particularly in areas such as nutrition, genetics, breeding and management. The establishment of the School provides a unique opportunity for integration of educational and research efforts right through from production of fibres to finished textile products. The School provides a stimulating environment for students who wish to make careers in fibre based rural and manufacturing industries, both of which are critically important in the economy of Australia.

Department of Textile Technology

Head of Department
Professor R.E. Griffith

Textile Technology is concerned with the conversion of both natural and man-made fibres into an extremely wide variety of finished products. These range from fabrics for apparel, soft furnishings, floor coverings and industrial use to such specialized textiles as tyre cord, ropes, protective clothing, sailcloth, parachute fabrics, medical dressings, composite materials, and many others.

In Australia, the textile industry has developed mainly in the past sixty years and today it is one of our largest manufacturing groups. As in overseas countries, the impact of science is bringing rapid changes to the industry, and a consequence of this has been a strong demand for personnel skilled in Textile Technology and Management.

Department of Wool and Animal Science

Head of Department
Associate Professor J.P. Kennedy

Agricultural products, particularly wool, still contribute a significant share of Australia's export income. The pastoral industry has also played a major role in the development of the continent and the largest single form of land-use still is grazing by sheep and cattle.

Farming has advanced technologically in recent years, however innovations are continually being sought to increase productivity, raise quality and improve marketing of rural products within the framework of local and international economics. There is a continual need for the feeding and clothing of humans on a planet with finite mineral and fuel resources. This challenge must be balanced with the need for conservation and careful manipulation of a pool of renewable living resources. Wool and pastoral scientists are required to research, communicate and administer the changes which are occurring.

Staff

Professor of Wool Technology and Head of School
R. E. Griffith, BSc *N.S.W.*, PhD *Leeds*, CText, FTI

Visiting Professor
Euan Maurice Roberts, MAgrSc *N.Z.*, PhD *N.S.W.*

Project Scientist
Baden Singh Deol, MSc *Panj.*, PhD *Syd.*

Administrative Officer
James William Pirie, BA DipEd *Syd.*

Department of Textile Technology

Head of Department
Professor R. E. Griffith

Professor of Textile Physics
Ronald Postle, BSc *N.S.W.*, PhD *Leeds*, CText, FTI, FAIP

Associate Professor
Michael Thomas Pailthorpe, BSc PhD *N.S.W.*, CText, FTI

Senior Lecturers
John Ilmar Curiskis, BSc PhD *N.S.W.*,
Nigel Anthony Gull Johnson, BSc *N.S.W.*, PhD *Leeds*, CText, FTI, MIAP

Lecturer
Vacant

Professional Officers
Jindrich Vavrinec Brancik, MSc *Brno*, PhD *N.S.W.*, MACS, FRSC
Rup Chand Dhingra, BSc *Punj.*, MTech *I.I.T.Delhi*, PhD *N.S.W.*, CText, FTI
Alvin Siu Wah Li, MSc *Leeds*, PhD *N.S.W.*, CText, ATI
Michael David Young, BSc PhD *N.S.W., CText, ATI*

Department of Wool and Animal Science

Associate Professor and Head of Department
John Patrick Kennedy, MSc *N.S.W.*, BSc *Oxf.*,FAIAS

Associate Professors
John William James, BA *Qld.*, DSc *N.S.W.*

Senior Lecturers
David John Cottle, BSc *N.S.W.*, PhD *N.E.*
*Stephen James Filan, BAgrEc N.E., MSc *N.S.W.*, MAIAS
Douglas McPherson Murray, BAgrSc PhD *Melb.*, MRurSc *N.E.*
Geoffrey Edward Robards, BSc *N.S.W.*, PhD *Melb.*

Lecturer
Gordon Whitfield King, BSc PhD *N.S.W.*, DipFinMgt *N.E.*, MAIAS, AASA, CPA

Professional Officers
David John Petrie, BSc *N.S.W.*
Eammon William Purcell, BRurSc *N.E.*

Project Officer
Jeffrey Eppleston, MScAg *Syd.*

*Conjoint appointment with the School of Geography

Course Outlines

Undergraduate Study

The School of Fibre Science and Technology participates in the Co-operative Education Program. The program applies to all three undergraduate courses taught in the School. Students in the program will complete their degree in four years, with several supervised terms of industry employment spread throughout the course. Students participating in the program will receive financial support of $8,800 per annum for each of the four years of the program. Selection into the program is based on high academic achievement and strong personal motivation for a successful career in the wool or textile manufacturing fields.

Department of Textile Technology

The Department of Textile Technology offers courses in Textile Technology and Textile Management. Both courses extend over four years full-time study and lead to the award of the degree of Bachelor of Science. For the award of Honours, students need to have distinguished themselves in formal studies, laboratory exercises, and in their final year project. Graduates of both courses qualify for membership of the Textile Institute.

Students in both courses must complete a minimum of 40 working days approved industrial training, of which at least 30 working days training must be taken at the end of the third year of study.

It is important to stress that the specialised nature of the training provided within the Department of Textile Technology does not mean a restricted range of job opportunities after graduation. Career possibilities extend through the textile industry, allied industries (such as the production of textile chemicals and surgical dressings), private consultants, government departments and authorities, teaching at secondary and tertiary levels, and pure or applied research in various organisations.

Graduates may be employed in quality control, technical management, research and development, international trade, production or general management. Within the textile industry graduates may, for example, enter any of the following areas: the manufacture of natural and or man-made fibres, yarns, fabrics, etc.; dyeing, printing and finishing of textiles; quality assurance; marketing and retailing, etc.

3170
Textile Technology - Full-time Course

Bachelor of Science
BSc

Textile Chemistry, Textile Physics, Textile Engineering Options

The conversion of textile raw materials into their finished products is simply a succession of, and an interaction between, a number of chemical, physical and engineering processes. It follows, therefore, that the disciplines involved in the study of textile technology, in addition to the technological aspects, includes a study in depth of one of the following: chemistry, engineering or physics.

Graduates will qualify for membership of one of the following professional bodies, depending upon which option of the course is taken: the Royal Australian Chemical Institute; the Institute of Engineers, Australia; or the Australian Institute of Physics.

All students take a common first year, and they need not choose the option they desire to follow until the end of that year.

In Year 2 and Year 3 students specialize in one of three options of the course, viz. Textile Chemistry, Textile Physics, or Textile Engineering. In Year 4 all students take the same subjects, except that the Advanced Textile Option is in the area of their own specialization.

Year 1 All options		**Hours per week** S1	S2
PHYS1002	Physics 1	6	6
CHEM1102	Chemistry 1A *and*	6	0
CHEM1201	Chemistry 1B *or*	0	6
CHEM1002	Chemistry 1	6	6
FIBR1001	Natural Fibre Production	6	0
MATH1032	Mathematics 1	6	6
FIBR1101	Fibre Science 1	0	6
		24	24

Textile Chemistry

Year 2			
CHEM2011	Physical Chemistry	6	0
CHEM2021	Organic Chemistry	0	6
CEIC2010	Instrumental Analysis	3	3
MATH2819	Statistics SA	2	2
FIBR2201	Computing Applications	4	0
TEXT2101	Fibre Science 2	0	4
TEXT2301	Yarn Technology 1	0	6
TEXT2401	Fabric Technology 1	6	0
	General Education Subject/s Category A	2	2
		23	23

Year 3		Hours per week S1	S2
CHEM3021	Organic Chemistry	6	0
Plus one of the following Chemistry electives			
CHEM2031	Inorganic Chemistry and Structure, *or*	0	6
CHEM3121	Synthetic Organic Chemistry, *or*	0	6
CHEM3321	Applied Organic Chemistry	0	6
or an alternative as approved by the Head of the School			
TEXT4601	Colouration Technology	0	4
TEXT3201	Textile Quality Control	0	2
TEXT3301	Yarn Technology 2	6	0
TEXT3401	Fabric Technology 2	0	6
TEXT3501	Finishing Technology A	5	0
TEXT3601	Colour Science	3	0
TEXT3801	Textile Engineering 1	0	2
*MANF0401	Production Management A	3	0
	General Education Subject/s Category B	0	4
		23	24

* subject under review for 1992

Textile Physics

Year 2			
PHYS2001	Mechanics and Computational Physics	4	0
PHYS2011	Electromagnetism and Thermal Physics	0	4
PHYS2021	Quantum Physics and Relativity	2	2
MATH2100	Vector Calculus	2.5	0
MATH2120	Mathematical Methods for Differential Equations	0	2.5
MATH2819	Statistics SA	2	2
FIBR2201	Computing Applications	4	0
TEXT2101	Fibre Science 1	0	4
TEXT2301	Yarn Technology 1	0	6
TEXT2401	Fabric Technology 1	6	0
	General Education Subject/s Category A	2	2
		22.5	22.5

*Note: because of pre-requisite requirements students wishing to take certain year 3 electives may substitute PHYS2031 Laboratory in year 2, and take PHYS2021 Quantum Physics and Relativity in year 3.

Year 3			
PHYS2031	Laboratory *	3	3
Plus Physics electives averaging not less then 3 hours per session, selected from the following:			
PHYS2940	Introduction to Physics of Measurement	3	0
PHYS3021	Statistical Mechanics and Solid State Physics	4	0
PHYS3060	Advanced Optics	0	2
PHYS3110	Experimental Physics B1	4	0
PHYS3120	Experimental Physics B2	0	4
PHYS3410	Biophysics	3	0
PHYS3710	Advanced Laser and Optical Applications	2	2
or an alternative as approved by the Head of the School			
TEXT3201	Textile Quality Control	0	2
TEXT3301	Yarn Technology 2	6	0
TEXT3401	Fabric Technology 2	0	6
TEXT4601	Colouration Technology	0	4
TEXT3501	Finishing Technology A	5	0
TEXT3601	Colour Science	3	0
TEXT3801	Textile Engineering 1	0	2
*MANF0401	Production Management A	3	0
	General Education Subject/s Category B	0	4
		23	24

* subject under review for 1992

Textile Engineering

Year 2			
MECH1110	Graphical Analysis and Communication	0	3
MECH1300	Engineering Mechanics 1	4	0
ELEC0802	Electrical Power Engineering	0	3
ELEC0805	Electronics for Measurement and Control	0	3
CIVL0616	Structures	3	0
MATH2021	Mathematics	2	2
MATH2819	Statistics SA	2	2
FIBR2201	Computing Applications	4	0
TEXT2101	Fibre Science 2	0	4
TEXT2301	Yarn Technology 1	0	6
TEXT2401	Fabric Technology 1	6	0
	General Education Subject/s Category A	2	2
		23	25

Year 3			
MECH2300	Engineering Mechanics 2A	3	0
MECH2310	Engineering Mechanics 2B	0	3
MECH2600	Fluid Mechanics 1	2	2
MECH2700	Thermodynamics 1	2	2
TEXT3201	Textile Quality Control	0	2
TEXT3301	Yarn Technology 2	6	0
TEXT3401	Fabric Technology 2	0	6
TEXT3501	Finishing Technology A	5	0
TEXT3601	Colour Science	3	0
TEXT3801	Textile Engineering 1	0	2
TEXT4601	Colouration Technology	0	4
*MANF0401	Production Management A	3	0
	General Education Subject/s Category B	0	4
		24	25

* subject under review for 1992

Year 4 (All Options)			
TEXT3101	Textile Structures 1	4	0
TEXT4001	Textile Industry Studies†	3	0
TEXT4003	Project	7	7
TEXT4013	Seminar	1.5	1.5
TEXT4101	Textile Structures 2	0	3
TEXT4201	Processing Laboratory	3	0
TEXT4501	Finishing Technology B	0	4
TEXT4801	Textile Engineering 2	0	3
Plus one advanced textile option			
TEXT4111	Advanced Textile Physics, or	0	2
TEXT4611	Advanced Textile Chemistry, or	0	2
TEXT4711	Advanced Textile Management	0	2
TEXT4811	Advanced Textile Engineering	0	2
*MANF0402	Production Management B	0	3
or an alternative as approved by the Head of the School			
APSE0002	Social Issues in Applied Science†	2	0
		20.5	21.5

* subject under review for 1992

†These subjects contribute towards satisfaction of the Category C General Education requirement.

3175
Textile Management - Full-time Course

Bachelor of Science
BSc

The production and marketing of textile products involves a number of manufacturing processes, and requires an understanding of basic management principles. The Textile Management course provides a comprehensive knowledge of all the textile sciences and technologies. In addition the course includes studies in economics, accounting, marketing, management, and other areas of commerce.

The course is designed to meet the need for executives in the textile and allied industries. A wide choice of electives is available in the third year of the course. This allows students to either gain a broad knowledge of the various areas of commerce, or to specialise in one of the following areas: Applied Economics; Accounting and Financial Management; or Strategic Marketing Management.

Year 1		Hours per week S1	S2
PHYS1002	Physics 1, *or*	6	6
PHYS1022	Introductory Physics		
CHEM1101	Chemistry 1A, *or*		
CHEM1401	Introductory Chemistry A	6	0
MATH1032	Mathematics 1, *or*	6	6
MATH1011	General Mathematics 1B *and*	6	0
MATH1021	General Mathematics 1C	0	6
ECON1101	Microeconomics 1	4	0
ECON1102	Macroeconomics 1	0	4
FIBR1101	Fibre Science 1	0	6
		22	22
Year 2			
MATH2819	Statistics SA	2	2
FIBR2201	Computing Applications	4	0
TEXT2101	Fibre Science 2	0	4
TEXT2301	Yarn Technology 1	0	6
TEXT2401	Fabric Technology 1	6	0
ACCT1501	Accounting and Financial Management 1A	4.5	0
ACCT1511	Accounting and Financial Management 1B	0	4.5
MARK2012	Marketing Systems	4	0
MARK2052	Marketing Research	0	4
	General Education Subject/s Category A	2	2
		22.5	22.5
Year 3			
TEXT3201	Textile Quality Control	0	2
TEXT3301	Yarn Technology 2	0	6
TEXT3401	Fabric Technology 2	6	0
TEXT3501	Finishing Technology A	5	0
TEXT3601	Colour Science	3	0
TEXT3801	Textile Engineering 1	0	2
TEXT4601	Colouration Technology	0	4
Plus 2 Commerce electives selected from the following:			
ACCT2522	Accounting and Financial Management 2A	4.5 or	4.5

Year 3		Hours per week S1	S2
ACCT2542	Accounting and Financial Management 2B	4.5 or	4.5
ECON2103	Applied Microeconomics	3.5 or	3.5
ECON2104	Applied Macroeconomics	3.5 or	3.5
ECOH2301	Management and Business Development	3	0
INFS1602	Computer Information Systems 1	3 or	3
INFS2603	Computer Information Systems 2	0	3
MARK3073	Brand Management	4	0
MARK3083	Strategic Marketing Management	0	4
IROB1701	Industrial Relations 1A	3.5 or	3.5
FINS2613	Business Finance 2A	3 or	3
LEGT7711	Legal Environment of Commerce	3 or	3
LEGT7731	Legal Regulation of Marketing and Distribution *or an alternative as approved by the Head of the School*	3 or	3
*MANF0401	Production Management A	3	0
	General Education Subject/s Category B	0	4
		20	20

* subject under review for 1992

Year 4			
TEXT3101	Textile Structures 1	0	
TEXT4001	Textile Industry Studies†	3	0
TEXT4003	Project	7	7
TEXT4013	Seminar	1.5	1.5
TEXT4101	Textile Structures 2	0	3
TEXT4201	Processing Laboratory	3	0
TEXT4501	Finishing Technology B	0	4
TEXT4711	Advanced Textile Management	0	2
TEXT4801	Textile Engineering 2	0	3
*MANF0402	Production Management B *or an alternative as approved by the Head of School*	0	3
APSE0002	Social Issues and Applied Science†	2	0
		21.5	23.5

* subject under review for 1992
†These subjects contribute to satisfaction of the Category C General Education requirement.

Department of Wool and Animal Science

The Department offers a full-time course of four years duration leading to the award of a Bachelor of Science degree at either Honours or Pass level. The course is the only one in Australia in which special emphasis is given to wool science. In addition,

studies concentrate on the most important animal industries (sheep and cattle).

Students receive a thorough grounding in the appropriate basic scientific disciplines as well as the theory and application of principles which are relevant to all aspects of pastoral production, including production and utilization of pastures; reproduction, nutrition, health, genetic improvement, ecology and management of grazing animals and the production, preparation for sale and specification of wool and meat. The course also includes study of the design and interpretation of experimental investigations, economics and business management as well as elective options on crop production, range land management and rural communications. Relevant subjects offered by other schools may also be included. An important component is the final year project whereby students engage in an area of personal research on a theoretical or experimental topic on which they are required to submit a thesis.

The course provides students with a broad overview of the pastoral industries. It aims to produce generalists rather than specialists and, although there is some scope for studying topics of special interest, the course is designed so that certain core subjects must be undertaken. Because of the broad education received, graduates are equipped for a wide variety of careers in and associated with agricultural production including research, advisory work, education, marketing, management and administration. Graduates are eligible for corporate membership of the Australian Institute of Agricultural Science.

Industrial Training Requirements

1. Students are required to obtain twenty-four weeks practical experience on commercial properties. At least twenty weeks of experience must be obtained concurrently with the course, while up to four weeks may be allowed for practical experience obtained immediately prior to the commencement of the course.

2. Students are encouraged to obtain experience in a diversity of pastoral enterprises, ie cattle, sheep and cropping, in different climatic zones.

3. A maximum of eight weeks shall be allowed for practical experience on any one property, including home properties. Up to eight weeks employment at research or teaching institutions is allowed towards the industrial training requirement.

4. In order to obtain recognition for practical work carried out, students shall, within six weeks of the commencement of the session immediately following the period of employment:

(1) Submit written evidence from the owner manager of the property or the director of the institution as to the length of employment.

(2) Submit a written report along the guidelines which are available from the Department.

3220
Wool and Pastoral Sciences - Full-time Course

Bachelor of Science
BSc

Year 1		Hours per week S1	S2
CHEM1002	Chemistry 1	6	6
FIBR1001	Natural Fibre Production	6	0
MATH1032	Mathematics 1 or	6	6
MATH1011	General Mathematics 1B and	6	0
MATH1021	General Mathematics 1C	0	6
FIBR1101	Fibre Science	0	6
BIOS1011	Biology A	6	0
BIOS1021	Biology B	0	6
		24	24
Year 2			
CHEM2929	Agricultural and Biological Chemistry	6	0
WOOL2103	Livestock Production 1	2	2
WOOL2203	Agronomy	3	6
WOOL2303	Agricultural Economics and Management	3	3
WOOL2503	Wool Science 1	3	3
WOOL2601	Animal Physiology 1	0	6
MATH2819	Statistics SA	2	2
FIBR2201	Computing Applications	4	0
	General Education Subject/s Category A	2	2
		25	24
Year 3			
WOOL3203	Pastoral Agronomy	4	4
WOOL3401	Animal Nutrition	0	4
WOOL3503	Wool Science 2	3	3
WOOL3701	Animal Health and Welfare	3	0
WOOL3803	Genetics 1	3	3
WOOL3901	Biostatistics 1	4	0
BIOC2312	Principles of Biochemistry and Molecular Biology	6	6
	General Education Subject/s Category B	2	2
		25	22
Plus one of the three available options			
WOOL3111	Livestock Production 2	0	3
WOOL3211	Crop Agronomy*	0	3
WOOL3221	Range Management*	0	3
WOOL3511	Wool Marketing	0	3
		25	25
Year 4			
WOOL4003	Project	6	6
WOOL4013	Seminar	2	2
APSE0002	Social Issues in Applied Science†	2	0

*Available in alternate years

Plus at least 14 hours each session of optional subjects. Not more than one subject in each session may be chosen from Group B.

†This subject contributes towards satisfaction of the Category C General Education requirement.

Optional subjects

Group A		Hours per week S1	S2
WOOL3111	Livestock Production 2	0	3
WOOL3211	Crop Agronomy*	0	3
WOOL3221	Range Management*	0	3
WOOL3511	Wool Marketing	0	3
WOOL4001	Rural Extension	4	0
WOOL4113	Livestock Production 3	3	3
WOOL4513	Wool Science 3	4	4
WOOL4711	Animal Health 2	3	0
WOOL4813	Genetics 2	4	4
WOOL4911	Biostatistics 2	0	4

* Available in alternate years.

Some subjects may not be offered in all years.

Group B		Hours per week S1	S2
GEOG2021	Introduction to Remote Sensing	4	0
GEOG3032	Remote Sensing Applications	0	4
MARK2012	Marketing Fundamentals	4	0
MARK2052	Marketing Research	0	4
BIOS3061	Environmental Botany	6	0
MICR2201	Introductory Microbiology	6	0

Or such other subjects as may be approved by the Head of Department

Graduate Study

Department of Textile Technology

The Department conducts a course which leads to the award of a Graduate Diploma in Textile Technology.

In addition, the Department welcomes enquiries from graduates in Science, Engineering and Applied Science who are interested in doing research leading to the award of the degrees of Master of Science or Doctor of Philosophy.

5090
Textile Technology Graduate Diploma Course

Graduate Diploma
GradDip

The course leading to the award of Graduate Diploma in Textile Technology is designed to prepare graduates for careers in the textile and allied industries. It also provides formal studies for graduates who are already employed in the textile industry. The normal requirement for admission to the course is a Bachelor degree or equivalent tertiary qualification.

The following program, which comprizes both formal lectures and laboratory work, may be taken as a one year full-time course or two-year part-time course.

		Hours per week S1	S1
TEXT5001	Textile Technology Dissertation	1.5	1.5
TEXT5003	Textile Technology	1.5	1.5
TEXT5101	Fibre Science A	6	0
TEXT5102	Fibre Science B	0	4
TEXT5201	Textile Quality Control	0	2
Plus two electives per session (averaging not less than 9 hours per session), selected from the following:			
TEXT5301	Yarn Technology A	0	5
TEXT5302	Yarn Technology B	5	0
TEXT5401	Fabric Technology A	5	0
TEXT5402	Fabric Technology B	0	5
TEXT5501	Finishing Technology A	5	0
TEXT5502	Finishing Technology B	0	5
TEXT5601	Colour Science	4	0
TEXT5602	Dyeing Technology or an alternative as approved by the Head of School	0	4
		18	18

Candidates wishing to specialize in the theory and practice of yarn and fabric technology (engineering/physics orientation) should undertake the optional subjects TEXT5301, TEXT5302, TEXT5401 and TEXT5402. Candidates wishing to specialize in the science and technology of textile dyeing and finishing (chemistry orientation) should undertake the optional subjects TEXT5501, TEXT5502, TEXT5601 and TEXT5602.

Department of Wool and Animal Science

The Department conducts a course which leads to the award of a Graduate Diploma in Wool and Pastoral Sciences.

In addition, the Department welcomes enquiries from graduates in Science, Agriculture and Applied Science who are interested in doing research leading to the award of the degrees of Master of Science or Doctor of Philosophy.

5081
Wool and Pastoral Sciences Graduate Diploma Course

Graduate Diploma
GradDip

The course leading to the award of the Graduate Diploma in Wool and Pastoral Sciences is specially designed for graduate students preparing themselves for careers in the pastoral industry. One of the principal functions of the course is to provide a bridge from other disciplines such as Agriculture, Veterinary Science and Pure Science for graduates who wish to study and work in the field of Wool and Pastoral Sciences, which is of such overall importance to Australia.

The normal requirement for admission to the course is a degree in Agriculture, Applied Science, Veterinary Science or Science in an appropriate field. In addition, students may be required to take a qualifying examination. Such qualifying examination will be of a standard which will ensure that the student has sufficient knowledge of the subject and the principles involved to profit by the course.

The following program may be completed in one year on a full-time basis. Students are required to carry out full-time study to the extent of eighteen hours lecture and laboratory work per week for two sessions. Both graduate subjects and undergraduate subjects may be chosen to suit the requirements of the student subject to their availability and the approval of the Head of the School.

Full-time Course

18 hours per week of which at least 10 must be chosen from:

		Hours per week
WOOL5113	Livestock Production	6
WOOL5213	Range Management	4
WOOL5513	Wool Science	6
WOOL5813	Animal Breeding	4
WOOL5913	Quantitative Methods	4

A maximum of 8 hours per week of study may be selected from approved undergraduate subjects.

Graduate Diploma students are expected to work at the level of honours students in the undergraduate courses and to carry out prescribed study of current research material in the appropriate field.

Graduate Programs In Rangeland Management

Programs are available leading to the award of Graduate Diploma in Rangeland Management (Course 5025) in the following areas of study:

- Range Management
- Management of Pastoral Enterprises

For course details see Graduate Study in the School of Geography section.

Subject Descriptions

Undergraduate Study

School of Fibre Science and Technology

Students should note that enrolment in all later year subjects taught by the School is subject to satisfactory course progression and approval of the Head of the School.

FIBR1001 Natural Fibre Production **S1 L3 T3**

Introduction to the world and Australian wool and cotton industries; fibre and skin biology; mechanisms of, and factors affecting, fibre growth and morphology; introduction to wool and cotton production, harvesting, preparation for sale; wool types and marketing.

FIBR1101 Fibre Science 1 **S2 L4 T2**

Fibre classification and raw materials. Necessary and desirable attributes of textile fibres. Production of natural and man-made fibres. Physics and chemistry of natural and man-made fibres. Introduction to fibre morphology and fibre structure. Introductory statistics and sampling theory. Basic techniques for the measurement of fibre properties. Fibre transverse dimensions and length. Practical fibre identification. World production and consumption of textile fibres.

FIBR2201 Computing Applications **SS L2 T2**

Introduction to hardware and software concepts; Operating systems. Introduction to computer programming: simple algorithms and data organization. Computer applications in fibre science and technology: computer-aided design and manufacture CAD CAM; process monitoring and control, computer-integrated manufacture CIM; data acquisition; modelling and optimisation techniques; databases, spreadsheets, text wordprocessing.

Department of Wool and Animal Science

APSE0002 Social Issues in Applied Science **S1**

The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

WOOL2103 Livestock Production 1 **F L2**

The sheep and beef cattle industries and their place in the economic life of Australia; levels of production and trends. The physical, biological, managerial and economic conditions influencing production. Sheep producing zones. Sheep breeds for wool production. Cross breeding, prime lamb production. Sheep and cattle management; nutrition, reproduction, survival.

A field excursion of one week's duration is held in Session 1.

WOOL2203 Agronomy **S1 L2 T1 S2 L3 T3**

Agricultural climatology, soil science, and soil conservation. Pastures in land use and land development. Principles of tillage, crop rotation, irrigation, conservation of fodder and fertilizer usage. Weeds and weed control. Practical work in the systematics of selected plant families.

WOOL2303 Agricultural Economics and Management 1 **F L2 T1**

Farm planning methods. Budgeting, gross margins, simplified programming and introduction to linear programming. Use of VAX computers: introduction to operating system, text editor, and linear programming software. Introduction to farm management implications of land tenure and title; valuation; depreciation; discounting; taxation.

Economic principles. Introduction to production economics theory, cost curves, and price theory.

WOOL2503 Wool Science 1 **F L2 T1**

(Preparation and Early Stage Processing) Fleece characteristics and their variation; wool faults; clip preparation - past, present and future; evaluation and typing of wool; value and use of wool; felting; fellmongering; marketing. Early stage processing and yarn manufacture.

WOOL2601 Animal Physiology 1 **S2 L3 T3**

Prerequisite: BIOS1021.

Physiology systems of mammalia are treated with special attention to homeostasis. Cell-membranes; blood and body fluids; the immune reaction. Cardiac control, functions and haemodynamics. Respiration. The endocrine system with particular emphasis upon growth, reproduction, lactation and stress. The nerve impulse, its excitation and transmission. Physiology of digestion, the gastro-intestinal tract and of the kidney. Heat tolerance and climatic adaptation.

WOOL3111 Livestock Production 2 **S2 L2 T1**

Prerequisite: WOOL2103.

The scope for intensification of ruminant production. The behaviour, nutrition, environmental physiology and health of intensively managed animals. Housing and environmental control of facilities. Examples of intensification, eg feed lots, sea transport.

WOOL3203 Pastoral Agronomy **F L3 T1**

Prerequisite: WOOL2203.

Pasture ecology. Establishment, management and utilization of pastures and fodder crops. Pasture-animal relationships, stocking rates, mixed stocking. Vegetation management in arid and semi-arid areas. Pasture evaluation and pasture research techniques.

WOOL3211 Crop Agronomy **S2 L2 T1**

Prerequisite: WOOL2203.

Field crop production associated with the pastoral industries. Crop physiology. Cropping practices. Pests and diseases.

WOOL3221 Range Management **S2 L1 T2**

Co or prerequisite: WOOL3203.

Basic range ecology and rangeland ecosystems. Plant physiology, growth and development of rangeland plants. Rangeland management practices. Monitoring of long-terms trends in productivity. Applications of remote sensing and ground truth sampling. Wild life resources and feral animals and their management. Sheep and beef cattle production in arid and semiarid environments. Administration of rangelands (eg the functions of the Western Lands Commission, the National Parks and Wildlife Service, and the Soil Conservation Service in New South Wales).

Involves one week of instruction at Fowlers Gap Research Station.

WOOL3401 Animal Nutrition **S2 L3 T1**

Composition and classification of foodstuffs and pastures. Physiology of ruminant digestion. Digestion absorption and metabolism of carbohydrates, proteins, fats, mineral and vitamins. Digestibility of foodstuffs. Nutrient and energy balances and requirements of livestock. Feeding standards and the quantitative application of nutritional data with particular reference to Australian conditions. Utilization of forage by grazing ruminants. Supplementary and drought feeding. Consideration of disorders due to nutrition.While particular emphasis is given to nutritional requirements of sheep, those of other farm livestock are dealt with in this section.

WOOL3503 Wool Science 2 **F L2 T1**

(Metrology and late stage processing) Sampling wool for measurement; measurement of fibre diameter, length, colour, yield, vegetable matter, regain, resistance to compression, bulk, medullation, dark fibres and style; test certificates; statistics; standards; use of measurements in marketing and manufacture; fabric manufacture, dyeing and finishing.

WOOL3511 Wool Marketing **S2 L2 T1**

Wool marketing systems; comparison with other countries, modelling. Wool commerce; financial factors. Information systems. Future directions.

WOOL3701 Animal Health and Welfare 1 **S1 L2 T1**

Prerequisite: WOOL2103.

Managerial control of grazing livestock health and welfare. The concept of economic approach to animal health. Introductory immunology. Skin health in sheep and cattle. Control of external parasites, particularly by insecticides. Reproductive health in sheep and cattle. Internal parasites. Legal and Public Health responsibilities; Acts of Parliament relating to animal health and welfare.

WOOL3803 Genetics 1 **F L2 T1**

Mendelian inheritance. Chromosomes, linkage and the physical basis of heredity. Gene action in physiology and development. Elements of molecular genetics. Principles of quantitative genetics, strength of inheritance and relationships. Selection and crossbreeding. Genetics applied to animal and plant improvement. Applications of genetics in sheep and wool production.

WOOL3901 Biostatistics 1 **S1 L2 T2**

Design and analysis of comparative experiments, for continuous and discrete random variables. Analysis of variance for fixed, mixed and random models. Linear regression and correlation. Multiple comparison methods.

WOOL4001 Rural Extension **S1 L2 T2**

Development of communication skills through experiential or active learning situation. Educational, psychological and sociological factors relating to the diffusion of innovations. Program planning and evaluation.

WOOL4003 Project **F T6**

Students are required to conduct an experimental or theoretical investigation under supervision and to submit a thesis describing the results of their investigations. Throughout the year students are required to submit progress reports to their supervisors and to present seminars. The written reports of the project shall be submitted by the last day of Session 2.

WOOL4013 Seminar **F T2**

Seminars deal with research and or development work being undertaken or recently completed by students and staff of the Department of Wool and Animal Science, other University schools and research organizations. There are also seminars on communication in wool and pastoral sciences and on problems facing rural industries.

WOOL4113 Livestock Production 3 **F L1 T2**

Principles of livestock production applied to reproduction and fertility; growth and development. The meat industry. Carcass conformation and composition. Pre and post mortem factors affecting meat quality. Meat marketing.

WOOL4513 Wool Science 3 **F L2 T2**

(Advanced Technology) Sale by description; modelling wool production; developmental metrology techniques; the Australian wool processing industry; breeding for wool quality; woollen metrology; keratin fine structure; caprine and cameloid fibres; processed wool metrology; wool classification; lot building; current wool research and development.

WOOL4711 Animal Health 2 **S1 L2 T1**

Prerequisite: WOOL2103.

Use and misuse of products used in animal health work. Internal parasitism. External parasitism. Feedlot health. Transport health. Problems causing disease and death. Health of horses and dogs used in livestock management.

WOOL4813 Genetics 2 **F L2 T2**

Prerequisite: WOOL3803.

Genetic structure of populations. Forces causing genetic change. Partition of genetic and phenotypic variation. Resemblance between relatives and estimation of genetic parameters. Direct and correlated selection responses. Aids to selection and selection indexes. Inbreeding and genetic drift. Genotype environment interaction. Heterosis and its utilization.

Interaction of natural and artificial selection. Limits of selective progress. Applications of molecular genetics.

WOOL4911 Biostatistics 2 **S2 L2 T2**

Least squares methods, applied to multiple regression and experimental design models. Factorial experiments. Analysis of covariance. Elements of multivariate analysis.

Department of Textile Technology

Students should note that enrolment in all later year subjects taught by the Department is subject to satisfactory course progression and approval of the Head of Department.

APSE0002 Social Issues in Applied Science **S1**

The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

TEXT2101 Fibre Science 2 **SS L2 T2**

Fibre microscopy. Electron microscopy. Fibre reflection and lustre. Morphological and fine structure of fibres. X-ray Crystallography. Polymer crystallisation. Molecular structure of proteins. Optical properties and fibre orientation. Infra-red spectroscopy. Fibre rheology. Mechanical properties. Moisture sorption and swelling. Addition and condensation polymerisation. Chemical constitution and reactivity of blended fibres and manmade fibres. Blended fibres.

TEXT2301 Yarn Technology 1 **SS L3 T3**

The preparation of staple fibres for yarns and non-woven fabrics: processes for tow conversion, opening, cleaning, blending, carding, drawing, and combing. Short-staple, worsted and woollen preparation systems. Computer blend selection; drafting theory; theory and measurememt of irregularity; levelling of slivers.

TEXT2401 Fabric Technology 1 **SS L3 T3**

Principles of weaving. Mechanisms of shedding, picking, and beating up. Secondary and auxilliary mechanisms of looms. Cam, dobby and jacquard shedding. Shuttle, projectile, rapier and jet weft insertion. Multiphase weaving; circular weaving. Woven cloth construction principles and weave represenation; basic weave structures. Leno and narrow fabric weaving. Woven pile fabric constructions; tufting yam preparation for weaving. Mechanics of woven fabric formation. Introduction to knitting technology.

TEXT3101 Textile Structures 1 **SS L2 T2**

Fibrous structures and textile assemblies. Fibre friction and viscoelasticity. Lubrication. Static electrification of textiles. Yarn structures. Fibre migration in yarns. Mechanics of continuous filament yarns, staple-fibre yarns, plied and textured yarns. Fabric testing; structure and dimensions; tensile strength; tear strength; fabric abrasion. Fabric low-stress mechanical and surface properties. Drape and handle. Fabric tailorability.

TEXT3201 Textile Quality Control **SS L T2**

User-seviceability testing. Fibre content and care-labelling. Process and quality control. Consumer problems.

TEXT3301 Yarn Technology 2 **SS L3 T3**

Properties of yarns. Introduction to geometry and mechanics of twisted structures. Staple yarn forming by ring, rotor and unconventional spinning methods. Twisting and winding processes. Throwing and texturing of continuous filament yarns. On-line monitoring of production and quality; automation. Measurement of yarn properties.

TEXT3401 Fabric Technology 2 **SS L3 T3**

Principles of knitting. Techniques of loop formation in weft and warp knitting; essential machine mechanisms. Knitted cloth construction principles and knitted structure representations; basic knitted structures. Techniques of jacquard needle selection and loop transfer for extended design effects in weft knitting; derivative weft knitted structures. Shaped weft knitted structures, including fully-fashioned knitting, hosiery manufacture, integral knitting techniques. Use of multiple guide bars, part-set threading, and auxillary mechanisms for extended design effects in tricot and raschel warp knitting; derivative warp knitted structures. Double needle bed warp knitting. Mechanics of knitted fabric formation. Stitch-bonded and non-woven fabric manufacture.

TEXT3501 Finishing Technology A **SS L3 T2**

Objects of finishing and typical flow diagrams for wool and cotton. The principles and technology of textile finishing processes for protein and cellulosic fabrics, including the removal of impurities and discoloration, the elimination or minimisation of deficiencies in properties, the development of specific properties. Properties of surfactant solutions, micelle formation, surfactants as emulsifiers and detergents, detergency. Manufacture, chemical constitution and properties of special purpose polymers.

TEXT3601 Colour Science **SS L2 T1**

Aspects of colour, colour mixing and colour vision. Absorptiometry, spectrophotometry and tristimulus colorimetry. Measurement and specification of colour and colour difference. Applications of colour measurement. Computer aided colour match prediction.

TEXT3801 Textile Engineering 1 **SS L2**

The application of engineering principles to textile machines and processes including elements of strength of materials; mechanics of solids; mechanical transmission of power; applied electricity; illumination design; process control. Analysis of engineering interactions in textile processes.

TEXT4001 Textile Industry Studies **SS L T3**

Econometrics of the textile and clothing industries. Models of production, import and export and consumption of textiles and clothing in Australia, and comparison with world data. Case studies in textile and clothing manufacture operations. Recent developments in fabric forming technology. Environmental considerations in relation to pollution from the textile industry. Wastewater treatment methods. Biodegradable polymers. The employment function of the textile and clothing industries. Social and political consequences of automation: polarisation

of workforce into highly-skilled and unskilled workers; conflict between maintaining a viable industry and maintaining employment levels.

TEXT4003 Project **F T7**

Students are required to carry out a research project and to submit a thesis describing their investigations. It is usual for students to be allocated projects in areas related to the particular course option they are studying.

TEXT4013 Seminar **F T1.5**

Students prepare and present a seminar before an audience consisting of staff of the Department, final year students, Graduate Diploma students, and any other interested undergraduate or postgraduate students, on a subject of topical and specific interest in the field of textile science, technology or management, and subsequently submit the seminar in writing.

TEXT4101 Textile Structures 2 **SS L1 T2**

Structural mechanics of woven, knitted and non-woven fabrics. Composite materials, fabric membrane properties. Clothing mechanics. Fabric rheology. Physical equilibration processes. Wrinkling properties. Clothing comfort and physiology. Thermal insulation. Diffusion of moisture. Heat and mass transfer. Capillary action of textiles.

TEXT4111 Advanced Textile Physics **SS L2**

Varieties of macromolecules. Polymeric solids. Nature of water and water theories. Generalized structural mechanics of textile assemblies. Yarn bending properties. Development of torque in twisted yarns. Structure of complex knitted fabrics. Tensile properties of woven and knitted fabrics. Warp-knitted structures. Fabric bending properties. Fabric shear properties. Fabric objective measurement technology.

TEXT4201 Processing Laboratory **SS T3**

Students undertake a project involving the design, production and assessment of textile products. Such as: rib jacquard outer fabric, towelling, printed tea towels, woven furnishing fabric, raschel outerwear fabric, etc.

TEXT4801 Textile Engineering 2 **SS L3 T1**

Thermodynamic principles and applications in textile processing including laws of thermodynamics; states and processes; fluid properties. Cycles and efficiency. Properties and use of steam. Air conditioning. Heat transfer. Flow of fluids. Energy use in textile processes. System dynamics in textile processes and procedures.

TEXT4501 Finishing Technology B **SS L2 T2**

The production of specified dimensions in textile fabrics; heat, chemical and mechanical processes, surface finishes, protective finishes. The application of special finishes including flame-proof finishes, crease-resistant finishes, etc. Dimensional stability and its measurement. Recent developments in finishing technology.

TEXT4601 Colouration Technology **SS L2 T2**

Classification of dyes and pigments and their methods of application. General properties of dyes, dyeing auxillaries and after treatments. Assessment of colourfastness properties of dyes and pigments. Mill water supplies and their treatment. Aspects of dyehouse effluent treatment. Textile printing methods. Textile dyeing machinery. Textile printing methods. Recent developments in dyeing and printing technology.

TEXT4611 Advanced Textile Chemistry **L1 T1**

Dyestuff aggregation in the dyebath and in the fibre. Fibre structure and dye sorption. Physical chemistry of dyeing; dyeing equilibria and dyeing kinetics of selected dye-fibre systems.

TEXT4711 Advanced Textile Management **SS L2**

Government policy in the textile, clothing and footwear industries. Production and marketing in the Australian environment. Case studies in management of textile operations.

Thermodynamic principles and applications in textile processing including laws of thermodynamics; states and processes; fluid properties. Cycles and efficiency. Properties and use of steam. Air conditioning. Heat transfer. Flow of fluids. Energy use in textile processes. System dynamics in textile processes and procedures.

TEXT4811 Advanced Textile Engineering **SS L2**

Dimensional analysis and theory of similitude. Heat and mass transfer. Drying. Motion of particles in fluids. Pumps and fans. Mechanics of machines.

Graduate Study

Department of Wool and Animal Science

WOOL5113 Livestock Production **F L2 T4**

Biology of reproduction and reproductive performance of sheep and cattle; growth and body composition; meat production and quality.

WOOL5213 Range Management **F L1 T3**

Objectives in the utilization and management of rangelands. Ecology of rangelands, with emphasis on the impact of grazing. Degradation of rangelands. Morphology and physiology of range plants in relation to management. Grazing management. Burning as a management practice. Assessment of range condition and trend. Applications of remote sensing. Sheep and cattle production in arid and semi-arid environments. Native and feral animals and their management. Diet selection of different species. Administration of rangelands. Assignment work and field studies, including a week at Fowlers Gap Arid Zone Research Station.

WOOL5223 Project in Range Management **F T9**

A theoretical and or experimental investigation of some aspect of management of rangelands.

WOOL5513 Wool Science **F L2 T4**

Biology and histology of fibre growth and fibre structure. Wool physics and chemistry. Objective characteristics of the Australian wool clip. Preparation for sale, measurement, specification, valuation and marketing of wool. Wool metrology and conditioning house procedures. Fibre parameters in processing.

WOOL5813 Animal Breeding **F L2 T2**

Co-requisite: WOOL3803.

Definition of breeding objectives; case studies of production recording and breed improvement programs for sheep and beef cattle. Development of performance recording systems: choice of traits to be recorded, recording and processing methods. Estimation of breeding value from performance records. Breed evaluation. Optimal design for breeding programs. The impact on genetic improvement of techniques for controlling reproduction.

WOOL5913 Quantitative Methods **F L2 T2**

Selected topics in: biostatistics, with emphasis on experimental design and on least squares procedures; mathematical programming methods for rural industries; data processing and computer programming; systems analysis and simulation methods.

Department of Textile Technology

TEXT5001 Textile Technology Dissertation **F T1.5**

Students review a particular aspect of textile technology, by conducting a literature survey and conferring with experts. The review is presented orally to the staff and students of the department, and submitted in written form.

TEXT5003 Textile Technology **F T1.5**

Students gain an overview of textile technology by reviewing the technology relating to one or more textile products, through a series of tutorials and exercises.

TEXT5101 Fibre Science A **SS L4 T2**

Fibre classification and raw materials. Necessary and desirable attributes of textile fibres. Production of natural and man-made fibres. Physics and chemistry of natural and man-made fibres. Introduction to fibre morphology and fibre structure. Introductory statistics and sampling theory. Basic techniques for the measurement of fibre properties. Fibre transverse dimensions and length. Practical fibre identification. World production and consumption of textile fibres.

TEXT5102 Fibre Science B **SS L2 T2**

Fibre microscopy. Electron microscopy. Fibre reflection and lustre. X-ray Morphological and fine structure of fibres. Crystallography. Polymer crystallisation. Molecular structure of proteins. Optical properties and fibre orientation. Infra-red spectroscopy. Fibre rheology. Mechanical properties. Moisture sorption and swelling. Addition and condensation polymerisation. Chemical constitution and reactivity of blended fibres and manmade fibres.

TEXT5201 Textile Quality Control **SS L T2**

User-seviceability testing. Fibre content and care-labelling. Process and quality control. Consumer problems.

TEXT5301 Yarn Technology A **SS L3 T2**

The preparation of staple fibres for yarns and non-woven fabrics: processes for tow conversion, opening, cleaning, blending, carding, drawing, and combing. Short-staple, worsted and woollen preparation systems. Computer blend selection; drafting theory; theory and measurememt of irregularity; levelling of slivers.

TEXT5302 Yarn Technology B **SS L3 T2**

Properties of yarns. Introduction to geometry and mechanics of twisted structures. Staple yarn forming by ring, rotor and unconventional spinning methods. Twisting and winding processes. Throwing and texturing of continuous filament yarns. On-line monitoring of production and quality; automation. Measurement of yarn properties.

TEXT5401 Fabric Technology A **SS L3 T2**

Principles of weaving. Mechanisms of shedding, picking, and beating up. Secondary and auxilliary mechanisms of looms. Cam, dobby and jacquard shedding. Shuttle, projectile, rapier and jet weft insertion. Multiphase weaving, circular weaving, woven cloth construction principles and weave represenation; basic weave structures. Leno and narrow fabric weaving, woven pile fabric constructions. Yarn preparation for weaving. Mechanics of woven fabric formation. Introduction to knitting technology.

TEXT5402 Fabric Technology B **SS L3 T2**

Principles of knitting. Techniques of loop formation in weft and warp knitting; essential machine mechanisms. Knitted cloth construction principles and knitted structure representations; knitted structures. Techniques of jacquard needle selection and loop transfer for extended design effects in weft knitting; derivative weft knitted structures. Shaped weft knitted structures, including fully-fashioned knitting, hosiery manufacture, integral knitting techniques. Use of multiple guide bars, part-set threading, and auxillary mechanisms for extended design effects in tricot and raschel warp knitting; derivative warp knitted structures. Double needle bed warp knitting. Mechanisms of knitting fabric formation. Stitch-bonded and non woven fabric manufacture. Tufting; recent developments in fabric forming technology.

TEXT5501 Finishing Technology A **SS L3 T2**

Objects of finishing and typical flow diagrams for wool and cotton. The principles and technology of textile finishing processes for protein and cellulosic fabrics, including the removal of impurities and discoloration, the elimination or minimisation of deficiencies in properties, the development of specific properties. Properties of surfactant solutions, micelle formation, surfactants as emulsifiers and detergents, detergency. Manufacture, chemical constitution and properties of special purpose polymers.

TEXT5502 Finishing Technology B **L2 T3**

The production of specified dimensions in textile fabrics; heat, chemical and mechanical processes, surface finishes, protective finishes. The application of special finishes including flame-proof finishes, crease-resistant finishes, etc. Dimensional stability and its measurement.Recent developments in finishing technology.

TEXT5601 Colour Science **SS L2 T2**

Aspects of colour, colour mixing and colour vision. Absorptiometry, spectrophotometry and tristimulus colorimetry. Measurement and specification of colour and colour difference. Applications of colour measurement. Computer aided colour match prediction.

TEXT5602 Dyeing Technology **SS L2 T2**

Classification of dyes and pigments and their methods of application. General properties of dyes, dyeing auxillaries and after-treatments. Assessment of colourfastness properties of dyes and pigments. Mill water supplies and their treatment. Aspects of dyehouse effluent treatment. Textile printing methods. Textile dyeing machinery. Recent developments in dyeing and printing technology.

School of Geography

Head of School
Professor B. J. Garner

Administrative Assistant
Ms. T. Bean

Geographers study the spatial relationships of the phenomena which form humans' physical and social environment, and aim to establish principles which govern those relationships. The geographer may concentrate on specific variables, as in systematic geography, or may deal with variables which affect a specific area, as in regional geography.

The cultural significance of geography lies in its contribution to an understanding of the total environment, but the geographer's skills also find practical application in the conservation and planned development of resources. Increasing numbers of geographers are employed as professionals in these applications. For instance, geomorphologists and biogeographers are undertaking resource inventory surveys and environmental assessment, and economic geographers are engaged as urban and regional planners and spatial analysts.

General Education Electives

For details of the General Education requirements see Faculty Information.

Staff

Associate Professor and Head of School
John Richard Dodson, MSc *Monash*, PhD *A.N.U.*

Professor of Geography
Barry Jardine Garner, BA *Nott.*, MA PhD *Northwestern*

Associate Professors
Ian Harry Burnley, MA *Cant.*, PhD *Well.*
Anthony Kinnaird Milne, BA *N.E.*, MA *Syd.*, PhD *Colorado*

Senior Lecturers
Stephen James Filan, BAgEc *N.E.*, MSc *N.S.W.*
Marilyn Dale Fox, BSc *Windsor*, PhD *Macq.*
Michael Dick Melville, BScAgr PhD *Syd.*
Morgan Eugene Cyril Sant, BA *Keele*, MSc PhD *Lond.*
Andrew Kerr Skidmore, BSc PhD *A.N.U.*
Peter Leon Simons, BA PhD *Syd.*
Susanne Rae Walker, MA *Well.*, DPhil *Oxf.*

Lecturers
Wayne David Erskine, BA PhD *N.S.W.*
Allan Evans, BSc *Alta.*
Bruno Peter John Parolin, BA *Monash*, MS *Oklahoma State*, PhD *Ohio State*, MIAG, MAAG, MRSA
Ian Phillip Prosser, BSc *N.S.W.*, PhD *A.N.U.*
Qiming Zhou, BSc *Beijing Normal*, PhD *N.S.W.*

Tutors
David John Edwards, BSc *N'cle. (N.S.W.)*
Raya Gadir, *BA DipEd Hebrew Jerusalem.*, PhD *N.S.W.*
Beverley Ann Scott, BA *Macq.*

Administrative Assistant
Toni Bean

Centre for Remote Sensing

In association with the Faculty of Engineering.

Director
Associate Professor B. C. Forster

Deputy Director
Associate Professor A. K. Milne

Professional Officer
Arthur Mark Hall, BSc *N.E.*

Laboratory Manager
John Charles Klingberg, BSc *Darling Downs I.A.E.*, GradDip *N.S.W.*

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

Course Outlines

Undergraduate Study

The three vocationally-oriented Applied Geography programs **3010** in the Faculty of Applied Science provide an analytical approach to understanding and investigating some of society's most pressing problems, including the use and management of scarce resources, the interaction between people and environment, soil erosion and conservation, land use conflicts, and spatial inequalities in economic and social well-being. These courses provide elective specialisations in physical geography (with special emphasis on either the biologic or geomorphic aspects), economic geography with emphasis on spatial analysis, and in human and physical resources (with emphasis on the integration of human and physical geography).

Geography is also available as a major sequence in the Arts course **3400**, where the emphasis is on the study of where and how people live, and on their activities in relation to the environment.

Major sequences in Science and Mathematics course 3970, programs **2700** and **6581** study the relationships between people and the physical environment, combining geographical studies, particularly in physical geography, with those in related disciplines, notably the biological and earth sciences.

Geography may also be combined with Civil Engineering in course **3730**, and with Law in course **4770**.

Students may enrol through the School of Geography for higher research degrees, or for formal graduate courses such as the Master of Applied Science in Geographic Information Systems **8024**; Masters' and Diploma courses in Remote Sensing **8026** and **8056**, or Masters' and Diploma courses in Rangeland Management **8025** and **5025**, Masters' in Environmental Managment **8046** and may undertake projects in the School as part of the Master of Environmental Studies degree **8045**.

Applied Geography - Full-time Courses

Bachelor of Science

The School offers three four-year full-time courses leading to the award of the degree of Bachelor of Science, which aim to train professional geographers for entry into applied fields.

There are elective specializations in physical geography (with special emphasis on either the biologic or geomorphic aspects), economic geography (with emphasis on urban and regional analysis), and in human and physical resources with emphasis on the integration of physical and human geography). First year subjects involve systematic studies of the physical and economic bases of geography. There is progressive specialization in the following years, with heavy emphasis on field observation and data handling. For the award of the degree at Honours level students will be required to have distinguished themselves in coursework, in additional assignments as directed by the Head of the School, and in the final year project for which a Report will be required.

All students are encouraged to spend a period of four to six weeks with organizations concerned with the investigation and planned use of resources et cetera.

Several units in Geography include laboratory and project work involving the use of computer and quantitative techniques. It is required that students provide their own drawing materials such as tracing and graph paper. Details of exact requirements are given at the beginning of the relevant subjects. Compulsory fieldwork incurs personal expenditure and for some subjects a charge is made for notes and materials.

3010.1000/2000/3000
Applied Geography - Full-time Course

Bachelor of Science
BSc

Applied Physical Geography, Applied Economic Geography and Human and Physical Resources

Year 1	All Strands	Hours per week S1	S2
MATH1011	General Mathematics 1B *and*	6	0
MATH1021	General Mathematics 1C *or*	0	6
MATH1032	Mathematics 1 *or*	6	6
MATH1042	Higher Mathematics 1	6	6
GEOG1000	Field Project 1	4	0
GEOG1043	Data Processing Systems	4	0
GEOG1044	Data Display Systems	0	4
GEOG1051	Global Environmental Problems and Processes	3	0
GEOG1062	Australia and Global Development	0	3
and either			
ECON1101	Microeconomics 1 *and*	3.5	0
ECON1102	Macroeconomics 1 *and*	0	3.5
GEOG1022	Locational Processes	0	4
or			
BIOS1011	Biology A *and*	6	0
BIOS1021	Biology B *and*	0	6
GEOG1031	Environmental Processes	0	4
or			
GEOL1101	Geological Processes* *and*	6	0
GEOL1201	Geological Environments* *and*	0	6
GEOG1031	Environmental Processes	0	4
		20.5/23	20.5/23

*Up to 1 day of field tutorials in GEOL1101 and up to 3 days in GEOL1201 are essential parts of these subjects. Attendance is compulsory.

Note: Students will incur personal costs in connection with the field work component. Details will be provided at enrolment.

Applied Physical Geography (3010.1000)

Year 2

		Hours per week S1	S2
GEOG2000	Field Project 2	1.5	1.5
GEOG2013	Geographic Data Analysis	4	0
GEOG2021	Introduction to Remote Sensing	0	4
GEOG3021	Biogeography	4	0
GEOG3051	Soils and Landforms	0	4
GEOG3122	Geographic Information Systems	0	4
GEOG3211	Australian Environments and Natural Resources	4	0
and either			
GEOL2111	Earth Materials 1 *and*	6	0
GEOL2211	Earth Materials 2*	0	6
or any two of the following			
BIOS2021	Introductory Genetics	6	0
BIOS2031	Biology of Invertebrates	0	6
BIOS2051	Flowering Plants	0	6
BIOS2061	Vertebrate Zoology	6	0
BIOS3101	Australian Ecosystems and Community Analysis	0	6
and for all students			
	General Education Subject/s (Category A)	2	2
		21.5	21.5

*Field work of up to 3 days, equivalent to 7 tutorial hours, is an essential part of this subject.

Note: Students will incur personal costs in connection with the Field Project.

Year 3

GEOG2032	Geomorphology	0	4
GEOG3000	Field Project 3	1.5	1.5
GEOG3011	Pedology	0	4
GEOG3032	Remote Sensing Applications	4	0
GEOG3062	Environmental Change	4	0
GEOG3082	Project Design and Formulation	0	3
GEOG3142	Geographic Information Systems Applications	4	0
and either			
CHEM1101	Chemistry A *or*	6	0
CHEM1401	Introductory Chemistry A	6	0
or one of the following			
BIOS3061	Environmental Botany *or*	6	0
BIOS3101	Australian Ecosystems and Community Analysis	0	6
GEOL7321	Geology for Geomorphologist and Pedologists	2	4
and for all students			
	General Education Subject/s (Category B)	2	2
		15.5/ 17.5/ 21.5	14.5/ 18.5/ 20.5

Note: Students will incur personal costs in connection with the Field Project.

Applied Economic Geography (3010.2000)

Year 2

		Hours per week S1	S2
ECON2103	Applied Microeconomics	0	4
ECON2104	Applied Macroeconomics	4	0
GEOG2000	Field Project 2	1.5	1.5
GEOG2013	Geographical Data Analysis	4	0
GEOG2052	Project in Spatial Analysis	0	4
GEOG2061	Regional Theory	4	0
GEOG2071	Transport and Land Use	4	0
GEOG2092	Australian Social and Economic Landscapes	0	3
GEOG3122	Geographic Information Systems	0	4
and			
	General Education Subject/s (Category A)	2	2
		19.5	18.5

Note: Students will incur personal costs in connection with the Field Project.

Year 3

GEOG2041	Mathematical Methods for Spacial Analysis	4	0
GEOG3000	Field Project 3	1.5	1.5
GEOG3082	Project Design and Formulation	0	3
GEOG3101	Sample Surveys and Analysis	0	4
GEOG3172	Spatial Population Analysis	4	0
plus two of the following			
GEOG2021	Introduction to Remote Sensing	0	4
GEOG3132	Marketing Geography	4	0
GEOG3142	Geographic Information Systems Applications	4	0
GEOG3152	Social Welfare and Urban Development	0	4
GEOG3333	Special Topic	2	2
plus two of the following			
	(one each session)		
ECON2108	Industry Economics and Australian Industrial Policy	0	3
ECON2117	Economics of Tourism	3	0
ECON2127	Environmental Resources and Cost Benefit Analysis	0	3
ECON3115	Economics of Developing Countries	3	0
and			
	General Education Subject/s (Category B)	2	2
		18.5	17.5

*One subject may be substituted for those listed with permission of Head of School.
Note: Students will incur personal costs in connection with the Field Project.

Human and Physical Resources (3010.3000)

Year 2		Hours per week S1	S2
GEOG2092	Australian Social and Economic Landscapes	0	3
GEOG2000	Field Project 2	3	0
GEOG2013	Geographical Data Analysis	4	0
GEOG3122	Geographic Information Systems	0	4
GEOG3021	Biogeography	4	0
GEOG3051	Soils and Landforms	0	4
and either			
ECON2103	Applied Microeconomics *and*	0	4
ECON2104	Applied Macroeconomics *and*	4	0
GEOG3333	Special Topic	2	2
or			
GEOL2111	Earth Materials 1 *and*	6	0
GEOL2211	Earth Materials 2*	0	6
or two of			
BIOS2031	Biology of Invertebrates	0	6
BIOS2051	Flowering Plants	0	6
BIOS2061	Vertebrate Zoology	6	0
and			
	General Education Subject/s (Category A)	2	2
		19	19

*Field work of up to 3 days, equivalent to 7 tutorial hours, is an essential part of this subject.
Note: Students will incur personal costs in connection with the Field Project.

Year 3			
GEOG2021	Introduction to Remote Sensing	0	4
GEOG3000	Field Project 3	3	0
GEOG3062	Environmental Change	4	0
GEOG3082	Project Design and Formulation	0	3
GEOG3172	Spatial Population Analysis	0	4
plus two of the following			
GEOG2032	Geomorphology	0	4
GEOG3011	Pedology	0	4
GEOG3032	Remote Sensing Applications	4	0
GEOG3132	Marketing Geography	4	0
GEOG3142	Geographic Information Systems Applications	4	0
GEOG3152	Social Welfare and Urban Development	0	4
and either two of the following			
ECON2109	Economics of Natural Resources	0	3
ECON2117	Economics of Tourism	3	0
ECON2127	Environmental Resources and Cost Benefit Analysis	0	3
or one of the following			
GEOL7321	Geology for Geomorphologists and Pedologists	2	4
BIOS3061	Plant Ecosystem Processes	6	0
BIOS3101	Australian Ecosystems and Community Analysis	0	6
and for all students			
	General Education Subject/s (Category B)	2	2
		15/ 16/ 17	21/ 20/ 17

Note: Students will incur personal costs in connection with the Field Project.

Applied Physical Geography, Applied Economic Geography and Human and Physical Resources.

Year 4	All Strands	Hours per week S1	S2
GEOG3042	Environmental Impact Assessment	0	4
GEOG4010	Field Project 4	0	8
GEOG4031	Project	16	0
GEOG4042	Practical Applications†	3	0
GEOG4052	Advanced Spatial Analysis*	0	4
GEOG4062	Advanced Environmental Analysis*	0	4
		19	20

*Up to two subjects may be substituted from those offered by the School of Geography, Department of Applied Geology or School of Biological Sciences, subject to approval by the Head of School.
Note: Students will incur personal costs in connection with project work in the final year of study.

†This subject contributes towards satisfaction of the Category C General Education requirement.

Graduate Study

8024
Graduate Program in Geographic Information Systems

Master of Applied Science
MAppSc

The Masters degree program in Geographic Information Systems is offered in both Geography and Geology within the Faculty of Applied Science. Entry into either discipline depends on the background of the applicant and the orientation of the proposed program.

Entry qualifications. Four-year Honours degree of appropriate standard in Geography, Geology, Surveying, or a relevant environmental science.

Course requirements. Candidates are required to complete a course totalling 30 credits (1 credit equals 1 hour per week for one session), made up of compulsory subjects, elective subjects and a project. The degree will normally comprise one year of full-time study or two years of part-time study.

Compulsory Subjects		Credits
GEOG9240	Principles of Geographical Information Systems	3
GEOG9241	Advanced Geographical Information Systems	3
GEOG9330	Spacial Data/Processing and Integration	3
Elective Subjects		
GEOG9150	Remote Sensing Applications	3
GEOG9210	Computer Mapping and Data Display	3
GEOG9250	Special Topic	3
GEOG9280	Applications and Management of GIS	3
GEOG9290	Image Analysis in Remote Sensing	3
SURV9532	Computer Assisted Mapping	3
SURV9600	Principles of Remote Sensing	3
SURV9602	Remote Sensing Procedures	3
SURV9604	Land Information Systems	3
SURV9608	Cadastral Systems	3
Project		
GEOG9509	Project *OR*	9
GEOG9512	Project	12

Note: Other subjects may be substituted for those listed with permission of the Course Coordinator to suit the specific needs of individual students.

Graduate Programs in Rangeland Management

General

The University has considerable experience of research and teaching relating to the management of arid zone rangelands, gained over many years by several of its schools. This experience is now used in the provision of these graduate programs based at the University campus in Kensington, Sydney, but also providing for the use of its field station resources including Fowlers Gap Arid Zone Research Station in western New South Wales.

Programs by coursework are available leading to the award of:

Master of Applied Science in Rangeland Management	Course **8025**
Graduate Diploma in Rangeland Management	Course **5025**

Entry qualifications
Masters degree course - Four-year degree at an appropriate standard in an appropriate discipline. Graduate Diploma course - Three-year degree from an approved university or qualifications deemed appropriate by the Faculty of Applied Science.

Course requirements
Candidates are required to complete a program totalling 30 credits for the Masters degree or 24 credits for the Graduate Diploma during one year of full-time study or two years of part-time study. 1 credit equals approximately 1 hour of class contact per week for one session. Students will be expected to devote an additional 15 hours per week outside lectures to independent study, fieldwork and completion of assignments.

Course structure
All students are required to complete the core of compulsory subjects which for the Masters degree includes a 9 credit Project. Students then complete the requirements for their Course by selecting the appropriate number of credits from the list of available subjects. Additional subjects may be selected with the permission of the Course Coordinator. In this way students have the flexibility to tailor the Course to suit their individual needs.

8025
Rangeland Management Graduate Course

Master of Applied Science
MAppSc

Compulsory Subjects		Credits
WOOL5213	Range Management	3
GEOG9320	Soil degradation and Conservation	3
GEOG9509	Project *OR*	9
WOOL5223	Project	9
Optional Subjects		
Choose subjects totalling 15 credits from the following list.		
CIVIL9842	Groundwater Hydrology	3
CIVIL9875	Hydrological Processes	3
WOOL5113	Livestock Production	12
ECON2109	Economics of Natural Resources	3
GEOG9150	Remote Sensing Applications	3
GEOG9240	Principles of Geographic Information Systems	3

		Credits
GEOG9310	River Managment	3
GEOG9130	Soil Studies for Arid Lands Management	3
GEOG9300	Vegetation Management	3
BIOS3014	Ecological Studies in Arid Lands Management	3

Additional subjects may be substituted with the permission of the Course Coordinator.

5025
Rangeland Management Graduate Diploma Course

Graduate Diploma
GradDip

Compulsory Subjects		Credits
WOOL5213	Range Management	3
GEOG9320	Soil Degradation and Conservation	3

Optional Subjects

Choose subjects totalling 18 credits, to include at least 9 credits of graduate level subjects.

CIVIL9842	Groundwater Hydrology	3
CIVIL9875	Hydrological Processes	3
WOOL2103*	Livestock Production 1	6
WOOL3111*	Livestock Production 2	3
WOOL3203*	Pastoral Agronomy	6
WOOL4113*	Livestock Production 3	6
WOOL5113	Livestock Production	12
ECON2109*	Economics of Natural Resources	3
GEOG3021*	Biogeography	3
GEOG2021*	Introduction to Remote Sensing	3
GEOG3051*	Soils and Landforms	3
GEOG3062*	Environmental Change	3
GEOG9240	Principles of Geographic Information Systems	3
GEOG9130	Soil Studies for Arid Lands Management	3
GEOG9300	Vegetation Management	3
GEOG9310	River Management	3
BIOS3014	Ecological Studies in Arid Lands Management	3

* Undergraduate level subjects.
Additional subjects may be substituted with the permission of the Course Coordinator.

Graduate Programs in Remote Sensing

Programs are available leading to the award of:

Master of Applied Science in Remote Sensing — Course 8026
Graduate Diploma in Remote Sensing — Course 5026

8026
Remote Sensing Graduate Course

Master of Applied Science
MAppSc

The masters degree program in Remote Sensing is offered in both the Faculty of Applied Science and the Faculty of Engineering. Entry into either Faculty depends on the background of the applicant and the orientation of the proposed program.

Entry qualifications. Four-year degree of appropriate standard in engineering, geography, geology, surveying, or in a relevant environmental biological or agricultural science.

Course requirements. Candidates are required to complete a course totalling 30 credits, made up of compulsory subjects, electives, and a project. Compulsory subjects not offered in a particular year may be substituted by an equivalent subject, approved by the appropriate Course Coordinator. The degree will normally comprise one year of full-time study or two years of part-time study.

Compulsory Subjects		Credits
GEOG9150	Remote Sensing Applications	3
SURV9600	Principles of Remote Sensing	3
GEOG9330	Spatial Data Processing and Integration	3
GEOG9290	Image Analysis in Remote Sensing	3

Elective Subjects

GEOG9210	Computer Mapping and Data Display	3
GEOG9240	Principles of Geographical Information Systems	3
GEOG9241	Advanced Geographical Information Systems	3
GEOG9250	Special Topic	3
GOEG9280	Applications and Management of GIS	3
GEOL0110	Geological Remote Sensing*	3
GEOL0310	Image Processing of Spatial Data Sets	3
GEOL0360	Remote Sensing Applications in Geoscience	3
GEOL9581	Microwave Remote Sensing	3
SURV9532	Computer Assisted Mapping	3
SURV9602	Remote Sensing Procedures	3
SURV9605	Ground Investigations for Remote Sensing	3

Project

GEOG9509	Project *OR*	9
GEOL0124	Project *OR*	9

		Credits
GEOG9512	Project *OR*	12
GEOL0114	Project	12

* Students who take GEOL0110 are precluded from taking GEOL0310 *and* GEOL0360.

Note: Other subjects may be substituted for those listed with permission of the Course Coordinator to suit the specific needs of individual students.

5026
Remote Sensing Graduate Diploma Course

Graduate Diploma
GradDip

The graduate diploma program in Remote Sensing is offered in both the Faculty of Applied Science and the Faculty of Engineering. Entry into either faculty depends on the background of the applicant and the orientation of the proposed program.

Entry qualifications. Three-year degree from an approved university and or qualifications deemed appropriate by the relevant faculty.

Course requirements. Candidates are required to complete a program totalling 24 credits or equivalent to 12 hours per week for two sessions of full-time study, made up of compulsory subjects (12 credits) and elective subjects (12 credits). Compulsory subjects not offered in a particular year may be substituted by an approved equivalent subject.

The course will normally comprise one year of full-time study or two years part-time study. One-third of the credits for elective subjects may be from approved undergraduate subjects.

Compulsory Subjects		**Credits**
SURV9600	Principles of Remote Sensing	3
SURV9605	Ground Investigations for Remote Sensing	3
GEOG9150	Remote Sensing Applications	3
GEOG9290	Image Analysis in Remote Sensing	3

Elective Subjects

From the following (or as approved by the relevant Faculty):

ELEC9408	Computer Display Systems and Interactive Instrumentation	3
CIVL9875	Hydrological Processes	3
CIVL9849	Irrigation	3
CIVL9861	Investigation of Ground Water Resources 2	3
CIVL9864	Arid Zone Hydrology	3
CIVL9865	Arid Zone Water Resources Management	3
GEOL9060	Environmental Geology	3
GEOL0200	Geology in Exploration 1	4
GEOL0110	Remote Sensing in Applied Geology	2
GEOL0150	Geology in Exploration 2	2
GEOG9160	Directed Problems in Remote Sensing	3
GEOG9210	Computer Mapping and Data Display	3
GEOG9240	Principles of Geographic Information Systems	3
SURV9211	Introduction to Geodesy	3
SURV9213	Physical Meteorology	3
SURV9532	Computer Assisted Mapping	3
SURV9604	Land Information Systems	3
REMO9581	Microwave Remote Sensing	3

Graduate Programs in Environmental Studies

8045

Master of Environmental Studies
MEnvStudies

This is an interdisciplinary course designed to study the nature of environmental problems and the methodology of evaluation. Emphasis is placed on the development of relevant skills in environmental analysis, management and planning.

The subject matter covers a set of themes: resource use and conservation, pollution abatement, hazard perception and adjustment. Strong attention will be given to environmental impact assessment and conflict resolution.

The course is designed around three broad components for a total of 36 credits (1 credit = 1 hour per week per one session):

- Core subjects Research Project (6 credits)
- Project (9 or 18 credits)
- Electives(12 or 21 credits)

The core subjects and electives will consist of subjects specially designed together with appropriate subjects taken from those offered by a number of Faculties and Boards of Studies within the University of New South Wales. Prerequisites shall be determined by the relevant Subject Authority.

Core Subjects		**Credits**
GEOG9180	Environmental Planning and Evaluation	2
GEOG9260	Medical Aspects	2
GEOG9270	Legislative Aspects	2

Project

GEOG9518	Research Project	18
or		
GEOG9509	Project in Environmental Studies	9

Elective Subjects*

Earth Science - Engineering

MINE1524	Mining Conservation	3
CIVL9847	Water Resources Policy	3
CIVL9851	Unit Operations in Public Health Engineering	3
CIVL9858	Water Quality Management	3
CIVL9868	Public Health Science	3
GEOL3251	Engineering and Environmental Geology	6
GEOL9020	Geopollution Management	3
GEOL9060	Environmental Geology	3
GEOG3011	Pedology	5
GEOG3042	Environmental Impact Assessment	4

		Credits
GEOG9150	Remote Sensing Applications	3
GEOG9160	Directed Problems in Remote Sensing	3
GEOG9170	Remote Sensing Instrumentation and Satellite Programs	3
GEOG9310	River Managment	3
GEOG9320	Soil Degradation and Conservation	3
*Chemistry - Biology**		
CHEM3311	Environmental Chemistry	6
CHEM7325	Toxicology, Occupational and Public Health	6
GEOG9300	Vegetation Management	3
GEOG3021	Biogeography	5
BIOS3061	Environmental Botany	6
CEIC5630	Industrial Water and Wastewater Engineering	3
INDC4110	Water Chemistry	3
FUEL5860	Unit Operations in Waste Management	3
FUEL5910	Atmospheric Pollution Control	3
FUEL5920	Practical Aspects of Air Pollution Measurement and Control	3
*Social-Economic-Planning**		
CIVL9402	Transport, Environment, Community	6
GEOG9120	Settlement in Australia	3
GEOG9210	Computer Mapping and Data Display	3
GEOG9230	Population, Health and Environment	2
GEOG9240	Principles of Geographic Information Systems	3
IROB5901	Organization Behaviour A	3
PLAN0911	Organisation of Town Planning	3
PLAN3214	Environmental Psychology	3
LAND9010	Conservation Studies	3
LAND9111	Landscape Planning	3
LAND9213	Land Systems and Management	4
GSBE1101	Community Noise Control	2
SOCI5306	Technology and Working Life	3
SOCI5316	Urban Studies	3
MNGT0204	Resource Markets and Management	3
MNGT0385	Business Government Relations	3
GEOG9250	Special Topic	3

* Other subjects may be added on approval of Course Coordinator.

8046
Environmental Management

Master of Applied Science
MAppSci

The Masters degree program in environmental management provides an opportunity to focus on the management of key natural resources, particularly soils, rivers, and vegetation. Emphasis is also placed on the application of information technology for planning and decision making.

Entry qualifications. Four year degree of appropriate standard in geography, environmental science, engineering, or in a relevant biological or agricultural science.

Course requirements. Candidates are required to complete a course of study totalling 30 credits (1 credit equals 1 hour per week of class contact for 1 session), made up of compulsory subjects (9 credits), a project (9 credits), and elective subjects (12 credits). Compulsory subjects not available in a particular year may be substituted by an equivalent subject, approved by the Course Coordinator. The degree will normally comprise one year of full-time study or two years of part-time study. Students will be expected to devote an additional 15 hours per week outside lectures and practical classes to independent study, fieldwork, and completion of assignments.

Compulsory subjects		Credits
GEOG9310	River management*	3
GEOG9320	Soil degradation and conservation*	3
GEOG9300	Vegetation management*	3
GEOG9509	Project	9
*Elective Subjects***		
GEOG9150	Remote sensing applications	3
GEOG9240	Principles of Geographic Information Systems	3
GEOG9241	Advanced Geographic Information Systems	3
GEOG9250	Special topic	3
GEOG9270	Legislative aspects	2
KCME4301	Environmental management	3
SURV9600	Principles of remote sensing	3

* Fieldwork forms a compulsory part of these subjects. Students will incur personal costs in connection with the fieldwork components.
** Alternative subjects may be substituted approved by the Course Coordinator.

Subject Descriptions

Undergraduate Study

GEOG1000 Field Project 1 **S2 T4**

A five days field project normally undertaken during the mid-year recess, designed to support teaching in Year 1 Level 1 subjects and to develop basic field methods and skills. Students will incur some personal expenses in connection with this subject, which is a compulsory part of the course.

GEOG1022 Locational Processes **S2 L2 T2**

Basic theoretical constructs for explaining the location of human activity. Concepts of optimal location and spatial competition, geographical variations in the factors of production, economies of scale and agglomeration, transaction costs and locational decision making under conditions of uncertainty. Practical study links theory and problem solving in economic geography.

GEOG1031 Environmental Processes **S2 L2 T2**

Excluded: GEOG1051, GENS4240.

Essential and continuing links between components of the physical environment. Movement of energy and matter in the physical environment, including consideration of Earth's energy balance, the hydrological cycle, nutrient cycles in vegetation and soil, imbalances leading to land degradation and instability, to and movement of materials.

GEOG1043 Data Processing Systems **S1 L2 T2**

Measurement, management, analysis and display of general and spatial data. Basic use of VAX computers; operating systems and file management. EDT editor. Use of software (SPSS^X) for management, processing, analysis and display of data.

GEOG1044 Data Display Systems **S2 L2 T2**

Prerequisite: GEOG1043.

Graphic information processing. Data display in tables, graphs, diagrams and maps. Thematic mapping. Effective use of colour and shading. Design principles and use of symbolism. Multiple-feature displays. Data entry and digitising. Graphics production, thematic mapping and computer-assisted cartography using GIMMS software.

GEOG1051 Global Environmental Problems and Processes **S1 L2 T1**

Prerequisite: Nil. Excluded: GEOG1031.

The subject outlines the principles and processes necessary to appreciate the physical background behind major global-scale environmental problems. Principles and processes include the linkages between the lithosphere, hydrosphere and biosphere, atmospheric circulation, energy and radiation balance and ecosystem function. Problems covered are the issues of desertification, deforestation, 'greenhouse', ozone depletion, energy conservation and pollution.

GEOG1062 Australia and Global Development **S2 L2 T1**

Prerequisite: Nil.

The main concern is the progressive integration of Australia into global capitalism and the developmental and environmental consequences of this process in Australia and Pacific Rim countries and adjacent territories. Topics covered include colonial and dependent development in Australia and resource use; applications of development theory as applied to core-periphery relationships between world financial centres and Australia, and between Australia and Pacific Island territories; transnational organisations and technology transfer and investment in Australia and Pacific countries; the relationship between changing trade patterns, production and development in Australia and Pacific Rim countries; Australia in a future world.

GEOG2000 Field Project 2 **S1 S2 T3**

A five days field project normally undertaken during a recess designed to support teaching in Year 2 subjects in physical and economic geography and to develop more advanced skills in data collection, observation and field methods. Students will incur some personal expenses in connection with this subject, which is a compulsory part of the course.

GEOG2013 Geographical Data Analysis **S1 L1 T3**

Prerequisite: Both GEOG1051 and either GEOG1031 or GEOG1062. Excluded GEOG2093.

Inferential statistics and hypothesis testing in the analysis of spatial data. Methods of sampling, comparing populations and of identifying relationships through correlation, association, regression, time series and classification. Topics covered are applicable to physical and economic geography.

GEOG2021 Introduction to Remote Sensing **S2 L2 T2**

Prerequisite: Successful completion of a Year 1 program in Applied Science, Science or Arts or equivalent as approved by the Head of School.

Principles and technical aspects of remote sensing. Forms of available imagery, their utility and facilities for interpretation. Basic airphoto interpretation techniques relevant to environmental assessment. Introduction to principles of the electromagnetic spectrum, photometry and radiometry. Sensor types, image formation and end products associated with selected satellite programs, including Landsat. Land-cover and land-use interpretation procedures in visual image analysis. Basic procedures in machine-assisted image enhancement.

GEOG2032 Geomorphology **S2 L2 T2**

Prerequisites: GEOG1031 or GEOG1051 or GEOL1201.

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.

GEOG2041 Mathematical Methods for Spatial Analysis **S1 L1 T3**

Prerequisite: MATH1011 and MATH1021 or MATH1032 or MATH1042 and GEOG1043 or FIBR2201.

Selected mathematical methods for the analysis of spatial problems, including applications of calculus in constrained and unconstrained optimisation; mathematical programming methods; network models; input-output analysis; in facility location and allocation problems.

GEOG2052 Project in Spatial Analysis **S2 L1 T3**

Prerequisite: GEOG2041.

Supervised application of quantitive methods in selected projects involving the analysis of spatial data and requires integrated applications of skills in data processing, geographic data analysis, and mathematical methods.

GEOG2061 Regional Theory **S1 L2 T2**

Regional theory and analytical methods with a particular focus on the explanation of the Richardson growth model and the practical application of its components, using Australian data. Capital formation and mobility, labour supply and technological change, assessments of recent changes in the Australian regional economic system. Practical work deals with the measurement and analysis of structural change, accessibility and economic interaction and regional economic welfare.

GEOG2071 Transport and Land Use **S1 L2 T2**

The relationships between transport and land use, mobility, accessibility, and activity systems in urban and rural environments. Emphasis on policy issues and case studies from Australia. Introduction to simple transport-land use models.

GEOG2092 Australian Social and Economic Landscapes **S2 L2 T2**

Prerequisite: GEOG1062.

Analysis of the principal factors and forces shaping the contemporary social and economic landscapes of Australia and the problems arising. Themes include Australia's changing population profile and distribution, the changing face of Australian cities, regional disparities in social and economic well-being, changing patterns of employment and industrial location, and the declining fortunes of rural Australia. Planning and policy responses to the problems of spatial change and reorganisation are emphasised and future scenarios addressed.

GEOG2093 Geographic Methods **S2 L2 T2**

Prerequisites: Both GEOG1051 and either GEOG1031 or GEOG1062. Excluded GEOG2013.

Statistical procedures and field methods used in both human and physical geography. Includes: measures of dispersion; measures of spatial distribution; samples and estimates; correlation and regression; tests for distribution in space; data collection and analysis; field observations. Three days field work is a compulsory part of the subject and students will incur some personal expenses with this.

GEOG2102 Environmental Issues in Australia **L2T1**

Prerequisite: GEOG1051 or GEOG1062.

Not offered in 1992.

Selected issues in Australia demonstrating the impacts of economic growth and development on the natural environment including a consideration of the ways in which economic forces and political factors affect the exploitation and carrying capacity of natural systems. Case studies taken from tourist developments, forestry, agriculture and land degradation, suburbanization, water quality and use, and power generation. Emphasis is placed on the philosophical and factual arguments for environmentally sound planning and resource management practices.

GEOG3000 Field Project 3 **S1 S2 T3**

Prerequisite: One of GEOG3011, GEOG3021, GEOG2032. This prerequisite does not apply to studentgs registered in course 3010.

A five days field project normally undertaken during a recess, designed to support teaching in Year 3 Level III subjects in physical and economic geography and to demonstrate the application of field methods in problem solving and research projects. Students will incur some personal expenses in connection with this subject, which is a compulsory part of the course.

GEOG3011 Pedology **S2 L2 T2**

Prerequisites: GEOG1031 or GEOG1051 and one of CHEM1101 or CHEM1401 or both GEOL1101 and GEOL1201 or both BIOS1011 or BIOS1021.

Methodology of pedogenic studies and the application of these studies to the understanding of soil-landform relationships. Soil physical and chemical properties and their interrelationships, emphasizing clay-mineral structure and behaviour, soil solution chemistry, soil water movement and the application of these properties to elements of soil mechanics. Soil properties in natural, rural and urban landscapes, including assessment of soil fertility, swelling characteristics, dispersibility, erodibility and aggregate stability. Laboratory analysis of soil physical and chemical characteristics with emphasis on properties associated with land capability assessment. Statistical analysis of soil data and its application to mapping. The use of soil micromorphological and mineralogical studies in pedology.

GEOG3021 Biogeography **S1 L2 T2**

Prerequisites: GEOG1031 or GEOG1051 or both BIOS1011 and BIOS1021.

Distribution of taxa. Floras of the Southern Hemisphere with particular reference to Australia. Endemic, discontinuous and relict taxa. Dispersal and migration of species. Origin, evolution and geological history of Angiosperms. The development of the Australian biogeographic element. Study of the recent past to understand present distributions of taxa. The role of humans and climatic change on Australian vegetation. Detection of pattern and association and their causes. Classification, ordination and mapping of vegetation. Ecology of selected Australian vegetation types. Management of vegetation in different climate regimes.

GEOG3032 Remote Sensing Applications **S1 L2 T2**

Prerequisite: GEOG2021 or SURV8711.

Spectral characteristics of natural phenomena and image formation. Ground truthing, collection and calibration. Introduction to computer classification procedures. Multitemporal sampling procedures, image to image registration and map to image registration. Major applications of remote sensing in the investigation of renewable and non-renewable resources to include: soils, geology, hydrology, vegetation, agriculture,

rangelands, urban analysis, regional planning, transportation and route location and hazard monitoring.

GEOG3042 Environmental Impact Assessment S2 L2 T2

Prerequisites: GEOG1031 or GEOG1051 or by permission from Head of School.

Rationale and basic objectives; standardized types of environmental impact assessment EIA, including matrix approach, adopted methods of EIA in Australia. Frequently used assessment and predictive techniques for meteorological, hydrological, biological, socio-economic impacts. Techniques of impact evaluation in terms of socio-economic criteria. Environmental decision making and planning under conditions of uncertainty. Case studies exemplifying procedures, techniques and issues. Trends, changes and possible future developments in EIA. Practical exercises representing components of typical EIAs.

GEOG3051 Soils and Landforms S2 L2 T2

Prerequisite: GEOG3011 or GEOG2032 or GEOG2081 or by permission from Head of School.

Organization 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. Lithoand chrono-stratigraphic use of soils in residual aeolian, fluviatile and coastal deposits.

GEOG3062 Environmental Change S1 L2 T2

Prerequisite: Successful completion of a Year 2 Programme in Applied Science, Science, or Arts or equivalent as approved by the Head of School.

The nature of environmental change on the land, oceans, biosphere and atmosphere. Evolution of the continents, oceans, life and atmosphere. Techniques for environmental reconstruction and chronology building. Quaternary climatic change and modelling. Human impact on the atmosphere and climatic consequences.

GEOG3071 Computer Cartography S1 L2 T2

Theoretical and practical problems in producing thematic maps by computer. Effective use of colour and shading on thematic maps. Design principles. Data entry and digitising. Production of multiple feature displays. Use of symbolism. Emphasis on developing skills in computer cartography through hands-on experience using GIMMS.

GEOG3082 Project Design and Formulation S2 L1 T3

Stages in the design of a research project. Undertaking a literature review relating to the project. Identification and formulation of working hypotheses. Writing up a research proposal. Timetables and planning strategies for project execution and completion.

GEOG3092 Geographic Data Analysis 3 S2 L2 T2

Advanced methods for spatial analysis; case studies; selected topics in applied economic geography with particular reference to urban and regional analysis and planning.

GEOG3101 Sample Surveys and Analysis S2 L2 T2

An introduction to sample survey data collection methods and techniques for the analysis of survey data. Topics include research design methods, questionnaire design and implementation and the analysis of categorical survey data using log-linear, logit and regression approaches.

GEOG3122 Geographic Information Systems S2 L2 T2

Prerequisite: GEOG3161 or by permission from the Head of School. This prerequisite does not apply to students enrolled in course 3010.

An introduction to information systems of particular relevance for geographers with special reference to computer-based systems for resource evaluation. Case study evaluation, application of the MAP and other GIS software.

GEOG3132 Marketing Geography S1 L2 T3

Prerequisite: MARK2042 This prerequisite does not apply to students enrolled in course 3010.

Organization and operation of the marketing function and trends in its performance. Merchandising strategies of wholesalers and retailers and the consequent location patterns of consumer oriented enterprises within cities. Retail feasibility studies and the structure and analysis of market areas in intra-urban areas. Consumer spatial behaviour, including search and decision processes. Shopping centre images and spatial choice models.

GEOG3142 Geographic Information Systems Applications S1 L2 T2

Prerequisite: GEOG3122

Examples of applications of geographical information systems in resources and environmental management and urban and regional analysis. Case studies include the monitoring of land degradation, management of biological and physical resources, environmental conflict resolution, administration of land records, provision of health services, transport and land use planning, marketing and territory assignment. Visits to inspect facilities and activities of key government agencies are included.

GEOG3152 Social Welfare and Urban Development S2 L2 T2

Prerequisite: GEOG2092 or GEOG3202 Note: This prerequisite does not apply to students enrolled in course 3010.

A consideration of welfare aspects of urban development, including social policies and urban structure; social costs and benefits of urban renewal especially in the inner city; growth centres and new towns; distributional aspects of social services; and spatial disparities in social well-being.

GEOG3161 Computer Mapping and Data Display S1 L1 T3

Prerequisites: Successful completion of a Year 1 program in Science or Arts or equivalent as approved by Head of School.

Introduction to theoretical and practical problems in displaying data graphically and constructing thematic maps by computer using the GIMMS mapping package. The emphasis is on developing skills in automated cartography through hands-on experience culminating in the preparation of a folio of maps of selected census data. No previous computing expertise is required.

GEOG3172 Spatial Population Analysis **S2 L2 T2**

Prerequisite: GEOG3202.

Population growth and structure in an international urban and regional context. The components and processes of population change; fertility, mortality and migration set within the framework of demographic transition and development theory. Theories of migration and mobility and of optimal populations. Demographic and social indicators for urban and regional analysis and their implications for inequalities in living conditions, at local, regional, and international scales. The adjustment of immigrant and migrant populations to the urban environment.

GEOG3181 Urban Activity Systems **S1 L2 T2**

Prerequisite: GEOG3202.

Focus is on trip making, movement, and activity patterns in urban areas. Topics include: the activity concept, travel behaviour and urban spatial structure; constraints to individual travel behaviour and activity pattern linkages; the urban transport disadvantaged; public transport problems and issues in Australian capital cities; travel and activity consequences of transport infrastructure developments.

GEOG3192 Urban and Regional Development **S2 L2 T2**

Focus is on the growing importance of recreation and tourism in urban and regional systems. Emphasis is on problems of land use and resource allocation and implications for planning in Australia. Theoretical and practical studies of leisure environments, open space provision, recreational demand, methods of forecasting, management of supply, resort development, economic and environmental impact assessment.

GEOG3202 Australian Social Environments **S1 L2 T2**

Prerequisite: GEOG1062.

Focus is on the interaction between human communities and the built environment in Australia: the effects of the natural environment on the evolution of settlement patterns; detailed analysis of rural and metropolitan social environments. Emphasis on inner city, suburbia, behavioural and social area approaches, and to managerialist and structural theories of social change on areas and their communities.

GEOG3211 Australian Environment and Natural Resources **S1 L2 T2**

Prerequisite: GEOG2032 or GEOG1051.

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.

GEOG3221 Advanced Geographic Methods **S1 L2 T2**

Prerequisites: GEOG2093. Excluded GEOG2013.

Additional quantitative research techniques normally taken by Honours students in their third year. Research organization; computer analysis; collection and organization of data; statistical description; hypothesis testing and sampling; simple and multiple association analysis; nonparametric methods.

GEOG3333 Special Topic **S1 or S2 T4**

Prerequisite: Nil.

Admission by permission to suitable students with good Passes in at least four subjects at Upper Level. A course of individually supervised reading and assignments as an approved topic in Geography not otherwise offered.

GEOG4010 Field Project 4 **S2 T8**

Develop skills in problem formulation and team-based field work. Preparation and presentation of professional quality reports of applied geographical analysis. Define problem, plan strategy for appropriate investigation. Conduct field studies, and report results of investigation. Field work of five days is compulsory. Students will incur some personal expenses in connection with this subject.

GEOG4031 Project **S1 T16**

Prerequisite: GEOG3082.

Implementation of the research proposal in Applied Geography prepared for GEOG3082 Project Design and Formulation under the direction of a supervisor; preparation of a project report.

GEOG4100/GEOG4050 Honours Geography **F**

Prerequisites: Arts students must satisfy Faculty requirements for entry to the Honours Level program and must have obtained at least 54 credit points in Geography subjects, including 12 Level 1 credit points. A minimum cumulative average at Credit level is required for all Upper Level subjects taken which must include GEOG3221.

Details of Honours Geography for science students are available from the School of Geography office.

Students are required: 1. To undertake an original piece of work extending throughout the year and to submit a thesis based upon it. 2. To participate in seminars and fieldwork as notified by the School of Geography.

GEOG4042 Practical Applications in Geography **S1 T3**

Seminars with practitioners in the fields of urban and regional analysis and environmental studies, including environmental impact statements; research proposals; report writing; the roles of government agencies and consultants; and budgeting for research projects; applying for positions and personal skills development.

GEOG4052 Advanced Spatial Analysis **S2 L2 T2**

Selected topics in economic and physical geography chosen to illustrate developments at the frontiers of research in spatial analysis.

GEOG4062 Advanced Environmental Analysis **S2 L2 T2**

Selected topics in the study of human and physical environments, chosen to illustrate contemporary frontiers of research and development in environmental studies.

Graduate Study

GEOG9130 Soil Studies for Arid Lands Management **S1 or S2 L2 T4 C6**

Soil forming processes in arid regions. Physical, ineralogical and chemical characteristics of arid soils, with emphasis on properties significant for land capability. Chemical and physical properties of saline and alkaline soils. Soil response to irrigation, secondary salinization and alkalinization. Classifications and distribution of arid zone soils and their environmental relationships. Field methods and soils survey techniques, statistical analysis of soil data and its application to mapping. Laboratory analyses of physical and chemical characteristics of soils, with emphasis on properties significant for land capability.

Based on GEOG3011 Pedology, with additional reading, tutorials, seminars and practical classes to stress the features of arid zone soils.

The formal component of the above teaching is completed at Kensington. However, a number of tutorial and laboratory hours are devoted to a field-based soil mapping project based at Fowlers Gap Research Station.

GEOG9150 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.

GEOG9160 Directed Problems in Remote Sensing **S2 T3 C3**

A detailed investigation of a particular aspect of remote sensing technology or an area of applications relevant to candidates interests and background.

GEOG9180 Environmental Planning and Evaluation **C2**

Seminars on environmental problems, socio-economic assessment of policies and proposed developments, resource management.

GEOG9210 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 and GIMMS for cartographic manipulation and output.

GEOG9230 Population, Health and Environment **C2**

Relationship between environmental factors and disease morbidity and mortality is examined by consideration of the epidemiological transition in different countries, and the spatial and occupational-specific variation in disease incidence in Australia. Methodology for standardising, testing for significance and data quality.

GEOG9240 Principles of Geographic Information Systems **S1 L1 T3 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.

GEOG9241 Advanced Geographical Information systems **S2 L1 T2 C3**

Prerequisite: GEOG9240

Advanced topics and concepts in GIS research and development. Focus is primarily on vector-based systems. Topics include data models, structures and capture; vector editing and algorithms; errors and data accuracy. Practical exercises based on ARC-INFO; INFO is used for data base management.

GEOG9250 Special Topic **S1 or S2 T3 C3**

Selected topics may be pursued in the forum of individually supervised readings and assignments linked to studies in postgraduate programs offered through the School of Geography.

GEOG9260 Medical Aspects **C2**

Aspects of medicine bearing upon physiological consequences of pollutants. Synergism and antagonisms, photosynthesis and phytotoxicity, metabolic mechanisms; morbidity and mortality surveys; exposure indices. Particular pollutants aldehydes, nitroolefins, carbon monoxide, sulphur dioxide, oxides of nitrogen, hydrocarbons, ozone and oxidants, particulates, carcinogens.

GEOG9270 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 of administration of available law. American experience. Economic and sociological factors.

GEOG9280 Application and Management of Geographical Information Systems **S2 L2 T1 C3**

The process and issues involved in an organisation acquiring, implementing and managing a GIS will be considered using real examples. Applications using GIS in the management of natural resources (forest, park, soil etc), utilities and casdastra at the local, national and global scale will be critically reviewed. The course will involve the practical use of project management tools and the application of GIS to solve a management

problem using ARC-INFO or MAP. INFO is used for database management.

GEOG9290 Image Analysis of Remote Sensing **S1 L1 T1 C3**

Techniques for extracting information from satellite imagery including image enhancement techniques, classification and feature recognition, statistical methods, and related procedures. Emphasis is on applications relating to vegetation cover and natural resource management. Practical work will be undertaken using the ERDAS image processing software.

GEOG9300 Vegetation management **S1 L2 T1 C3**

The subject provides a background in theory and practice in vegetation management, particularly under Australian conditions. It covers the description and measurement of vegetation, vegetation dynamics, vegetation response to perturbation and human impacts, theories, and modelling of vegetation change. A third of the subject is devoted to management strategies of selected vegetation types.

GEOG9310 River management **S1 L2 T1 C3**

The principles of river management including total or integrated catchment management, environmental impact assessment, in-stream uses and hydrogeomorphic behaviour. Issues covered include regulated rivers, interbasin diversions, extractive industries, urbanisation, river engineering, legislative controls and institutional responsibilities. The course develops an understanding of how and why rivers respond to human activities and ways of ameliorating negative impacts. Field work is an essential part of the subject and the Nepean River will be used as a case study of management problems.

GEOG9320 Soil Degradation and Conservation **S2 L2 T1 C3**

Identification, assessment and analysis of the main processes of soil degradation, including the role of climate, vegetation, geomorphology and pedology in controlling the processes. Discussions of appropriate management strategies for reducing degradation and for reclaiming degraded landscapes. Topics include: surface wash, gully erosion, wind erosion, soil acidification, soil structure decline, salinisation, accumulation of toxins and desertification.

GEOG9330 Spatial Data Processing and Integration **L1 T2 C3**

Geographical information systems and remote sensing have many similarities, including geometric rectification, incorporation of reference data into the analysis of GIS and remotely sensed data, accuracy assessment, the form and structure of the data, visual analysis of spatial data and digital processing methods (Boolean overlay, decision support systems, affined transformations and expert systems). These topics will be considered and applied in the laboratory using remotely sensed and GIS data. INFO is used for database management and ARC-INFO, ERDAS and MAP to demonstrate the practical application of the topics.

GEOG9509 Project **S2 T9 C9**

A practical application or investigation in environmental studies or in land classification as a basis for land management or land-use planning: or an investigation of soil degradation in relation to soil-vegetation characteristics and land use; or a comparative review of existing approaches to land evaluation. Involves preparation of a report, and fieldwork at Fowlers Gap Research Station or in another part of arid or semi-arid Australia. Tutorial hours are equivalent contact hours, but also involve fieldwork out of session.

GEOG9512 Project **C12**

An investigation of a problem in remote sensing or geographical information systems which involves an identifiable research-component. Such an investigation should be related to the research interests of particular Schools within the Faculty of Applied Science.

GEOG9518 Research Project **F T9 C18**

As for GEOG9509 Project, but involving more substantial research over a longer period. Tutorial hours are equivalent contact hours, but may also involve fieldwork out of session.

School of Materials Science and Engineering

Head of School
Professor D. J. Young

Administrative Assistant
Mr O. S. Andersen

At the basis of most of the technological advances of recent years, the explosion in new highly sophisticated materials is transforming everything in our manufactured environment, from the humble set of scissors to jet aircraft and America's Cup yachts. New advanced ceramics – lighter, harder and more stable at high temperatures than any metal – are finding applications in motor vehicle engines, electronics components and surgical implants. Manufacturers are looking to these and other sophisticated materials to meet the demands of the new high tech industries (such as lasers, electronics and fibre optics), or in the quest for enhanced fuel economy, durability or fabrication streamlining in their products.

Materials Science has been designated as a primary area for increased investment by the Federal Government in order to meet the expected growth of the materials industry in Australia, particularly in the more sophisticated applications such as electronic and electrical ceramics, high temperature materials, surface coatings, machine tool materials and engineering polymers, increases in the number of graduates and postgraduates are anticipated over the coming decade. In addition, if Australia is to be competitive in the area of advanced materials, the manufacturing industry in this country will have to be developed and restructured, and this can be expected also to create new positions for materials graduates.

The School of Materials Science and Engineering is in a good position to provide the increased numbers of graduates necessary for development of these new initiatives in materials. It is the only school in Australia which offers professional courses in ceramic engineering, metallurgical engineering, and materials engineering as well as providing postgraduate specialization in these fields. The School is extremely well equipped with a wide range of advanced computing, mechanical testing, X-ray, optical and electron microscopy facilities.

Ceramic Engineering and Ceramics

The ceramic industry produces enormous volume and variety of products used in engineering applications, building construction and in our everyday life. As well as the traditional bricks, roof tiles, sheet and container glass and tableware, ceramics have been found essential as abrasives, refractories, enamels and in electrical and electronic applications and nuclear fuels. In may of these cases, ceramic articles make possible the manufacture of other products either by being a key component, such as an electronic or magnetic part, or by forming the material of construction of, for example, a blast furnace or an abrasive wheel. Modern ceramics comprise such a varied and complex group of materials that a high level of training is required to control their manufacture with the required precision and to supervise their proper use. Ceramic engineers are needed in increasing numbers both in Australia and overseas countries and the Department offers the only degree course in Ceramic Engineering in Australasia. The Ceramic Engineering course trains students in the relation between the structure and the properties of ceramic materials, the engineering and process chemistry of their manufacture and the design principles of their use. Careers open to graduates fall into three broad categories. Some go initially into

activities associated directly with production, i.e. the design and layout of plants, supervision of their construction, and control of their operations. Others move into research and development in industrial laboratories or research institutions. The final group enters fields outside of Ceramic Engineering directly, where the graduate's background in materials and engineering is utilised. In all cases, graduates with organizing ability frequently move into managment if they have an interest in this side of the industry.

In Australia, a number of government research organizations are active in ceramic research, e.g. the Australian Nuclear Science and Technology Organization, and the Divisions of Materials Science and Building Research of CSIRO. Investigations with more immediate applications are carried out in industrial laboratories. Even when the basic principles of a process have been worked out in the laboratory, its successful transfer to an industrial scale requires a great deal of effort and expertise. This is an area which offers great scope for further development in Australia.

Graduates in Ceramic Engineering are eligible for membership of the Institution of Engineers, Australia, the Institute of Ceramics Great Britain, the Royal Australian Chemical Institute and the National Institute of Ceramic Engineers, USA.

Metallurgical Engineering

The metallurgical profession has developed in importance in keeping with growth of Australian metal and mineral industries. These industries are recognized as being important to the Australian economy and there is a strong demand for professional metallurgists in all sectors of these industries, as well as manufacturing industry.

Graduate metallurgists have a wide choice of type of employment and location. They may work in production, technical control or development, in metal or mineral producing plants in locations such as Newcastle, Port Kembla, Broken Hill, Mt Isa, Townsville, Gladstone, Port Pirie, Whyalla, Kwinana, Kalgoorlie or Pilbara; or in manufacturing plants, including the automobile, aircraft, construction industries located mainly in the population centres. In the metal industry opportunities for a career in management are excellent, since it is a tradition in this industry that management should be in the hands of technical people. If graduates are inclined towards research and development, they will find considerable scope in various government, university, and industrial research laboratories.

The undergraduate courses in metallurgical engineering and metallurgy are broadly based on engineering and physical sciences and have been designed to prepare graduates for employment in any field of metallurgy within the metal and manufacturing industries or in research institutions.

Graduates in Metallurgical Engineering are eligible for membership of the Institution of Engineers, Australia, the Australasian Institute of Mining and Metallurgy and the Institution of Metals and Materials Australasia.

Students are required to have gained at least sixteen weeks of approved industrial experience before graduation, and to have submitted satisfactory reports on such work. Industrial experience is usually obtained during the long recess periods.

Materials Engineering

Materials Engineering is a new and broad ranging discipline which applies the principles of science and engineering to the design and development of metallic, ceramic and plastic materials and to their manufacture into goods and their subsequent performance in service. It is founded on the relationship between structure and properties an understanding of which permits materials to be engineered to specific end use requirements. Virtually every man-made material is now the subject of study of the Materials Engineer.

Due to an increasing demand for optimised materials, graduates in Materials Engineering are presented with an outstanding range of job opportunities. Many graduates pursue an industrial career either in the materials producing industries, the utilities or manufacturing sector. Materials and process development and selection, supervision of manufacturing and production processes technical trouble shooting and testing are areas in which Materials Engineers are commonly engaged. Alternatively, graduates may pursue a research career, working in laboratories run by materials producing companies, statutory commonwealth government departments. Graduates with an organising ability frequently move into management both in industry and research. Since materials engineering is a broadly-based scientific/engineering discipline, there is considerable flexibility in career selection.

Graduates in Materials Engineering are eligible for membership of the Institution of Engineers, Australia.

Staff

Professor and Head of School
David John Young, BSc PhD *Melb.*, FRACI, FIEAust., MAmerIChE

M.M. Chair of Superconductivity
Shi Xue Dou, BSc PhD *Dal.*

Associate Professor
Charles Christopher Sorrell, BS *Missouri,* MS *Penn.,* PhD *N.S.W.,* FGAA, NICE

Senior Lecturers
Sri Bandyopadhyay, MTech PhD *Monash,* FIEAust
Sidney Blairs, BSc PhD *Manc.,* FIEAust, CPEng
Alan Gordon Crosky, BSc PhD *N.S.W.,* CPEng, MIEAust.
Peter Krauklis, BSc PhD *N.S.W.,* CPEng, MIEAust, MIM, CE
Sviatoslav Antonovich Prokopovich, MSc *N.S.W.,* ASTC, CPEng, MIEAust
John Maurice Wheatley, MA PhD *Camb.,* MWeld *Lond.,* CPEng, FIEAust, FAusWI
David Ronald Young, BScEng PhD *Lond.,* ARSM, AMAusIMM

Lecturers
Alan Keith Hellier, MA *Camb.*, PhD *N.S.W.*, AMIM, AMIMechE, MAusIMM

Honorary Visiting Professor
Max Hatherly, MSc PhD *N.S.W.*, ASTC, CPEng, FTS, FIM

Professional Officers
Frederick Henry Scott, BSc *N.S.W.*, MAIP
John Walton Sharp, BScTech *N.S.W.*

Administrative Assistant
Ole Staer Andersen, Magr *Copenhagen*, MGenStud *N.S.W.*

Course Outlines

Undergraduate Study

Ceramic Engineering and Ceramics

A four-year full-time course in Ceramic Engineering leading to the award of the BE degree, and a six-year part-time course in Ceramics leading to the award of the BSc(Tech) degree, are offered within the School.

3025
Ceramic Engineering - Full-time Course

Bachelor of Engineering
BE

Year 1		Hours per week S1	S2
CHEM1002	Chemistry 1	6	6
MATH1032	Mathematics 1	6	6
MATS1001	Introduction to Materials Industry	2	0
MATS1011	Introduction to Materials Engineering	0	1
MATS1021	Introduction to Computing	0	2
MECH0130	Engineering Drawing and Descriptive Geometry	4	0
MECH0440	Engineering Statics	0	3
PHYS1002	Physics 1	6	6
		24	24

Year 2			
CHEM2011	Physical Chemistry	6	0
CHEM2838	Inorganic Chemistry and Structure for Materials Science	0	5
MATH2021	Mathematics	2	2
MATS1002	Microstructural Analysis	3	0
MATS1032	Materials Engineering 1A	3.5	0
MATS1042	Crystallography & X-ray Diffraction	0	4
MATS1052	Materials Engineering 1B	0	3.5
MATS1062	Mechanical Prop of Materials	4	0
MATS1072	Physics of Materials	3	0
MATS1082	Thermodynamics of Materials 1	0	3
MATS1092	Materials and Design 1	0	2
MATS1102	Numerical Methods	1.5	1.5
	General Education (Category A)	2	2
		25	23

Year 3		Hours per week S1	S2
FUEL0040	Fuel Engineering for Ceramic Engineers	1	1
INDC3070	Instrument and Process Control 1	0	3
MATH2819	Statistics SA	2	2
MATS1113	Ceramic Process Principles 1	2	0
MATS2123	Ceramic Process Principles 2	0	2
MATS2133	Ceramic Raw Materials	2	0
MATS2143	Ceramic Equipment	0	3
MATS2153	Ceramic Processing Lab	3	3
MATS1163	Chemistry of the Solid State	3	0
MATS2173	Chemistry of Ceramic Processes (Units 1 and 2)	2	2
MATS2203	Physico-Chemical Ceramics Laboratory	3	4
MATS2193	Origins of Microstructure (Units 1 & 2)	4	0
MATS1093	Thermodynamics of Materials 2	2	0
	General Education (Category B)	0	4
		24	24

Year 4			
APSE0002	Social Issues in the Applied Sciences†	2	0
CEIC4010	Process Economics 1	1	0
CEIC4020	Process Economics 2	0	1
INDC4070	Laboratory Automation Science	4	0
MATS1244	Management	0	2
MATS2244	Ceramic Process Engineering	2	0
MATS2254	Ceramic Engineering Design	0	2
MATS2264	Sintering of Ceramics	2	0
MATS2274	Mechanical Properties of Ceramics	0	2
MATS2284	Thermal Properties of Ceramics	0	2
MATS1294	Electrical Ceramics	0	3
MATS2304	Project (Ceramic Engineering)	6	6
MATS1464	Materials Seminar	2	2
MATS2324	Materials and Design 3 (Unit 1)	2	0
MATS1534	Design with Brittle Materials	3	0
MINE7341	Mineral Process Engineering	2	0
		26	20

3030
Ceramic Engineering - Part-time Course

Bachelor of Science Technology
BScTech

Stage 1		Hours per week S1	S2
PHYS1002	Physics 1	6	6
MATH1032	Mathematics	6	6
		12	12

†This subject and others in the professional program, contribute towards satisfaction of the Category C General Education requirement.

Stage 2		**Hours per week** S1	S2
CHEM1002	Chemistry 1	6	6
MATS1001	Introduction to Materials Industry	2	0
MATS1011	Introduction to Materials Engineering	0	1
MATS1021	Introduction to Computing	0	2
MECH0440	Engineering Statics	0	3
MECH0130	Engineering Drawing and Description Geometry	4	0
		12	12
Stage 3			
CHEM2011	Physical Chemistry	6	0
CHEM2031	Inorganic Chemistry and Structure for Materials Science	0	5
MATH2021	Mathematics	2	2
MATS1072	Physics of Materials	3	0
MATS1082	Thermodynamics of Materials 1	0	3
	General Education (Category A)	0	2
		11	12
Stage 4			
MATS1002	Microstructural Analysis	3	0
MATS1032	Materials Engineering 1A	3.5	0
MATS1042	Crystallography & X-ray Diffraction	0	4
MATS1052	Materials Engineering 1B	0	3.5
MATS1062	Mechanical Properties of Materials	4	0
MATS1092	Materials and Design 1	0	2
MATS1102	Numerical Methods	1.5	1.5
	General Education (Category A)	0	2
		12	13
Stage 5			
MATS1113	Ceramic Process Principles 1	2	0
MATS2123	Ceramic Process Principles 2	0	2
MATS2133	Ceramic Raw Materials	2	0
MATS2143	Ceramic Equipment	0	3
MATS2153	Ceramic Processing Laboratory	3	3
MATS1163	Chemistry of the Solid State	3	0
MATS1093	Thermodynamics of Materials 2	2	0
	General Education (Category B)	0	4
		12	12
Stage 6			
FUEL0040	Fuel Engineering for Ceramic Engineers	1	1
INDC3070	Instrumentation and Process Control 1	0	3
MATS2173	Chemistry of Ceramic Processes (Units 1 & 2)	2	2
MATS2193	Physico-Chemical Ceramics Laboratory	3	4
MATS2193	Origins of Microstructure (Units 1 & 2)	4	0
MATH2819	Statistics SA	2	2
		12	12

Metallurgical Engineering

A four-year full-time course in metallurgical engineering leading to the award of the BMetE degree (Physical Metallurgy or Process Metallurgy Major) and a six-year part-time course in metallurgy leading to the award of the BSc(Tech) degree are offered within the School.

3125
Metallurgical Engineering - Full-time Course

Bachelor of Metallurgical Engineering
BMetE

Students entering the Bachelor Metallurgical Engineering program may elect to major in either Process Metallury or Physical Metallurgy. Selection of these alternative study programs may be deferred until the end of the second year of full-time study.

The School of Materials Science and Engineering introduced a 'Process Metallurgy' option into its Metallurgical Engineering degree program, starting in 1990. This option is designed to produce graduates with training appropriate to the primary metallurgy industry. It has been established in response to a request from the BHP Company to provide metallurgical education to personnel from all of its steelmaking centres. Students will complete the first one or two years of their degree at their local university engineering school, and then transfer with advanced standing to UNSW. Before selecting UNSW, BHP Company examined metallurgy programs at all Australian institutions.

It is intended that this program will serve the entire primary metallurgy industry. The aluminium industry has indicated its support by offering scholarships to attract additional students into the degree program.

Year 1 of the course consists of physics, chemistry, mathematics and engineering subjects and is essentially the same as that for a number of other engineering and science courses offered in the Faculty of Applied Science. Year 2 introduces Materials Science and Materials Engineering subjects supported by chemistry and mathematics and is common with Year 2 in the full-time Ceramic Engineering and Materials Engineering Courses. Physical Metallurgy and Metallurgical Engineering are introduced in Years 3 and 4. In Year 3 the major strands are supported by other engineering subjects and in Year 4 by a thesis project, seminar and professional electives.

Students are required to have gained at least sixteen weeks of approved industrial experience before graduation, and to have submitted satisfactory reports on such work. Industrial experience is usually obtained during the long recess periods at the ends of Years 2 and 3. During Years 2, 3 and 4 of the course, visits are made to various metallurgical works, and students are required to submit reports on some of these.

Year 1		Hours per week S1	S2
CHEM1002	Chemistry 1	6	6
MATH1032	Mathematics 1	6	6
MATS1001	Introduction to Materials Industry	2	0
MATS1011	Introduction to Materials Engineering	0	1
MATS1021	Introduction to Computing	0	2
MECH0440	Engineering Statics	0	3
MECH0130	Engineering Drawing and Descriptive Geometry	4	0
PHYS1002	Physics 1	6	6
		24	24
Year 2			
CHEM2011	Physical Chemistry	6	0
CHEM2838	Inorganic Chemistry and Structure for Materials Science	0	5
MATH2021	Mathematics	2	2
MATS1002	Microstructural Analysis	3	0
MATS1032	Materials Engineering 1A	3.5	0
MATS1042	Crystallography and X-Ray Diffraction	0	4
MATS1052	Materials Engineering 1B	0	3.5
MATS1062	Mechanical Properties of Materials	4	0
MATS1072	Physics of Materials	3	0
MATS1082	Thermodynamics of Materials 1	0	2
MATS1092	Materials and Design 1	0	3
MATS1102	Numerical Methods	1.5	1.5
	General Education (Category A)*	2	2
		25	23

*Students who have completed two years' study at an approved tertiary institution are exempted from Category A.

Year 3 (Physical Metallurgy Major)			
MATH2819	Statistics SA	2	2
MATS1043	Heat, Fluid and Mass Flow in MaterialsProcessing	3	0
MATS1083	Non-Ferrous Alloys	0	3
MATS1093	Thermodynamics of Materials 2	2	0
MATS1203	Materials and Design 2	2	2
MATS1253	Ferrous Alloys	0	3
MATS1263	Alloy Steels	0	2
MATS4223	Mechanical Behaviour of Materials (Units 1-4 & 6,7)	4	7
MATS4363	Origins of Microstructure	7	3
MINE7341	Mineral Process Engineering	2	0
	General Education (Category B)	2	2
		24	24

Year 4 (Physical Metallurgy Major)			
APSE0002	Social Issues in Applied Science†	2	0
MATS1154	Advanced Materials	3	0
MATS1244	Management	0	4
MATS1464	Materials Seminar	2	2
MATS3484	Welding Science and Technology (Unit 1)	0	1
MATS4104	Metallurgy Project	6	6
MATS4114	Professional Electives	4	4
MATS4134	Stucture and Properties of Metallurgy Phases	0	3
MATS4144	Mechanical and Thermal Processing of Materials	3	0
MATS4324	Materials and Design 3	4	2
		24	22

Year 3 (Process Metallurgy Major)			
FUEL3010	Fuel Engineering 1 (Units 2 to 4)	1	2
INDC3070	Instrumentation & Process Control 1	0	3
MATS1043	Heat, Fluid and Mass Flow in Materials Processing	3	0
MATS1083	Non-ferrous Alloys	0	3
MATS1093	Thermodynamics of Materials 2	2	0
MATS1203	Materials and Design 2	2	2
MATS1253	Ferrous Alloys	0	3
MATS1263	Alloys Steels	0	2
MATS2173	Chemistry of Ceramic Processes (Unit 1 Refractories)	2	0
MATS5203	Origins of Microstructure (Unit 1 Phase Equilibria)	2	0
MATS5213	Metallurgical Plant Practice (Part)	0	2
MATS5223	Mechanical Behaviour of Materials (Unit 4 Metal Forming Processes)	2	0
MATS5253	Metallurgical Reaction Engineering	2	2
MATS5263	Extractive Metallurgy 1	2	5
MINE7341	Mineral Process Engineering	2	0
	General Education (Category B)	4	0
		24	24

Year 4 (Process Metallurgy Major)			
APSE0002	Social Issues in Applied Science†	2	0
MATS1154	Advanced Materials	3	0
MATS1164	Welding Sci and Technology	0	3
MATS1244	Management	0	4
MATS1464	Materials Seminar	2	2
MATS4104	Metallurgical Engineering Project	6	6
MATS5224	Mechanical Behaviour of Materials (Unit 6 Quality Assur & Ctrl)	0	1
MATS5314	Kinetics and Mass Transfer in Metallurgical Processes	3	1
MATS5324	Modelling Metallurgical Processes	0	4
MATS5334	Professional Electives	7	3
MATS5384	Air Pollution Control in the Metallurgical Industry	1	0
		24	24

†This subject and others in the professional program contribute towards satisfaction of the Category C General Education requirement.

3130
Metallurgy - Part-time Course

Bachelor of Science (Technology)
BSc(Tech)

This course is designed for students who are employed in the metallurgical and manufacturing industries and extends over six part-time years of study. Some of the subjects of stages 3, 4, 5 and 6 may be available only in day-time classes, and up to one day of release from industry per week may be required. The course essentially covers the same subject matter as the first three years and part of Year 4 of the full-time Metallurgical Engineering course and involves the same major strands of study in Physical Metallurgy and Metallurgical Engineering. The course has recently been revised. In the later stages of the course, there is less emphasis on primary metallurgy than in the full-time course and there is more emphasis on secondary Metallurgical Engineering which is developed to Year 4 level, while Physical Metallurgy is taken to Year 3 level. Students are required to complete an approved program of industrial training of not less than twelve months prior to the award of the degree. Industrial training should normally be completed concurrently with attendance in the course, but with approval of the Head of School may be completed after completion of the prescribed course of study.

Stage 1		**Hours per week** S1	S2
MATH1032	Mathematics 1	6	6
PHYS1002	Physics 1	6	6
		12	12
Stage 2			
CHEM1002	Chemistry 1	6	6
MATS1001	Introduction to Materials Industry	2	0
MATS1011	Introduction to Materials Engineering	0	1
MATS1021	Introduction to Computing	0	2
MECH0440	Engineering Statics	0	3
MECH0130	Engineering Drawing and Description Geometry	4	0
		12	12
Stage 3			
CHEM2011	Physical Chemistry	6	0
CHEM2838	Inorganic Chemistry and Structure for Material Science	0	5
MATH2021	Mathematics	2	2
MATS1002	Microstructural Analysis	3	0
MATS1072	Physics of Materials	3	0
MATS1082	Thermodynamics of Materials 1	0	3
	General Education (Category A)	0	2
		14	12

Stage 4		**Hours per week** S1	S2
MATS1032	Materials Engineering 1A	3.5	0
MATS1042	Crystallography and X-Ray Diffraction	0	4
MATS1052	Materials Engineering 1B	0	3.5
MATS1062	Mechanical Properties of Materials	4	0
MATS1092	Materials and Design 1	0	2
MATS1102	Numerical Methods	1.5	1.5
	General Education (Category A)	2	0
		11	11
Stage 5			
MATS1083	Non-Ferrous Alloys	0	3
MATS1253	Ferrous Alloys	0	3
MATS4053	Metallographic Techniques	2	0
MATS4463	Origins of Microstructure (Units 1-3)	7	0
MATS7223	Mechanical Behaviour of Materials (Units 1-3 & 4A)	3	4
MINE7341	Mineral Process Engineering	2	0
	General Education (Category B)	0	2
		14	12

Note: * Unit 4A comprises part of Unit 4

Stage 6			
MATS1203	Materials and Design 2	2	2
MATS1464	Materials Seminar	2	2
MATS4144	Mechanical and Thermal Processing of Materials	3	0
MATS1263	Alloy Steels	0	2
MATS1164	Welding Science and Technology	0	3
MATS4204	Industrial Metallurgy Project	3	3
	General Education (Category B)	2	0
		12	12

Materials Engineering

A four year full-time course in materials engineering leading to the award of the BMatE degree is offered within the School.

3615
Materials Engineering - Full-Time Course

Bachelor of Materials Engineering
BMatE

Year 1		**Hours per week** S1	S2
CHEM1002	Chemistry 1	6	6
MATH1032	Mathematics	6	6
MATS1001	Introduction to the Materials Industry	2	0

		Hours per week S1	S2
MATS1011	Introduction to Materials Engineering	0	1
MATS1021	Introduction to Computing	0	2
MECH0130	Engineering Drawing and Descriptive Geometry	4	0
MECH0440	Engineering Statics	0	3
PHYS1002	Physics 1	6	6
		24	24

Year 2

CHEM2011	Physical Chemistry	6	0
CHEM2838	Inorganic Chemistry and Structure for Materials Science	0	6
MATH2021	Mathematics	2	2
MATS1002	Microstructural Analysis	3	0
MATS1032	Materials Engineering 1A	3.5	0
MATS1042	X-Ray Diffraction and Electron Microscopy	0	4
MATS1052	Materials Engineering 1B	0	3.5
MATS1062	Mechanical Properties of Materials	4	0
MATS1072	Physics of Materials	3	0
MATS1082	Thermodynamics of Materials 1	0	3
MATS1092	Materials and Design 1	0	2
MATS1102	Numerical Methods	1.5	1.5
	General Education (Category A)	2	2
		24	24

Year 3

CEIC4010	Process Economics 1	1	0
MATH2819	Statistics SA	2	2
MATS1113	Ceramic Process Principles 1	2	0
MATS1163	Chemistry of the Solid State	3	0
MATS4363	Origins of Microstructure	7	3
MATS1203	Materials and Design 2	2	2
MATS3223	Mechanical Behaviour of Materials (Units 1,2,4,5)	4	3
MATS1253	Ferrous Alloys	0	3
MATS1093	Thermodynamics of Materials 2	2	0
MATS3443	Polymer Science and Engineering	0	6
MINE7341	Mineral Process Engineering	2	0
	General Education (Category B)	0	4
		25	23

Year 4

MATS1083	Non-Ferrous Alloys	0	3
MATS1244	Managment	0	4
MATS1263	Alloy Steels	0	2
MATS1294	Electrical Ceramics	0	3
MATS1464	Materials Seminar	2	2
MATS1534	Design with Brittle Materials	3	0
MATS3324	Materials and Design 3 (Units 1 & 2)	4	0
MATS3484	Welding Science and Technology (Unit 1)	0	1

		Hours per week S1	S2
MATS3524	Materials Engineering Project	6	6
MATS3544	Polymer Engineering	3	3
MATS3554	Professional Electives	4	2
APSE0002	Social Issues in Applied Science†	2	0
		24	26

†This subject and others in the professional program contribute towards the satisfaction of the Category C General Education requirement.

Graduate Study

The School welcomes enquiries from graduates in Science, Engineering and Applied Science who are interested in doing research leading to the award of the degrees of Master of Science, or Doctor of Philosophy in metallurgy or ceramic engineering or who are interested in programs involving formal course work and research leading to the award of Graduate Diploma in Corrosion Technology or Master of Applied Science in Engineering Materials.

Information about research scholarships, fellowships and grants in-aid is available from the Head of School and graduates are advised to consult him before making a formal application for registration.

8065
Engineering Materials

Master of Applied Science
MAppSc

The MAppSc course in Engineering Materials provides a comprehensive study of the full range of materials. The program is designed for graduates wishing to acquire expertise in the selection, use and design capabilities of modern materials. It is particularly appropriate to graduates in other branches of engineering, and to honours graduates in science. A specialist course of study of Corrosion Technology is available as part of the degree, if desired.

The program consists of one year's full-time study. This is made up of a formal time allocation of 18 hours per week, and will normally be supplemented by additional project work during the summer break. The balance between formal lecture courses and project work will be varied to suit individual students' needs.

Compulsory Core		**Hours per week** S1	S2
MATS6475	Materials Science and Engineering	3	3
MATS6485	Materials Technology	3	3
MATS6405	Graduate Materials Seminar	2	2
		8	8
Project			
MATS6555	Minor Graduate Materials Project	3	3
or			
MATS6415	Graduate Materials Project	6	6
or			
MATS6565	Major Graduate Materials Project	9	9

Elective Subjects

Additional subjects are chosen from those offered by the School of Materials Science and Engineering, or from those offered by other Schools ;in the University subject to approval by the Head of School. Full details of all subjects are listed in the University calendar and handbooks.

Depending on the candidate's background, enrolment in a limited number of undergraduate subjects may be appropriate, but may not exceed 15% of the non-project component. In all cases, the total of the compulsory core, project and elective subjects will be a minimum of 18 hours per week.

5010
Graduate Diploma in Corrosion Technology

Graduate Diploma
GradDip

The graduate Diploma course in Corrosion Technology is open to graduates in Engineering, Applied Science of Science who wish to undertake formal studies to promote their careers in industry. At present it may only be taken as a two-year part-time course and is offered every second year.

The course is designed for those professionals in industry who are faced with the problem of combating corrosion. It aim is to develop an appreciation of the fundamentals and principles of corrosion and the available methods of overcoming it. For graduates from Engineering (non-chemical) or Science(in a particular major) a bridging course may be necessary.

Year 1 of the course introduces elementary aspects of corrosion technology and suitably orientates students depending on their initial qualifications. Year 2 of the course contains more detailed instruction at a graduate level in corrosion theory and prevention, together with a suitable project.

Year 1		**Hours per week** S1	S2
MATS6203*	Design for Corrosion Prevention	0	2
MATS6495	Corrosion Materials	3	3
MATS6535	Industrial Coatings for Corrosion Protection	2	0
		5	5

* Unit 1 of MATS1203 Materials and Design 2

Year 2			
MATS1092	Materials and Design 1	0	2
MATS6545	Corrosion Technology	3	3
MATS6005	Corrosion Project	6	6
		9	9

For further information on this course contact Professor D. J. Young, Head, School of Materials Science and Engineering.

Subject Descriptions

Undergraduate Study

APSE0002 Social Issues in Applied Science S1

The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

MATS1001 Introduction to the Materials Industry S1 L1 T1

The roll of materials science and engineering in industry. Engineering materials. Information retrieval. Communication skills. Plant visits. Introductory materials science. Structure and properties of main types of engineering materials with emphasis on the ways in which properties may be controlled by controlling structure.

MATS1002 Microstructural Analysis S1 L1 T2

Specimen preparation techniques. Principles of optical microscopy. Quantitative microscopy and sterology. Electron microscopy. Microchemical analysis.

MATS1011 Introduction to Materials Engineering S2 L1

Metals, ceramics, polymers and composites, their structure, chemical, physical and mechanical properties, engineering applications and production with particular reference to Australian industries.

MATS1021 Introduction to Computing S2 L2

Introductory computing. Outline of computer architecture. Features of common computing languages; syntax, structure, variable typing, portability. Basic syntax. Common numerical techniques, function evaluation, Monte Carlo techniques; assignments involving application of these techniques.

MATS1032 Materials Engineering 1A S2 L1 T2.5

Fluid flow in materials processing. Application of the principles of fluid flow in the production and application of ceramic and metallic materials. Subject examples are drawn from ceramic, materials and metallurgical engineering practice in the broadest sense.

MATS1042 Crystallography and X-Ray Diffraction S2 L2 T2

Introduction to crystallography, crystal structure, Bravais lattices, Miller indices. Miller-Bravais indices. Production, absorption and diffraction of X-rays. Powder and single crystal X-ray methods. Stereographic projections. Applications of diffraction methods to solid solutions and solubility limit. Thermal analysis, stress measurement, X-ray fluorescence spectroscopy chemical analysis.

MATS1043 Heat, Fluid and Mass Flow in Materials Processing S1 L2 T1

Transport processes. Application of transport principles to primary and secondary metallurgical practice. Course examples are drawn from metallurgical engineering practice in the broadest sense. Heat losses from BOS vessels and ladles. Slab cooling in hot strip mills. Interaction of free and submerged gas jets with melts. Accretion, stability, backwall and tuyere erosion. Continuous casting. Solidification in metal and sand moulds. Solute transference between liquid metals and slags. Vacuum and magnesium desulphurisation of steel melts. Lead softening. Cementation. Role of line and point defects on reactivity.

MATS1052 Materials Engineering 1B S2 L1 T1.5

Heat applications of principles of steady and unsteady heat transfer in the production and application of materials. Course examples are drawn from materials engineering practice in the broadest sense. Heat flow in materials processing involving high temperature solid, liquid and gaseous phases. Thermal properties of dense and porous materials. Heat treatment, casting, sintering, corrosion, etc. Computer programs for calculating heat flow in materials.

MATS1062 Mechanical Properties of Materials S1 L2 T2

Prerequisite: MECH0130.

Mechanical properties of solids. Nature and significance of mechanical properties. Mechanical testing; the tension test, hardness testing and impact testing. Stress-strain-time relationships. Analysis of stress and strain, stress and strain transformation relationships, Mohr's circle, elastic stress-strain relationships, application to various types of loading and metal working processes. Failure and yielding criteria. Influence of stress state, temperature, strain rate and environment on mechanical behaviour.

MATS1072 Physics of Materials S1 L2 T1

Pre-requisite: PHYS1002.

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

MATS1082 Thermodynamics of Materials 1 S2 L2 T1

Fundamental principles of the thermodynamics of closed and open systems. Phase equilibria, the stability and composition of coexisting phases. Chemical potential, fugacities and activities of gases and gas mixtures. The thermodynamics of nucleation and growth of precipitates and spinodal decomposition. Order-disorder in phases. Tabular, analytical and diagrammatic representation of thermodynamic properties. Mass and energy balances. Application of thermodynamics to materials properties and preparation.

MATS1083 Non-ferrous Alloys **S2 L1 T2**

Metallography of non-ferrous alloys. Structure/property relationships in non-ferrous alloys. Hardening mechanisms. Metallography and properties of copper, aluminium, nickel, magnesium, lead, tin and titanium based alloys.

MATS1092 Materials and Design 1 **S2 L1 T1**

An appreciation of the relationships between the properties of materials, component design, manufacturing and product performance. Materials selection as an integral part of successful design. Long term potential for materials improvement and substitution. Plant visits to successful materials processing plants.

MATS1093 Thermodynamics of Materials 2 **S1 L2**

Thermodynamic functions of mixing, excess and integral mixing functions. Thermodynamics stability and models of solutions. Long-range order in solutions. Calculation of phase diagrams. Thermodynamics of non-stoichiometric phases. Thermodynamics of surfaces and interfaces, influence of curvature, adsorption and segregation, surface energies. Thermodynamics of polymer solutions. Equilibria in complex systems, surface treatments, materials preparation. Computer programs for materials preparation, reactivity and industrial applications.

MATS1102 Numerical Methods **F L1 T.5**

Finite difference and finite element techniques and their application to materials phenomena involving diffusional transport, elasticity and plasticity.

MATS1113 Ceramic Process Principles 1 **S1 L2**

The nature of ceramics. The scope of the ceramic industry, and principal unit operations. Particle packing: two, three and multi-component systems. Principal unit operations used in the ceramic industry. Drying and firing of ceramics. Glass and other melt forming processes. Hot forming and miscellaneous forming methods.

MATS1154 Advanced Materials

Unit 1 Magnetic Materials **S1 L1**

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.

Unit 2 Heat Resisting Alloys **S1 L1**

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.

Unit 3 Fibre Reinforced Composites **S1 L.5**

Fibre composites, fibre and matrix materials, fabrication. Design with fibre composites. Mechanical properties and environmental effects, corrosion, fatigue, creep and damage tolerance.

Unit 4 Titanium alloys **S1 L.5**

Classification of titanium alloys. Commercial alloys, aerospace and corrosion resistant alloys. Heat treatment, strengthening mechanisms, superplastic forming, forging, powder metallurgy.

MATS1163 Chemistry of the Solid State **S1 L3**

Crystal chemistry; nature of bonding in solids, ionic, and silicate structures; and structure-composition relationships. Glass and glass-ceramics. Reaction with solids, grain boundary and interfacial effects, ceramic reactions and polymorphic transformations (oxides, non-oxides, aluminosilicates).

MATS1164 Welding Science and Technology

Unit 1 Welding Technology **S1 or S2 L1**

Fusion welding and allied processed. Capabilities, advantages and limitations.

Unit 2 Welding Metallurgy **S1 or S2 L1 T1**

Metallurgical aspects of fusion welding and allied processes. Cause of welding defects and weldability of carbon and alloy steels, stainless steels, aluminium and other common non-ferrous alloys. Assessment of welds by mechanical testing and non-destructive methods.

MATS1173 Chemistry of Ceramic Processes

Unit 1 Refractories **S1 L2**

Classification of refractories. Chemical and physical properties of refractories. Introduction to raw materials and manufacturing technology. A detailed study of chemical reactions occurring between refractories and solid, liquid and gas phases in ferrous and non-ferrous metal industry. Review of phase equilibria.

MATS1203 Materials and Design 2

Unit 1 Design for Corrosion Control **S1 L1 T1**

Electrochemical corrosion, types of corrosion, influence of alloying and heat treatment,. influence of stress. Corrosion prevention, cathodic protection, passivation and inhibitors, selection of materials, designing against corrosion.

Unit 2 Surface Treatment and Wear **S2 L1 T1**

Coatings for corrosion prevention, engineering and decorative purposes. Adhesion. Surface modification. Specifications for coating systems. Selection testing and evaluation of coating. Classification of wear modes. Mechanisms of adhesive and abrasive wear. Selection, testing and evaluation of materials for wear mitigation. Wear-resistance materials.

MATS1244 Management **S2 L4**

The major issues, research findings and management strategies relating to the human side of enterprise. Topics include management and power, leadership and innovation, managerial decision-making, stress at work, group dynamics and inter-group conflict, organisational design, goal setting and performance appraisal, approaches to personal and organisational development. Marketing and sales; marketing research, marketing strategies, customer relations, total product package. Project management: project planning and

scheduling, contract planning and control, recent developments.

MATS1253 Ferrous Alloys **S1 L1 T2**

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

MATS1263 Alloy Steels **S2 L1 T1**

Alloy steels. Ternary equilibria involving iron and carbon. Metallography and properties of alloy steels. Effects of alloying elements on austenite formation and decomposition under equilibrium and non-equilibrium conditions. Heat treatment of alloy steels. Metallography and properties of alloy cast irons.

MATS1294 Electrical Ceramics **S2 L1 T2**

The intrinsic and extrinsic disorder of ceramic phases. Highly conductive ceramics. Grain boundary phenomena. Electronic and surface conduction. Insulators and substrates. Structure and property relations in ceramic capacitor materials. Piezo - and pyroelectric ceramics. Processing, applications and sensors.

MATS1464 Materials Seminar **F T2**

Demonstration of public speaking skills and techniques. Preparation of visual aids. Library usage. Preparation and standards of written material. Chairpersonship. Each student is required to make two oral presentations based on the honours project.

MATS1534 Design with Brittle Materials **S1 L1.5 T1.5**

General design considerations. Nature and properties of ceramic materials: glasses, polycrystalline ceramics and other ceramic materials. Effects of composition and microstructure on physical properties of ceramics. Manufacture of ceramic materials. Design approaches for ceramics: empirical, deterministic, probabilistic and linear elastic fracture mechanics. Effects of time under load. Design of components and selection of materials. Inspection and non-destructive testing.

MATS2123 Ceramic Process Principles 2 **S2 L2**

Plasticity in a clay - water system. Linear drying shrinkage. Air - water vapour system, psychrometry and drying calculations. Effect of porosity on ceramics. Calculations involving ceramic suspensions. Glass, glaze and porcelain enamel calculations. Relationship between the composition and physical properties of glasses. Rational analysis of clay and fluxing materials. Body formulation. Flue gas analysis and combustion calculations. ceramic laboratory instrumentation. Safety aspects in ceramics.

MATS2133 Ceramic Raw Materials **S1 L2**

The geological origin of ceramic raw materials. The minerals, mineralogical composition, properties and uses of commercial clays. The sources, physical properties and uses of non-clay raw materials.

MATS2143 Ceramic Equipment **S2 L3**

The principles of operation, construction and fields of application of equipment used in the ceramic industry in the following areas: mining and beneficiation; preparation of raw materials and auxillary processing operations; forming, drying and firing of ceramic products.

MATS2153 Ceramic Processing Laboratory **F T3**

Laboratory programme illustrating processing and engineering aspects of ceramic technology. Students are required to take part in a series of factory inspections.

MATS2173 Chemistry of Ceramic Processes

Unit 1 Refractories **S1 L2**

Classification of refractories. Chemical and physical properties of refractories. Introduction to raw materials and manufacturing technology. A detailed study of chemical reactions occurring between refractories and solid, liquid and gas phases in ferrous and non-ferrous metal industry. Review of phase equilibria.

Unit 2 Technical and Non-Technical Ceramics **S2 L2**

High-temperature reactions involving clays, silicates, oxides, and non-oxides. Processing effects of calcining, chemical reaction and vitreous and crystalline bond formation. Chemical and physical aspects of production of whitewares, porcelain, heavy clay products, glass, cements, cermets, and advanced high-purity ceramics.

MATS2193 Origins of Microstructure

Unit 1 Phase Equilibria **S1 L1 T1**

Phase rule. Two-component systems: free energy-composition and temperature-composition diagrams, solubility limits, compound formation, invariants. Three-component systems: isothermal sections and liquidus projections. Solidification and crystallization; cooling curves, crystallisation paths.

Unit 2 Diffusion **S1 L1 T1**

Fick's first and second laws. Solutions for short and long times by analytical and numerical methods. Boundary conditions for solid-fluid and solid-solid interfaces. Diffusion couples. Atomic level diffusion theory.

MATS2203 Physico-Chemical Ceramics Laboratory **S1 T3 S2 T4**

Laboratory programme illustrating the physical and chemical properties associated with the processing and performance of ceramic materials. Students are required to take part in a series of factory inspections.

MATS2244 Ceramic Process Engineering **S1 L2**

Advanced treatment of fluid flow and heat transfer: non-Newtonian fluids and unsteady state heat transfer. Flow through porous media. A detailed study of ceramic forming methods.

MATS2254 Ceramic Engineering Design **S2 L2**

Engineering aspects of ceramic processing. Ceramic engineering design including design of dryers, kilns and glass tanks. Case studies. Pollution control equipment.

MATS2264 Sintering of Ceramics **S1 L1.5 T.5**

Defects and phase transitions. Recrystallization, grain growth, and nucleation. Stages of sintering. Transport mechanisms, different modes of sintering (vapour, liquid, reactive liquid, solid), additives, and hot pressing. Secondary phenomena (oxidation, decomposition, phase transformations, trapped gases, non-uniform mixing, overfiring), time-temperature effects, firing shrinkage, and warpage.

MATS2274 Mechanical Properties of Ceramics **S2 L2**

Elasticity and anelasticity, submicroscopic flaw theory, nucleation and formation of crack, and brittle fracture and crack propagation. Atomistic and microstructural aspects of crack propagation. Fracture strength of ceramics, fracture toughness, R-curve behaviour, static fatigue, impact resistance and microhardness. High-temperature effects (strength, creep, creep rupture, viscous deformation, thermal stresses, thermal shock).

MATS2284 Thermal Properties of Ceramics **S2 L2**

Heat capacity, measurement of heat capacity and factors affecting heat capacity. Thermal expansion, measurement of thermal expansion and factors affecting thermal expansion. Thermal conductivity, thermal diffusivity, measurement of thermal conductivity and thermal diffusivity, factors affecting thermal transport, phonon and photon conductivity and factors affecting phonon and photon conductivity. Thermal stresses and thermal shock. Influence of structure and composition of pure materials on thermal conductivity of multiphase ceramics.

MATS2304 Project (Ceramic Engineering) **F T6**

An experimental or technical investigation or design related to some aspects of ceramic engineering.

MATS2324 Materials and Design 3 **S1 or S2 L1 T1**

Unit 1 Engineering Design

Brief review of theory of elasticity. Brittle fracture and strength theories. Quantitative design against fracture in terms of linear elastic fracture mechanics and elastic-plastic fracture mechanics using COD and J-integral approaches. Application of fracture mechanics to fatigue. Case studies. Engineering design codes of practice.

MATS3223 Mechanical Behaviour of Materials (Units 1,2,4, & 5)

Unit 1 Deformation **S1 L2**

Atomic and molecular description of deformation. Introduction to dislocation theory and its application of mechanical properties. Chain dynamics under stress.

Unit 2 Fractographic analysis **S2 L1 T1**

Classification of macroscopic and microscopic fracture mechanisms. Initiation and propagation of ductile, brittle, fatigue, creep, stress corrosion, and corrosion fatigue fractures. Effect of material defects, design deficiencies and incorrect processing on the origin and cause of fracture. Analysis of various modes of fracture using fractographic techniques involving optical microscopy and scanning and transmission electron microscopy.

Unit 4 Metal forming processes **S1 L1 T1**

Metal forming. Introduction to metal forming operations. Factors affecting deformation and workability. Hot working, cold working and recrystallization. Processes: forging, rolling, extrusion and wire drawing. Die materials and geometry. Deformation parameters and processing defects. Plant visits.

Unit 5 Polymer forming processes **S2 L1**

Industrially significant manufacturing processes.

MATS3324 Materials and Design 3 (Units 1 & 2)

Unit 1 Engineering Design 1 **S1 or S2 L1 T1**

Brief review of theory of elasticity. Brittle fracture and strength theories. Quantitative design against fracture in terms of linear elastic fracture mechanics and elastic-plastic fracture mechanics using COD and J-integral approaches. Application of fracture mechanics to fatigue. Case studies. Engineering design codes of practice.

Unit 2 Production Engineering **S1 or S2 L2**

Product design, development and manufacture. Industrial design, commercial philosophy, market competition, innovation, intellectual property, financing, manufacturing, marketing. Project scheduling and control, preparation of specifications, use of standards and codes. Product liability, product reliability, safety standards and regulations.

MATS3443 Polymer Science and Engineering **S2 L4 T2**

Polymer structure. Mers, bond strength, functionality. Addition and condensation polymerisation. Chain branching, cross linking, crystallinity. Thermosets and thermoplastics. Copolymers, blending, plasticisers. Polymer orientation. Polymer tailoring. Melt, glass and lower transitions. Effect of chemical molecular structure on performance. Elastomers, fibres, foams, composites. Elementary polymer identification. Common families of commodity plastics, engineering plastics and elastomers.

MATS3484 Welding Science and Technology

Unit 1 Welding Technology **S1 or S2 L1**

Fusion welding and allied processes. Capabilities, advantages and limitations.

MATS3524 Materials Engineering Project **F6**

An experimental or technical investigation or design related to some aspects of materials engineering.

MATS3544 Polymer Engineering **F L2 T1**

Mechanical behaviour of polymers. Critical effects of temperature variation on behaviour of thermoplastics under load. Comparison with thermosets. Factors contributing to

strength and toughness. Viscoelasticity. Yielding, deformation and fracture. Elastomer performance. Effect of strain rate. Crazing. Effect of additives and fillers on performance. Abrasion resistance. Strategies to reduce stress and increase toughness. Creep, recovery and stress relaxation. Time-temperature superposition. Fatigue. Selection of commodity plastics, engineering plastics and elastomers for particular applications. Adhesives. Mechanisms of adhesion. Coatings. Properties and performance requirements of coatings. Degradation. Weathering, thermal resistance, radiation resistance and resistance to other environments.

MATS3554 Professional Electives (Materials Engineering) S1 4 S2 2

A combination of elective subjects totalling 56 hours in the year.

MATS4104 Metallurgy Project/Metallurgical Engineering Project F6

An experimental investigation of some aspects of metallurgy or metallurgical engineering.

MATS4114 Professional Electives (Physical Metallurgy) S1 6 S2 4

A combination of elective subjects totalling 112 hours in the year.

MATS4134 Structure and Properties of Metallurgical Phases

Unit 1 Structure and Properties of Solids S2 L1 T1

Application of defect solid state chemistry to materials preparation and reactivity. Non-stoichiometric and stoichiometric-dependent physical and chemical properties of metal compounds.

Unit 2 Structure and Properties of Melts S2 L1

The atomistic and microscopic approach to melts in process metallurgy, liquid metals, mattes, molten salts and slags. Relationships between melt structure, mechanism and reaction kinetics in smelting and refining operations.

MATS4144 Mechanical and Thermal Processing of Materials S1 or S2 L3

Unit 1 Deformation and Forming of Sheet Metal S1 or S2 L2

Mechanisms of deformation. Origin of rolling and annealing textures. Inhomogeneities of deformation. Texture control and controlled rolling. Application to transformer steel, HSLA steel, deepdrawing steel, tungsten filaments. Superplasticity, creep, deformation maps. Sheet metal forming. Industrial operations of cutting, piercing, blanking, folding, bending, stretching, flow turning, deep drawing. Materials requirements for dies and sheet. Assessment of formability. Forming limit diagrams.

Unit 2 Powder Metallurgy S1 or S2 L1

Mechanisms of sintering in metals. Techniques of powder metallurgy, compaction, powder characteristics. Sintering in the presence of liquid phase, cementation, cermets. Preparation of super-alloys.

MATS4204 Industrial Metallurgy Project F3

An experimental investigation of some aspect of industrial metallurgy.

MATS4223 Mechanical Behaviour of Materials (Units 1,2,3,4, 6 & 7)

Unit 1 Deformation S1 L2

Atomic and molecular description of deformation. Introduction to dislocation theory and its application to mechanical properties. Chain dynamics under stress.

Unit 2 Fractographic Analysis S2 L1 T1

Classification of macroscopic and microscopic fracture mechanisms. Initiation and propagation of ductile, brittle, fatigue, creep, stress corrosion, and corrosion fatigue fractures. Effect of material defects, design deficiencies and incorrect processing on the origin and cause of fracture. Analysis of various modes of fracture using fractographic techniques involving optical microscopy and scanning and transmission electron microscopy.

Unit 3 Deformation and Strengthening Mechanisms S2 L1 T1

Strengthening mechanisms, creep, fracture, grain size dependence of strength. Introduction to generation of deformation and recrystallization textures. Measurements of age-hardening, activation energy of strain ageing.

Unit 4 Metal Forming Processes S1 L1 T1

Metal forming. Introduction to metal forming operations. Factors affecting deformation and workability. Hot working, cold working and recrystallization. Processes: forging, rolling, extrusion and wire drawing. Die materials and geometry. Deformation parameters and processing defects. Plant visits.

Unit 6 Quality Assurance and Control S2 L1

Concepts of quality assurance and quality control. Techniques of liquid penetrant, magnetic particle ultrasonic, radiographic and eddy current inspection. Systems and processes, inspection and evaluation, acceptance standards, case studies. Optimisation of quality assurance and control.

Unit 7 Advanced Fractographic Analysis S2 L.5 T.5

Extension of fractographic analysis to include creep, hydrogen embrittlement and corrosion fatigue. Analysis of service failures using metallographic and fractographic techniques.

MATS4324 Materials and Design 3

Unit 1 Engineering Design S1 or S2 L1 T1

Brief review of theory of elasticity. Brittle fracture and strength theories. Quantitative design against fracture in terms of linear elastic fracture mechanics and elastic-plastic fracture mechanics using COD and J-integral approaches. Application of fracture mechanics to fatigue. Case studies. Engineering design codes of practice.

Unit 2 Production Engineering S1 or S2 L2

Product design, development and manufacture.j Industrial design, commercial philosophy, market competition,

innovation, intellectual property, financing, specifications, use of standards and codes. Product liability, product reliability, safety standards and regulations.

Unit 3 Design for Welding S2 L1 T1

Design of welded fabrications to reduce distortion and the risk of failure by fatigue, brittle fracture, etc.. Welding application codes, weld quality requirements and quality assurance with welded fabrication.

MATS4363 Origins of Microstructure (Units 1,2,3,4)

Unit 1 Phase Equilibria S1 L1 T1

Phase rule. Two-component systems: free energy-composition and temperature-composition diagrams, solubility limits, compound formation, invariants. Three-component systems: isothermal sections and liquidus projections. Solidification and crystallisation; cooling curves, crystallisation paths.

Unit 2 Diffusion S1 L1 T1

Fick's first and second laws. Solutions for short and long times by analytical and numerical methods. Boundary conditions for solid-fluid and solid-solid interfaces. Diffusion couples. Atomic level diffusion theory.

Unit 3 Metallography and Phase Equilibrium Laboratory S1 T3

Determination of equilibrium phase diagrams. Solidification processes in moulds. Metallography of non-ferrous alloys.

Unit 4 Phase Transformations S2 L2 T1

Solidification: single phase, eutectic and near-eutectic, peritectic. Diffusional transformations: precipitation, ripening, cooperative transformations, TTT and CCT curves. Diffusionless transformations: crystallography, nucleation and growth modes.

MATS4463 Origins of Microstructure Double Degree and BSc(Tech) (Units 1,2,3)

Unit 1 Phase Equilibria S1 L1 T1

Phase rule. Two-component systems: free energy-composition and temperature-composition diagrams, solubility limits, compound formation, invariants. Three-component systems: isothermal sections and liquidus projections. Solidification and crystallisation; cooling curves, crystallisation paths.

Unit 2 Diffusion S1 L1 T1

Fick's first and second laws. Solutions for short and long times by analytical and numerical methods. Boundary conditions for solid-fluid and solid-solid interfaces. Diffusion couples. Atomic level diffusion theory.

Unit 3 Metallography and Phase Equilibrium Laboratory S1 T3

Determination of equilibrium phase diagrams. Solidification processes in moulds. Metallography of non-ferrous alloys.

MATS5203 Origins of Microstructures (Unit 1)

Unit 1 Phase Equilibria S1 L1 T1

Phase rule. Two-component systems: free energy-composition and temperature-composition diagrams, solubility limits, compound formation, invariants. Three-component systems: isothermal sections and liquidus projections. Solidification and crystallisation; cooling curves, crystallisation paths.

MATS5213 Metallurgical Plant Practice S1 or S2 T2.5

Up to 3 days of metallurgical plant inspections and case studies equivalent to 35 tutorial hours are associated with this subject. Ferrous and non-ferrous plant practice.

MATS5223 Mechanical Behaviour of Materials (Unit 4 only)

Unit 4 Metal forming Processes S1 L1 T1

Metal forming. Introduction to metal forming operations. Factors affecting deformation and workability. Hot working, cold working and recrystallization. Processes: forging, rolling, extrusion and wire drawing. Die materials and geometry. Deformation parameters and processing defects. Plant visits.

MATS5224 Mechanical Behaviour of Materials (Unit 6 only)

Unit 6 Quality Assurance and Control S2 L1

Concepts of quality assurance and quality control. Techniques of liquid penetrant, magnetic particle, ultrasonic, radiographic and eddy current inspection. Systems and processes, inspection and evaluation, acceptance standards, case studies. Optimisation of quality assurance and control.

MATS5253 Metallurgical Reaction Engineering F2

Introduction to reactor design, batch and flow reactors, steady state and unsteady state, multiple reactor systems. Heterogeneous kinetics in extractive systems, reactions between phases. Design of reactors for pyrometallurgical and hydrometallurgical processes.

MATS5263 Extractive Metallurgy S1 L2 S2 L2 T3

A review of the unit operations used in the iron and steel industry, sintering, pellitisation, iron blast furnace, desulphurisation, steelmaking, deoxidation and ladle metallurgy, direct reduction, plasma developments, mini steel plant. Unit operations for the treatment of no-ferrous minerals, roasting, sintering, smelting, refining and electrowinning.

Application of principles of aqueous thermodynamics, electrochemistry, chemical and electrochemical kinetics to hydrometallurgical processes: leaching of mineral and concentrates, solution purification, precipitation, and other separation processes, ion-exchange and liquid-liquid extraction, electrowinning and electrorefining.

MATS5314 Kinetics and Mass Transfer In Metallurgical Processes S1 L2 T1 S2 L1

Kinetics and mass transfer in metallurgical processes. Kinetics of interphase transfer in metallurgical systems. Single particle, fluid/solid reactions, topochemical reactions, reactions of

porous solids. Application to reduction of iron oxides. Reaction between liquid metals and gases, reactions involving drops and bubbles. Reaction between liquid metals and slags, mass transfer at bubble stirred inter faces. Application to metal refining process. Vacuum degassing and refining processes.

MATS5324 Modelling Metallurgical Processes S2 L3 T1

The mathematical and physical modelling of primary and secondary metals processing operations. Ladle metallurgy operations, entrainment of gases by molten metals, electromagnetically driven flows, dispersion of alloying additions, coalescance of inclusions, modelling metal flow and solidification, blast furnace drainage, mathematical plasticity, estimation of stresses developed during industrial deformation processes, rolling, drawing, bending.

MATS5334 Professional Electives (Process Metallurgy) S1 S2 5

A combination of elective subjects totalling 140 hours in the year.

MATS5384 Air Pollution Control in the Metallurgical Industry S1 or S2 L.5 T.5

Case studies of emission surveys, measurements and compliance program planning in the primary and secondary metallurgical industries.

MATS7134 Structure and Properties of Metallurgical Phases

Unit 1 Structure and Properties of Solids S2 L1 T1

Application of defect solid state chemistry to materials preparation and reactivity. Non-stoichiometric and stoichiometric-dependent physical and chemical properties of metal compounds.

Unit 2 Structure and Properties of Melts S2 L1

The atomistic and microscopic approach to melts in process metallurgy, liquid metals, mattes, molten salts and slags. Relationships between melt structure, mechanism and reaction kinetics in smelting and refining operations.

MATS7144 Mechanical and Thermal Processing of Materials

Unit 2 Powder Metallurgy S1 or S2 L1

Mechanisms of sintering in metals. Techniques of powder metallurgy, compaction, powder characteristics. Sintering in the presence of liquid phase, cementation, cermets. Preparation of super-alloys.

MATS7154 Advanced Materials

Unit 1 Magnetic Materials S1 L1

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.

Unit 2 Heat Resisting Alloys S1 L1

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.

MATS7164 Welding Science and Technology

Unit 2 Welding Metallurgy S1 or S2 L1 T1

Metallurgical aspects of fusion welding and allied processes. Causes of welding defects and weldability of carbon and alloy steels, stainless steels, aluminium and other common non-ferrous alloys. Assessment of welds by mechanical testing and non-destructive methods.

MATS7223 Mechanical Behaviour of Materials (Units 1-3 & 4A)

Unit 1 Deformation S1 L2

Atomic and molecular description of deformation. Introduction to dislocation theory and its application to mechanical properties. Chain dynamics under stress.

Unit 2 Fractographic analysis S2 L1 T1

Classification of macroscopic and microscopic fracture mechanisms. Initiation and propagation of ductile, brittle, fatigue, creep, stress corrosion, and corrosion fatigue fractures. Effect of material defects, design deficiencies and incorrect processing on the origin and cause of fracture. Analysis of various modes of fracture using fractographic techniques involving optical microscopy and scanning transmission electron microscopy.

Unit 3 Deformation and strengthening mechanisms S2 L1 T1

Strengthening mechanisms, creep, fracture, grain size dependence of strength. Introduction to generation of deformation and recrystallization textures. Measurements of age-hardening, activation energy of strain ageing.

Unit 4 (Part of) Metal forming processes S1 L1 T1

Metal forming. Introduction to metal forming operations. Factors affecting deformation and workability. Hot working, cold working and recrystallization. Processes: forging, rolling, extrusion and wire drawing. Die materials and geometry. Deformation parameters and processing defects. Plant visits.

MATS7244 Advanced Electron Optics S1 or S2 L1 T1
See School for details.

MATS7264 Sintering of Ceramics S1 L1.5 T.5

Recrystallization, grain growth, and nucleation. Stages of sintering. Transport mechanisms, different modes of sintering (vapour, liquid, reactive liquid, solid), additives, and hot pressing. Secondary phenomena (oxidation, decomposition, phase transformations, trapped gases, non-uniform mixing, overfiring), time-temperature effects, firing shrinkage, and warpage.

MATS7274 Mechanical Properties of Ceramics **S2 L2**

Elasticity and anelasticity, submicroscopic flaw theory, nucleation and formation of cracks, and brittle fracture and crack propagation. Atomistic and microstructural aspects of crack propagation. Fracture strength of ceramics, fracture toughness, R-curve behaviour, static fatigue, impact resistance and microhardness. High-temperature effects (strength, creep, creep rupture, viscous deformation, thermal stresses, thermal shock).

MATS7284 Thermal Properties of Ceramics **S2 L2**

Heat capacity, measurement of heat capacity, and factors affecting heat capacity. Thermal expansion, measurement of thermal expansion and factors affecting thermal expansion. Thermal conductivity, thermal diffusivity, measurement of thermal conductivity and thermal diffusivity, factors affecting thermal transport, phonon and photon conductivity, and factors affecting phonon and photon conductivity. Influence of structure and composition of pure materials on thermal conductivity of multiphase ceramics.

MATS7384 Air Pollution Control in the Metallurgical Industry **S1 or S2 L.5 T.5**

Case studies of emission surveys, measurements and compliance program planning in the primary and secondary metallurgical industries.

MATS7470 Polymer Processing and Fabrication **S1 L2 T2**

Factors affecting quality and efficiency of extrusion, injection moulding and other fabrication techniques. Polymer viscous flow; viscometry; fluid flow and heat transfer in melt processing. Effect of polymer chemical structure, temperature and molecular weight upon flow properties. Computer simulation of polymer flow during processing.

MATS7480 Polymer Product Design **S2 L2**

Designing with polymeric materials. Selection and compounding of rubbers. Rubber modification of plastics. Polymer blending, mixing and recycling. Design of plastic and rubber components. Plant visits.

MATS7490 High Temperature Techniques **S1 or S2 L1**

Experimental methods for the determination of thermophysical and thermochemical properties at elevated temperatures.

MATS7500 Mathematical Plasticity **S1 or S2 L1**

Mathematical approaches to macroscopic plastic deformation; slip line field analysis, upper and lower bound techniques, finite element techniques. Application to estimation of loads and stresses developed during industrial deformation processes: rolling, drawing, bending.

MATS7534 Design with Brittle Materials **S1 L1.5 T1.5**

General design considerations. Nature and properties of ceramic materials: glasses, polycrystalline ceramics and other ceramic materials. Effects of composition and microstructure on physical properties of ceramics. Manufacture of ceramic materials. Design approaches for ceramics: empirical, deterministic, probabilistic and linear elastic fracture mechanics. Effects of time under load. Design of components and selection of materials. Inspection and non-destructive testing.

MATS8193 Origins of Microstructure

Unit 1 Phase equilibria **S1 L1 T1**

Phase rule. Two-component systems: free energy-composition and temperature-composition diagrams, solubility limits, compound formation, invariants. Three-component systems: isothermal sections and liquidus projections. Solidification and crystallisation; cooling curves, crystallisation paths.

Unit 2 Diffusion **S1 L1 T1**

Fick's first and second laws. Solutions for short and long times by analytical and numerical methods. Boundary conditions for solid-fluid and solid-solid interfaces. Diffusion couples. Atomic level diffusion theory.

Unit 3 Metallography and phase equilibrium laboratory **S1 T3**

Determination of equilibrium phase diagrams. Solidification processes in moulds. Metallography of non-ferrous alloys.

MATS9193 Origins of Microstructure

Unit 2 Diffusion **S1 L1 T1**

Fick's first and second laws. Solutions for short and long times by analytical and numerical methods. Boundary conditions for solid-fluid and solid-solid interfaces. Diffusion couples. Atomic level diffusion theory.

Unit 4 Phase transformations **S2 L2 T1**

Solidification: single phase, eutectic and near-eutectic, peritectic. Diffusional transformations: precipitation, ripening, cooperative transformations, TTT and CCT curves. Diffusionless transformations: crystallography, nucleation and growth modes.

MATS9223 Mechanical Behaviour of Materials (Units 1,2,3,7)

Unit 1 Deformation **S1 L2**

Atomic and molecular description of deformation. Introduction to dislocation theory and tis application to mechanical properties. Chain dynamics under stress.

Unit 2 Fractographic analysis **S2 L1 T1**

Classification of macroscopic and microscopic fracture mechanisms. Initiation and propagation of ductile, brittle, fatigue, creep, stress corrosion, and corrosion fatigue fractures. Effect of material defects, design deficiencies and incorrect processing on the origin and cause of fracture. Analysis of various modes of fracture using fractographic techniques involving optical microscopy and scanning and transmission electron microscopy.

Unit 3 Deformation and strengthening mechanisms **S2 L1 T1**

Strengthening mechanisms, creep, fracture, grain size dependence of strength. Introduction to generation of deformation and recrystallization textures. Measurements of age-hardening, activation energy of strain ageing.

Unit 7 Advanced fractographic analysis **S2 L.5 T.5**

Extension of fractographic analysis to include creep, hydrogen embrittlement and corrosion fatigue. Analysis of service failures using metallographic and fractographic techniques.

MATS9323 Mechanical Behaviour of Materials (Units 1,2,3)

Unit 1 Deformation **S1 L2**

Atomic and molecular description of deformation. Introduction to dislocation theory and its application to mechanical properties. Chain dynamics under stress.

Unit 2 Fractographic analysis **S2 L1 T1**

Classification of macroscopic and microscopic fracture mechanisms. Initiation and propagation of ductile, brittle, fatigue, creep, stress corrosion, and corrosion fatigue fractures. Effect of material defects, design deficiencies and incorrect processing on the origin and cause of fracture. Analysis of various modes of fracture using fractographic techniques involving optical microscopy and scanning and transmission electron microscopy.

Unit 3 Deformation and strengthening mechanisms **S2 L1 T1**

Strengthening mechanisms, creep, fracture, grain size dependence of strength. Introduction to generation of deformation and recrystallization textures. Measurements of age-hardening, activation energy of strain ageing.

MATS9340 Design with Advanced Materials **S2 L4 T2**

The development, application and design with advanced materials of relevance to the chemical process industries. Studies of case histories of engineering service failures.

MATS9420 Materials for Mining Engineers **F L2 T1**

Solidification of metals, structure and defects in castings and welds. Phase equilibrium and strengthening mechanisms in alloys ! application to engineering materials, including ferrous and non-ferrous alloys. Non-equilibrium structures, heat treatment and modification of structures and properties. Elastic and plastic deformation. Mechanical properties of solids and their significance. Mechanical testing! tension, hardness, impact. Stress-strain-time relationships and the influence of stress state, temperature, strain rate and environment. Corrosion. Fracture and fatigue. Use of hardfacing and carbides in minimising wear of mining machinery.

MATS9520 Engineering Materials **S1 L2 L/T1**

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

MATS9530 Materials Engineering **S1 or S2 L2 T1**

Prerequisite: MATS9520.

Materials used in Mechanical Engineering and related fields (Manufacturing Engineering Management, Aerospace Engineering, Naval Architecture) are discussed with emphasis on the dependence of properties and performance on microstructure. Aspects of materials selection during the design of engineering components which affect the service performance in applications where failure can occur by brittle fracture, corrosion, creep or fatigue, will also be discussed.

MATS9640 Materials Science and Engineering for Electrical Engineers **S2 L3 T1**

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

MATS9650 Pyrometallurgical Processes **S1 L2**

The applicationof thermodynamics to the understanding of pyrometallurgical processes and a review of the unit operations, roasting, sintering, smelting and refining for the treatment of ferrous and non-ferrous minerals.

Graduate Study

MATS6005 Corrosion Project **F6**

A substantial project on some aspect of corrosion science or technology.

MATS6203 Materials and Design 2

Unit 1 Design for corrosion control (Unit 1 of MATS1203) **S1 L1 T1**

Electrochemical corrosion, types of corrosion, influence of alloying and heat treatment, influence of stress. Corrosion prevention, cathodic protection, passivation and inhibitors, selection of materials, designing against corrosion.

MATS6405 Graduate Materials Seminar **F2**

Instruction in written or oral presentation of technical and scientific material at an advanced level which involves a presentation by the candidate of a lecture on a selected topic.

MATS6475 Materials Engineering **F L2 T1**

The characteristics of crystalline solids. Defect structure of crystals and influence of defects on their mechanical behaviour. Micromechanism of elastic and plastic deformation. Microstructure and structure-property relationships of the main types of engineering materials (Metals, Ceramics, Polymers and Composites). Phase Equilibria of alloys; microstructural control by thermomechanical processing and application to commercial engineering materials. Fracture mechanisms for ductile, brittle, creep and fatigue modes of failure in service. Metallic corrosion and degradation of other classes of materials. Polymer materials: The structure and properties of polymers. Mechanisms for the modification of properties. Ceramic materials: The structure and properties of ceramics. Composite materials. Design and development of materials for specific engineering applications. Appropriate laboratory and tutorial work.

MATS6485 Materials Technology **F L1.5 T1.5**

Material properties and their effect on component design, manufacturing and product performance. Materials selection as an integral part of successful design. Long term potential for materials improvement and substitution. Plant visits to successful materials processing plants. Atomic and microstructure determination: X-ray production, absorption and diffraction using powder and single crystal methods. Stereographic projections and crystal geometry. Application of diffraction methods to solid solutions and solubility limit, thermal analysis, stress measurement, and chemical stream analysis. Electron optics and analysis. Transmission and scanning electron microscopy. Energy-loss spectrometers Microanalysis.

MATS6495 Corrosion Materials **F L2 T1**

Properties and efficient selection of materials for corrosion resistance. Applications in manufacturing, mining and process industries, in transportation equipment, and in structures. Materials selection for service in particular environments.

MATS6535 Industrial Coatings for Corrosion Protection **S1 L2**

Special topics on heavy-duty organic, inorganic and metallic coatings using in atmospheric, marine and industrial environments.

MATS6545 Corrosion Technology **F L3**

Environmental fracture; corrosion in specific environments; corrosion of specific equipment types; principles of materials selection and design; surface preparation and maintenance coatings; polymeric materials and linings, inhibitors and electrochemical tests methods; cathodic protection.

MATS6555 Minor Graduate Materials Project **F3**

A small technical investigation or a design project, including a written report.

MATS6565 Major Graduate Materials Project **F9**

A substantial experimental or theoretical investigation, or design project, including a written thesis.

School of Mines

Head of School
Professor F. F. Roxborough

The School of Mines, which was formed in 1986, consists of two Departments and an Centre corresponding to the three main professions on which the mining and minerals industry of Australia depends. These are the Departments of Applied Geology and Mining Engineering, and the Centre for Minerals Engineering (in conjunction with the School of Chemical Engineering).

Prior to the formation of the School of Mines, Applied Geology and Mining Engineering were separate Schools and Mineral Processing and Extractive Metallurgy (referred to as Mineral Engineering) was spread among several other Schools in the Faculty. Bringing the three together into the School of Mines is an important development in mining industry education in Australia.

Geologists, Mining Engineers and Minerals Engineers work closely together in the mining industry. The Geologist is responsible for discovering new mineral resources and for defining the size, value and condition of the deposit. The Mining Engineer decides if the deposit is worth mining, designs the mine and thereafter manages it throughout its life. The Minerals Engineer deals with these resources after they have been mined, and designs and manages the large plants needed to turn the crude ore into metal or the raw coal into saleable fuel.

Each is an expert in her or his own field, but each also needs to have a good appreciation of the work of the other two. Professional roles in the mining industry are not always clear cut and it is a distinct advantage for geologists, mining engineers and minerals engineers to study and interact together while at University, in preparation for their necessarily close involvement with each other during their professional careers.

Separate degree courses are available in each, as described below. Students enrol in the course of their own choice and many activities are departmentally centred, but others are School-based to provide a corporate identity with the mining and allied industries.

Department of Applied Geology

Head of Department
Associate Professor G. R. Taylor

Geology is 'the science of the earth', and as such covers a broad spectrum of knowledge on the constitution and evolution of our planet. Applied geology involves a specific interest in the use of earth science for the benefit of humanity, including, for example, the search for and evaluation of metallic ore-bodies and accumulations of fossil fuels, or the application of geological knowledge to a range of engineering and environmental problems.

Department of Mining Engineering

Head of Department
Associate Professor E. G. Thomas

Mining Engineering is concerned with the design, development and management of mines for the extraction of the earth's mineral and energy resources. Mining production whether underground, at the surface, offshore or on the sea floor is a technically advanced engineering activity and the mining engineering course caters for the present day and future requirements of the industry. The mining engineer is a front line

executive in control of all phases of a mining project from evaluation of a coal or an ore deposit, the planning and development of its extraction, its processing on site, the safe disposal of waste products and the restoration of the environment during and after mining.

Most mining engineers are trained for careers in mine production and management and their engineering and managerial roles necessitate liaison with a range of experts, from those engaged in exploration geology, to those in end-product development and marketing. The mining engineering course involves a strong grounding in basic sciences, engineering principles and management as a foundation to training for the production and mine management functions. The course also provides a good appreciation of the science of geology, the technology of mineral processing and the economics of resources so that the mining engineer can effectively work in any section of the mining industry from evaluation of ore reserves to marketing and finance.

The mining engineer's training has an appeal to many other industries in that it combines excellence in a broad range of disciplines from science and engineering to economics of management of human resources. With such a background, mining engineers can easily adapt to work in almost any industry either on graduation or at a later stage in their career.

After graduation, mining engineers who choose to develop careers in production management, will be required to gain further practical experience before obtaining a Mine Managers Certificate of Competency, in either Coal or Metalliferous Mining. These statutory certificates of competency are issued by the State Department of Industrial Relations, which in the case of New South Wales coal mining comes under the Coal Mines Regulation Act No. 67, 1982, and for metalliferous mining under the Mines Inspection Act No. 75, 1901, as amended. Arrangements have been made with the Universities of Newcastle and Tasmania for students who have completed a specified program at these institutions to be admitted with advanced standing to Year 3 of the Mining Engineering degree course at the University of New South Wales.

Centre for Minerals Engineering

Director

Dr T. Tran

Students wishing to specialize in Minerals Engineering enrol in the BE course in Chemical Engineering in years 1 and 2, and undertake studies in Minerals Engineering in years 3 and 4 as professional electives in this degree.

For details of subjects offered, please see the course outline for **Course 3040** in the Chemical Engineering section.

General Education Electives

For details of changes in the General Education requirements see Faculty Information

Staff

Professor of Mining Engineering and Head of School
Frank Ferdinand Roxborough, BSc PhD *Durh.*, CPEng, CEng, FIEAust, FIMinE, FIMM, FAusIMM

Visiting Professor
Miklos Dezso Gyorgy Salamon, DipIng(MIN) *Sopran.*, PhD *Durh.*, Hon.DSc. *Miskolc,* CEng, PrEng, FSAIMM, FIMM, MAIME

Administrative Assistant
Sue Fletcher, BSc DipEd *N.S.W.*, MA(Ed) *Fairfield*

Department of Applied Geology

Associate Professor and Head of Department
Geoffrey Robert Taylor, MSc *Birm.*, PhD *N.E.*, FGS, MIMM

Professor of Engineering Geology
Grant Hocking, BTech *C.E. S.A.I.T.*, MSc *N'cle.(U.K.), PhD DIC Lond.*, FGS, MAIME, MSRM

Professors of Geology
Gerald James Spurgeon Govett, DSc *Wales*, PhD DIC *Lond.*, CEng, FIMM, FIEAust
John Roberts, BSc *N.E.*, PhD *W.Aust.*

Associate Professors
Alberto Albani, DrGeolSc *Florence*, MSc PhD *N.S.W.*
Bastiaan Jan Hensen, MSc *Ley.*, PhD *A.N.U.*
Colin Rex Ward, BSc PhD *N.S.W.*, FAusIMM, MAIG

Senior Lecturers
Alistair Chisholm Dunlop, *BSc N.E.*, PhD *Lond.*, DIC, *MIMM*
Michael Barry Katz, BSc *Mich.T.U.*, MSc *McG.*, PhD *Tor.*
Greg McNally, BSc *Syd.*, BA *N.E.*, MAppSc *N.S.W.*
Noel Merrick, MSc Syd., DipDP *N.S.W.I.T.*
Gerrit Neef, BSc *Lond.* PhD *Well.*, FGS
Peter Cyril Rickwood, BSc *Lond.*, PhD *Cape T.*, CChem, MRIC AMAusIMM

Lecturer
Paul Gordon Lennox, BSc *Tas.*, PhD *Monash*

Tutor
Malcolm David Buck, MSc *Waik.*, PhD *N.S.W.*

Honorary Visiting Fellow
Ervin Slansky, BSc PhD RnDr *Charles*

Honorary Associates
Frederick Charles Loughnan, BSc *Syd.*, PhD DSc *N.S.W.*
Edward Tyne, BSc GradDip(GeoPhys) PhD *N.S.W.*

Professional Officers
Zaynab Fidahusayn Muhammad Aly, MSc *Lond.*
Peter Richard Atherden, BSc *N.S.W., MSc Macq.*
Mark Francis Reddy, BSc *N.S.W.*

Administrative Assistant
Lynne Anne Bruce

Department of Mining Engineering

Associate Professor and Head of Department of Mining Engineering
Edward George Thomas, BE PhD *Qld.*, FAusIMM, MAIME, MCIMM

Professor of Mining Engineering
Frank Ferdinand Roxborough

Senior Lecturers
Amal Krishna Bhattacharyya, BSc *Glas.*, MSc *Durh.*, PhD *N'cle.(U.K.)*, CPEng, PEng, FMinE, FAusIMM, MCIMM, MAIME
Gour Chand Sen, MSc *Wales*, PhD *Durh.*, CPEng, FIExpE, FIMinE, FAusIMM
Peter Nigel Holtham, *BSc Leeds*, MSc *Manc.*, PhD *N.S.W.*, AMAusIMM
Venkata Satyanarayana Vutukuri, BScEng *Ban.*, MS *Wis.*, FAusIMM, FMVSSA, MMGI, MAIME
John Ormiston Watson, BScEng *Nott.*, PhD *S'ton.*

Lecturers
Christopher Raymond Daly, BE MSc(Acoustics) PhD *N.S.W.*, AIME
Drago Panich, BE *N.S.W.*, MSc *N'cle.(U.K.)*

Honorary Associate
Bernhard John Frederick Ralph, BSc *Tas.*, PhD *Liv.*, FRACI, FTS

Administrative Assistant
Sue Fletcher

Professional Officer
Vacant

Centre for Minerals Engineering

Director
Tam Traan, BSc PhD *N.S.W.*, MAME, MAIME, IChE, ARACI

Senior Lecturer
Dr P. N. Holtham

Key Centre for Mines
Incorporates the University of New South Wales and the University of Wollongong

Acting Director and Associate Professor
Geoffrey Robert Taylor, MSc *Birm.*, PhD *N.E.*, FGS, MIMM

Associate Director - International
Michael Barry Katz, BSc *Mich T.U.*, MSc McG., PhD *Tor.*

Industry Research Officer
Trevor Leahey, BSc *Syd.*

Senior Research Assistant
Judith Egan, BSc *Latrobe*, MSc *UNC-CH*

Administrative Assistant
Vacant

Centre for Groundwater Management and Hydrogeology

In association with the Faculty of Engineering.

Associate Professor and Director
Michael John Knight, BSc PhD *Melb.*, FGS, MIE Aust

Associate Professor and Deputy Director
Colin Raymond Dudgeon, BE ME PhD *N.S.W.*

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

Senior Research Fellow
Jerzy Jankowski, MSc PhD *Wroclaw*

Project Scientist
David Ronald Cohen, BSc *Syd.*, MSc *Qu.*, PhD *N.S.W.*

Professional Officer
Robert Gregor McLaughlan, BSc DipMAppSc, GradDip *N.S.W.*

Administrative Assistant
Areerom Romy Peters

Course Outlines

Undergraduate Study

Department of Applied Geology

The Applied Geology course provides a comprehensive education in all aspects of earth science. It leads to the award of a Bachelor of Science (BSc) degree over four years full-time study, with honours for students who perform with merit throughout the course program.

Through lectures, laboratory work, projects and field tutorials students learn the fundamental principles of geology. At the same time they gain the practical skill and knowledge of geological applications necessary for employment in research, industry or government. Graduates are prepared by the course to enter any branch of the geological profession, or to undertake further studies leading to a Higher degree. They are also well equipped to change their field of employment as different opportunities arise.

No previous knowledge of geology is required to enter this course but a sound background in mathematics together with at least one other science subject is essential. Students that have not undertaken Chemistry at HSC level are advised to take Chemistry at the introductory level in Year 1, this incurs no extension to the duration of the course. Students, who have reached a satisfactory standard in HSC Geology may be offered an alternative program in Year 1.

Reciprocal courses are offered through the Board of Science and Mathematics in Geology (double major), Geophysics, Earth and Environmental Science and courses that combine a single major in Geology with Physics, Chemistry, Mathematics or Botany and Zoology. These courses are all of three years full-time duration leading to a BSc at Pass level. An optional fourth year leading to Honours is available for students of high academic standing.

3000
Applied Geology - Full-time

Bachelor of Science
BSc

Year 1

		Hours per week S1	S2
CHEM1002	Chemistry 1	6	6
or			
CHEM1302	Introductory Chemistry	6	6
MATH1032	Mathematics 1	6	6
or			
MATH1011	General Mathematics 1B	6	0
and			
MATH1012	General Mathematics 1C	0	6
GEOL1101	Geological Processes	6	0
GEOL1201	Geological Environments	0	6
and either			
PHYS1002	Physics 1	6	6
or			
PHYS1022	Introductory Physics	6	6
or			
BIOS1011	Biology A	6	0
BIOS1021	Biology B	0	6
or			
GEOG1022	Locational Processes	0	4
GEOG1031	Environmental Processes	0	4
GEOG1043	Data Processing Systems	4	0
		22/24	22/24

** Up to 2 days of fieldwork in GEOL1101 Geological Processes and up to 4 days fieldwork in GEOL1201, Geological Environments are essential parts of these subjects. Attendance is compulsory.

Year 2

GEOL2011	Mineralogy and Igneous Petrology	6	0
GEOL2031	Sedimentology and Palaeontology	6	0
GEOL2022	Petrology and Structural Geology	0	6
GEOL2041	Geological Computing	3	0
GEOL2042	Geological Statistics	0	3
GEOL2062	Geological Surveying	0	3
GEOL2051	Introductory Geophysics	3	0
GEOL2072	Environmental Geology	0	3
GEOL2092	Introductory Geochemistry	0	3
	General Education Subject/s (Category A)	2	2
		20	20

* Field work of up to 2 days is a compulsory part of the subject.
** Field work of up to 5 days is a compulsory part of the subject.
*** Field work of up to 4 days is a compulsory part of the subject.

Year 3 (For students enrolled in Year 3, 1992 only)

GEOL3111	Earth Materials 3	6	0
GEOL3211	Earth Materials 4*	0	6
GEOL3121	Earth Environments 2**	6	0
GEOL3331	Exploration Geophysics	3	2
GEOL3130	Mathematical Geology 2	3	0
GEOL3141	Mineral and Energy Resources 1***	6	0
GEOL3241	Mineral and Energy Resources 2*	0	6
GEOL3251	Engineering and Environmental Geology***†	0	6
GEOL3281	Exploration Geochemistry	0	2
GEOL3271	Structural Geology*	0	2
	General Education Subject/s (Category B)	2	2
		26	26

* Field work of up to 4 days is a compulsory part of the subject.
** Field work of up to 7 days is a compulsory part of the subject.
*** Field work of up to 3 days is a compulsory part of the subject.

Year 3 (New Programme, to be offered commencement of 1993)

		Hours per week S1	S2
GEOL3011	Mineralogical Techniques	3	0
GEOL3021	Igneous and Metamorphic Processes**	4	0
GEOL3031	Stratigraphy and Basin Analysis*	6	0
GEOL3101	Ore Deposits	6	0
GEOL3052	Exploration Geophysics	0	4
GEOL3102	Fossil Fuels and Non-metallic Resources*	0	6
GEOL3072	Engineering Geology***	0	3
GEOL3082	Structural Geology*	0	3
GEOL3092	Exploration Geochemistry	0	2
	General Education Subject/s (Category B)	2	2
		21	20

* Field work of up to 4 days is a compulsory part of the subject.
** Field work of up to 7 days is a compulsory part of the subject.
*** Field work of up to 3 days is a compulsory part of the subject.

Year 4

GEOL4111	Advanced Geological Techniques*	6	0
GEOL4121	Professional Practice**†	6	0
GEOL4131	Special Topics in Applied Geology**	12	0
GEOL4203	Field Project†		24
		24	24

* Field work of up to 7 days is a compulsory part of this subject.
** Formal classes are scheduled for 13 weeks only to accommodate the field tutorial component of GEOL4111.
†These subjects contribute towards the satisfaction of the Category C General Education requirement.

Recommended Programs in subject GEOL4131 Special Topics in Applied Geology:

		Hours per week (13 weeks)
a)	**Mineral Exploration and Mining Geology'**	
	Principles of Mining *or* Mines Development	2
	Mine Economics	4
	Mineral Process Engineering or Sampling and Analytical Methods	2
	Exploration Geology	2
		10
b)	**Sedimentary Basin Studies**	
	Seismic Stratigraphy	2
	Advanced Sedimentology	4
	Advanced Coal Geology	2
	Advanced Petroleum Geology	2
		10
c)	**Geophysics*†**	
	Gravity and Magnetic Methods	2
	Seismic Methods	2
	Electrical Interpretation	2
	Regional Geophysics	2
	Geophysical Interpretation	2
		10
d)	**Engineering Geology***	
	Engineering Geology	4
	Geomechanics	2
	Hydrogeology	2
	Environmental Geology	2
Total		10

Plus one additional two hour subject from either the above list or a list of other topics, subject to the approval of the Head of Department.

* An additional two hour subject may be prescribed by the program authority.
† Fieldwork of up to three days is a compulsory part of this program.

Department of Mining Engineering

The Department offers a 4 year full-time course in Mining Engineering leading to the award of the degree of Bachelor of Engineering at Pass or Honours level, and a graduate course requiring one year of full-time or two years of part-time study leading to the award of the Graduate Diploma GradDip in Mining and Mineral Engineering.

3140
Mining Engineering - Full-time Course

Bachelor of Engineering
BE

Year 1 of the course is similar to that of several other Engineering courses and Year 2 includes those subjects of common relevance to the Engineering disciplines. Year 3 is largely devoted to basic mining subjects and Year 4 provides advanced instruction in subjects essential to all mining engineers. In addition, the fourth year offers a wide range of elective subjects, allowing students, if they so wish, to concentrate their studies on a particular sector of the industry, such as coal mining or metalliferous mining. An important fourth year requirement is for students to undertake personal research or a study project in mining or minerals engineering on which they are required to submit a thesis for examination.

For the award of Honours at the conclusion of the full-time course, students will need to have distinguished themselves in the formal work, in other assignments as directed by the Head of School, and in the final year project.

In the undergraduate course it is compulsory for students to gain practical experience in the mining industry during successive long recesses. The minimum requirement is 100 days which must be completed before graduation. The School assists students in securing suitable vacation employment. Students are required to submit for assessment an industrial

training report on the vacation and other relevant experience acquired.

Year 1		Hours per week S1	S2
PHYS1002	Physics 1	6	6
CHEM1807	Chemistry 1 ME	6	0
MECH1300	Engineering Mechanics 1	4	0
MECH1500	Computing	0	3
MINE0110	Stress Analysis in Mining 1	0	3
MINE0210	Mining, Minerals and the Environment*	0	3
MINE0310	Descriptive Engineering	2	0
MINE0410	Technical Communication	0	3
MATH1032	Mathematics 1	6	6
		24	24

* Visits to mines and related undertakings are a requirement of this subject.

Year 2			
PHYS2920	Electronics	3	0
MATS9420	Materials for Mining Engineers	3	3
ELEC0802	Electrical Power Engineering	0	3
MINE0120	Stress Analysis in Mining 2	3	0
MINE1320	Fluid Mechanics and Thermodynamics	2	2
MINE1420	Mine Development*	1	1
MINE1720	Microcomputers Mining	2	0
MATH2009	Engineering Mathematics 2	4	4
MATH2819	Statistics SA	2	2
GEOL5211	Geology for Mining Engineers**1	2	2
SURV0441	Surveying for Engineers	0	4.5
	General Education Subject/s (Category A)	2	2
		24	23.5

* Visits to mines and related undertakings are a requirement of this subject.
** Includes two compulsory field tutorials.

Year 3			
MINE1130	Mining Methods	2	2
MINE1231	Geomechanics A	3	0
MINE1232	Geomechanics B	0	2
MINE1330	Mine Transport	0	2
MINE1530	Power Supply in Mines	2	0
MINE1630	Excavation Engineering	2	2
MINE1730	Computer Applications in Mining	1	1
MINE1830	Mine Ventilation and Drainage	2	2
MINE1930	Mine Survey Camp	0	2.5
MINE2230	Mine Feasibility Studies	0	1
MINE4330	Mining Laboratory	2	2
MINE7342	Minerals Engineering Processes	3	3
SURV0580	Mining Surveying	3	0
GEOL5311	Geology for Mining Engineers 2*	4	4
	General Education Subject/s (Category B)	2	2
		26	25.5

* A geology field excursion is held in Session 2.

Year 4		Hours per week S1	S2
MINE1140	Geotechnical Engineering	2	2
MINE1740	Mining Legislation	0	2
MINE2140	Mine Economics and Planning	4	2
MINE2240	Operational Management	2	2
MINE3040	Mine Safety Engineering	2	2
MINE4140	Minerals Industry Project	5	5
MINE4240	Industrial and Research Seminars	1	1
APSE0002	Social Issues in Applied Science†	2	0
MINE4540	The Mining Engineering Profession in Society†	0	2

together with an approved group of three advanced subjects selected from the following†

MINE1040	Underground Coal Mining*	2	2
MINE1440	Surface and Offshore Mining	2	2
MINE1840	Underground Metalliferous Mining†	2	2
MINE1940	Tunnel Engineering and Shaft Sinking	2	2
MINE7440	Mineral Process Technology	2	2
		24	24

† Approval for a group of subjects must be obtained from the Head of School and must include at least one of the subjects marked*. An elective subject of special interest to a particular student but not on the above list may be taken, with the approval of the Head of Department.
†These subjects contribute towards the satisfaction of the Category C General Education requirement.

Graduate Study

Department of Applied Geology

Master of Applied Science courses are designed to give advanced training in developing specialisations within geology and are structured specifically for candidates from industry to take on a part-time basis.

Courses currently offered are in the fields of Engineering Geology, Hydrogeology, Environmental Geology, Mineral Exploration, Exploration Geophysics.

8020
Engineering Geology-Hydrogeology -Environmental Geology Course

Master of Applied Science
MAppSc

The course consists of a Project (Group A) and from five to eight subjects chosen from Group B, of which five are core subjects of the course. The total credit point requirement of the course is 30, of which the project could account for 6,9,15 credit points. The 6 and 9 credit point project is aimed at those students who prefer a higher content of teaching in their MAppSc course, or who find that their interests are not fully covered within the core subjects. The five core subjects are all taught in the first session. Up to three additional subjects, completed by full-time attendance during the second session, or part-time, or as an external student, may be credited towards the degree, with a consequent reduction in the project requirements. The project normally consists of field and laboratory work, and is related to the students major interests. Students must consult the Course Director for approval of the project topic.

Group A		**Hours Per Week**	**Credits**
GEOL9444	Project (Engineering Geology)	-	6
GEOL9454	Project (Engineering Geology)	-	9
GEOL9464	Project (Engineering Geology)	-	15

Group B		**Hours Per Week**	**Credits**
Core Subjects			
CIVL9788	Site Investigation	3	3
GEOL9011	Hydrogeology G	3	3
GEOL9030	Geological Engineering	3	3
GEOL9040	Fundamentals of Geomechanics	3	3
GEOL9060	Environmental Geology	3	3
GEOL9330	Geological Engineering	E	3
GEOL9340	Fundamentals of Geomechanics	E	3
Optional Subjects			
CIVL9790	Stability of Slopes	3	3
GEOL0110	Geological Remote Sensing	3	3
GEOL9020	Geopollution Management	3	3
GEOL9070	Engineering Geophysics	3	3
GEOL9320	Geopollution Management	E	3
MINE9414	Advanced Rock Mechanics	3	3

E= External
An additional requirement for the award of the MAppSc Engineering Geology is the satisfactory completion of laboratory and field practical sessions, attendance on field excursions, and contributions to tutorials and seminars.

8091
Mineral Exploration Graduate Course

Master of Applied Science
MAppSc

This course is under revision and will not be offered in 1992.

The course is designed to give broad training in techniques of modern mineral exploration to geologists and mining engineers. Practical aspects are emphasised and the field-laboratory project is oriented to current problems of mineral exploration. The duration of the course is one academic year of full-time study; the course is, however, divided into three units to facilitate part-time study. All students must complete Units A, B and C. Formal course work Units A and B accounts for 20-22 hours per week during Session 1. Some students depending upon their qualifications may be required to take a Special Project, GEOL0004 either as a pre or co-requisite. The courses within the three units may be varied at the discretion of the Head of the Department to suit the requirements of individual students.

Unit A (Weeks 1-7 Session 1)

GEOL0010 Seminar
GEOL0020 Geology in Exploration 1
GEOL0030 General Introduction to Exploration Geophysics
GEOL0040 Introduction to Exploration Geochemistry
GEOL0050 Introduction to Data Processing and Interpretation
GEOL0060 Resource Economics 1
and *either*
GEOL0070 Exploration Geophysics
or
GEOL0080 Exploration Project
MINE0130 Principles of Mining
and
MINE0440 Mining Economics
Seven days of field tutorials are an integral part of Unit A.

* These are one session subjects, i.e. weeks 1-14.

Unit B (Weeks 8 -14 Session 1)

GEOL0090 Advanced Geology in Exploration
GEOL0100 Resource Economics 2
GEOL0110 Remote Sensing
GEOL0120 Mining Law and Exploration Management
GEOL0240 Seminar
MINE0014 Exploration Drilling
and *either*
MINE0130* Principles of Mining
and
GEOL0440 Mining Economics
or
GEOL0130 Exploration Project

* These are one session subjects, ie weeks 1-14.

Unit C (Session 2)

GEOL0144 Field-Laboratory Project

8092
Exploration Geophysics Graduate Course

Master of Applied Science
MAppSc

This course is under revision and will not be offered in 1992.

This is a specialised course in the techniques of exploration geophysics relevant to the current needs of the exploration industry. Practical applications are emphasised, and the field-laboratory project is designed to investigate aspects of specific exploration problems.

The duration of the course is one academic year of full-time study; the course is, however, divided into three units to facilitate part-time study. All students must complete units A, B and C. Formal course work Units A and B accounts for 20-22 hours per week during Session 1. Some students depending upon their qualifications may be required to take a Special Project, GEOL0004 either as a pre or co-requisite. The courses within the three units may be varied at the discretion of the Head of the Department to suit the requirements of individual students.

Unit A (Weeks 1-7 Session 1)

GEOL0010 Seminar
GEOL0020 Geology in Exploration 1
GEOL0030 General Introduction to Exploration Geophysics
GEOL0040 Introduction to Exploration Geochemistry
GEOL0050 Introduction to Data Processing and Interpretation
GEOL0060 Resource Economics 1
GEOL0070 Exploration Geophysics

Seven days field tutorials are an integral part of Unit A.

Unit B (Weeks 8-14 Session 1)

GEOL0210 Geological Interpretation
GEOL0220 Advanced Exploration Geophysics
GEOL0240 Seminar

Unit C (Session 2)

GEOL0234 Field-Laboratory Project

8094
Geological Data Processing

Master of Applied Science
MAppSci

This program is intended for industry-based geologists who wish to enhance their skills in the computer processing of geological data. It is delivered as a series of separate academic subjects, each consisting of a one week residential short course with additional assignment material and an industry-based project. The short courses are scheduled to allow the degree program to be completed on a part-time basis over two years. The program allows an emphasis to be placed on data processing in mineral exploration, exploration geochemistry, ore reserve estimation, image processing and remote sensing, exploration geophysics or fossil fuel deposits. Optional subjects are also available to provide complimentary training in topics such as mine and environmental management and project evaluation.

Candidates are required to complete a course of 30 credits including either a 6 or 12 credit project. Alternative subjects may be substituted in the published program at the discretion of the Head of the Department.

Core Subjects		**Credits**
These subjects are compulsory		
GEOL0300	Computing and Statistics for Geologists*	3
GEOL0310	Image Processing of Spatial Data Sets	3
GEOL0320	Geostatistical Ore Reserve Estimation	3
		9
and either		
GEOL0304	Data Processing Project 1	6
or		
GEOL0314	Data Processing Project 2	12

Electives

Between 9 and 15 credits of elective subjects may be selected to make a total of 30 credits.

Technical

GEOL0330	Conceptual Models for Exploration Geology	3
GEOL0340	Geochemical Exploration Techniques	3
GEOL0350	Exploration Geochemical Data Processing	3
GEOL0360	Remote Sensing Applications in Geoscience	3
GEOL0370	Fundamentals of Exploration Geophysics	3
GEOL0380	Electrical Methods in Geophysical Exploration	3
GEOL0390	Data Processing for Fossil Fuel Resources	3
GEOL9060	Environmental Geology	3
GEOG9210	Computer Mapping and Data Display	3
GEOG9240	Geographic Information Systems	3
REMO9581	Microwave Remote Sensing	3

Business Managment

KCME4201	Export Marketing for the Mining Industry	3
KCME4202	Mine Evaluation and Project Assessment	3
KCME4203	Mine Management	3
KCME4301	Environmental Management for the Mining Industry	3

or such other subjects as the course authority may deem to be appropriate and equivalent.

* For students with an adequate background in computing and statistics this subject may be replaced by an additional elective subject. The approval of the course authority is required.

1000
Doctor of Philosophy (PhD) and
2000
Master of Science (MSc)

Research may be undertaken in fundamental or applied aspects of Geology. Collaborative programmes with industry and government are encouraged. The following lists should not be considered as limiting the possible scope of any research project.

Mineral and Energy Resources

Exploration Geochemistry
Exploration Geophysics
Mineral Exploration
Ore Forming Processes
Resource Economics
Remote Sensing in Exploration
Image Processing
Petroleum and Coal Geology
Non-metallic Mineral Resources
Marine Geophysics
Mathematical Geology
Sedimentary Basin Analysis
Geological Data Processing

Engineering and Environmental Studies

Environmental Geology
Engineering Geology
Geomechanics
Clays and Aggregates
Coastal and Esturine Geology

Hydrogeology and Waste Management

Hydrogeology
Geopollution Management
Groundwater Geophysics
Groundwater Studies and Modelling
Waste and Landfill Disposal
Groundwater Contaminant Transport

Fundamental Geological Studies

Palaeontology
Micropalaeontology
Petrology
Stratigraphy
Sedimentology
Structural Geology
Antarctic Geology
Marine Science

Centre for Groundwater Management and Hydrogeology

The Centre for Groundwater Management and Hydrogeology was established in 1987 as a Federal National Centre. It is a joint enterprise of the faculties of Applied Science and Engineering with general aims to research groundwater problems of strategic national importance and to co-ordinate and develop postgraduate courses, continuing education programs and to liaise with industry. The Centre offers specialized graduate courses in Hydrogeology and Groundwater Management and in Waste Management. A Graduate Diploma in Waste Management is also offered.

For the Master of Applied Science in Groundwater Management and Hydrogeology candidates are required to complete 30 credits, made up of the core subjects, elective subjects and a project.

The degree may be taken internally on a full-time (normally 2 sessions) or a part-time (normally 4 sessions) basis. The course of study must be approved by the Director of the Centre for Groundwater Management and Hydrogeology.

8021
Hydrogeology and Groundwater Management Graduate Course

Master of Applied Science
MAppSc

Core Subjects		**Credits**
GEOL9010	Hydrogeology	3
CIVL9880	Groundwater Modelling	3
MINE9374	Hydrogeochemistry	3
CIVL9875	Hydrological Processes	3
GEOL9090	Computing for Groundwater Specialists	

Options

GEOL9020	Geopollution Management	3
GEOL9080	Groundwater Geophysics	3
GEOL9100	Remote Sensing of Groundwater Resources	3
CIVL9842	Groundwater Hydrology	3
CIVL9847	Water Resources Policy*	3
CIVL9849	Irrigation*	3
CIVL9850	Drainage of Agricultural land*	3

Project

GEOL91144	Groundwater Research Project	12
GEOL9124	Groundwater Project	9

* Existing subject not offered each year

8612 (Internal)
8614 (External)
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 30 credits, made up of compulsory subjects, elective subjects and a project. The degree may be obtained internally on a full-time (normally 2 sessions) or part-time (normally 4 sessions) basis. An external course program is also offered (normally over 4 sessions) to students outside Sydney with resource material posted to students and evaluation made on written assignments and examinations.

Candidates are enrolled as MEngSc or MAppSc depending on their previous qualification experience and course content.

Internal Program

Compulsory Subject		Credits
CIVL9872	Solid Waste Management	3
CIVL9881	Hazardous Waste Management	3
CIVL9884	Environmental Engineering Science 1	3
CIVL9886	Environmental Engineering Science 3	3
FUEL5880	Unit Operations in Wastewater Sludge and Solids Management	3

Project (MEngSc)

CIVL9909		9

Project (MAppSc)

GEOL9504		9

Elective Subjects

(2 of the following for MEngSc, 3 for GradDip)

CEIC5630	Industrial Water and Wastewater Engineering	3
CIVL9857	Sewage Treatment and Disposal	3
CIVL9887	Advanced Topics in Waste Management	3
FUEL5920/ CIVL9870	Atomospheric Pollution Control Hydraulics and Design of Water and Wasterwater Treatment Plants	3
GEOG3042	Environmental Impact Assessment	3
GEOL9011	Hydrology G	3
GEOL9020	Geopollution Management	3
GEOL9060	Environmental Geology	3
MINE1524	Mining Conservation	3
MINE5355	Mine Fill Technology	2
SAFE9543	Management of Dangerous Materials	3
SAFE9242	Human Behaviour and Safety Science	3

External Program

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

Project	Credits
CIVL8909	9

Project

CIVL8803	3

Notes: MEngSc students undertake a 9 credit project to make 30 credits an GradDip students complete a 3 credit project to make 24 credits.
Civil subjects starting with 8 are the external equivalents of the internal subjects starting with 9.
* Subject to approval of Course Coordinator.

5070
Waste Management Graduate Diploma Course

Graduate Diploma
GradDip

Candidates are required to complete a course totalling at least 24 credits made up of compulsory subjects, elective subjects and a 3 credit report. The diploma may be obtained full-time normally (2 sessions) or part-time (4 sessions) basis. An external course program is also offered (normally over 4 sessions).

Selection of subjects for formal course work must be approved by the Director of the Centre for Groundwater Management and Hydrogeology.

Core Subjects		Credits	Session
CIVL9872, CIVL8872*	Management of Wastes	3	2
CIVL9873, CIVL8873*	Waste and Wastewater Analysis and Environmental Requirements	3	1
CIVL9874, CIVL8874*	Waste Management Science	3	1
CIVL9883, CIVL8883*	Sources of Waste and Landfill Disposal	3	1
FUEL5880, FUEL5881*	Unit Operations in Wastewater Sludge and Solids Management	3	1

* denotes external subject numbers

Elective Subjects

MINE1524	Mining Conservation
MINE5355	Mine Fill Technology
FUEL5920	Atmospheric Pollution Control Theory
FUEL5921	Atmospheric Pollution Control Practical Aspects
CIVL9857	Sewage Treatment and Disposal
CIVL9870	Hydraulics and Design of Water and Wastewater Treatment Plants
CIVL9882	Industrial Waste Management
GEOL9010	Hydrogeology
	Geopollution Management
GEOL9060	Environmental Geology
SAFE9543	Management of Dangerous Materials

SAFE9242 Human Behaviour and Safety Science
CEIC5630 Industrial Water and Wastewater Engineering

Alternative Graduate Programs in association with the Department of Applied Geology are available in the following areas:

School of Geography

5026 Graduate Diploma in Remote Sensing (GradDip)
8026 Remote Sensing Graduate Course (MAPPSc)
8045 Environmental Studies Graduate Course (MEnvStudies)

Faculty of Engineering

5495 Graduate Diploma in Remote Sensing (GradDip)
8640 Remote Sensing Graduate Course (MEngSc)

Department of Mining Engineering

8055
Mining and Mineral Engineering Graduate Course

Master of Applied Science
MAppSc

This course is offered to provide postgraduate training in subjects appropriate to the mining industry. There is a core of professional subjects, and the electives needed to complete the course be taken to suit a graduates previous experience or a chosen career path.

The MAppSc course is linked with the Mining Management Graduate and Graduate Diploma Courses offered through the Key Centre for Mines, and transfer between these programs will be possible with appropriate credit for subjects completed.

The Master of Applied Science program has been designed for completion of its 36 credit points in one year full time. The teaching components should be completed in two sessions. The subjects which are listed below may be offered in two formats dependent on class sizes and student skills, and in general should be completed within one session.

A full teaching session subject will comprise approximately fourteen weeks of lectures, tutorials, and any associated laboratory work. Alternatively, the lecture material may be offered as a one-week short course module in conjunction with the Key Centre equivalent course. The module would be preceded and followed by appropriate reading and tutorials. Assessment will consist of a combination of assignments and examinations complement the lecture mode.

Due to the varied entry routes there will be a difference of skills among candidates. Consequently there are two prescribed core courses, one for non-mining entrants, and the other for qualified mining graduates and entrants from the Graduate Diploma course. Exemptions may be given from one or more core subjects to appropriate candidates but a full complement of 36 credit points must still be attained.

Entry for Four-Year Graduates - Non-Mining

Core Subjects		**Credits**
MINE0130	Principles of Mining	2
MINE1224	Mining Engineering Technology	6
MINE1524	Mining Conservation	3
MINE3114	Mineral Beneficiation	3
and one of		
MINE5064	Minor Project	6
MINE5124	Project	12
MINE5184	Major Project	18

Entry for Graduates in Mining Engineering or from Course 5040

Core Subjects		
MINE5324	Principles of Mining Engineering (2)	6
MINE1524	Mining Conservation (1)	3
and either		
MINE3224	Mineral Beneficiation Technology	6
or		
MINE4424	Mineral Industry Analysis	3
and one of		
MINE5064	Minor Project	6
MINE5124	Project	12
MINE5184	Major Project	18
MINE3654	Minerals Engineering Project	9

Notes: (1) or equivalent subject from Key Centre for Mines
(2) Minerals Engineering candidates may be permitted to substitute electives if they have a mining industry background.
(3) The choice of project is subject to approval from the Head of School.

Elective subjects for all candidates		
GEOL0300	Computing and Statistics for Geologists	3
GEOL0330	Geostatistical Ore Reserve Estimations	3
GEOL0390	Conceptual Models for Exploration Geology	3
MINE0014	Exploration Drilling	3
MINE1514	Ground Control and Excavation Engineering	3
MINE1534	Environmental Conditions in Mines	3
MINE1544	Rock Excavation and Transportation	3
MINE3224	Mineral Beneficiation Technology	6
MINE3514	Mineral Beneficiation Plant Design	3
MINE3614	Minerals Engineering 1	6
MINE3624	Minerals Engineering 2	6
MINE3634	Minerals Engineering Laboratory	3
MINE3644	Minerals Engineering 3	6
MINE4424	Minerals Industry Analysis	3
MINE4055	Numerical Methods in Geomechanics	3
MINE4155	Stability of Slopes	3
MINE5155	Rock Mechanics Measurements	3
MINE5255	Strata Control Engineering	3
MINE5355	Mine Fill Technology	3
MINE5455	Advanced Rock Cutting Technology	3
MINE5555	Blasting Technology	3
MINE5655	Rock Slope Stability	2
MINE5755	Subsistence Engineering	2
MINE9174	Fire and Explosion	2
MINE9364	Equilibrium Concepts in Water Systems	3

		Credits
MINE9374	Hydrogeochemistry	3
MINE9415	Advanced Rock Mechanics	3

Notes: (1) Any Key Centre module may also be taken, subject to (2).
(2) Electives must be chosen on enrolment and approved by the Course Director; some electives are mutually exclusive.
(3) Attention is also drawn to subjects available from the for Department of Safety Science, the Centre for Waste Management and the School of Chemical Engineering. Subjects to timetables and minimum class sizes in various departments, electives may be chosen from those and other course authorities.
(4) Not all electives in the above list will be offered each year.

8056
Mining Geomechanics Graduate Course Part-time (External)

Master of Applied Science
MAppSc

The course is offered to enable graduate mining engineers, geologists and civil engineers stationed in remote locations to carry out advanced theoretical and practical studies in geomechanics applicable to mining operations. Most of the work is completed by correspondence, with the exception of short annual residential schools of two weeks duration at the Kensington campus.

Enquiries from graduates living in the Sydney metropolitan area, as well as from graduates in other disciplines, are welcomed. In the latter case it may be necessary to include supporting subjects at undergraduate level within the Masters' program as approved by the Head of Department, up to a maximum of 25 per cent of the total program. It may also be necessary in some circumstances to take some prerequisite or co-requisite background undergraduate subjects, as directed by the Head of Department.

The program consists of formal study equivalent to six hours of lectures per week, for three years on a part-time external basis. One third of total program consists of a project on an approved topic covering a field or laboratory investigation of a mining geomechanics problem.

Six of the subjects, in addition to the project, form a compulsory core strand. These are augmented by a range of elective subjects. Two electives are to be selected for study, subject to the approval of the Head of School and availability of the topics.

Assessment is by formal examination at appropriate country centres where necessary and by assignment work.

Year 1		Hours per week S1	S2
GEOL9030	Fundamentals of Geomechanics	3	0
MINE5155	Rock Mechanics Measurements	3	0
GEOL9040	Geological Engineering	0	3
One elective subject		0	3

Year 2

MINE9415	Advanced Rock Mechanics	3	0
MINE4055	Numerical Methods in Geomechanics	3	0
MINE4155	Stability of Slopes	0	3
One elective subject		0	3

Year 3		Hours per week S1	S2
MINE4555	Mining Geomechanics Project	6	6

Elective Subjects to be chosen from

GEOL9010	Hydrogeology
MINE5355	Mine Fill Technology
MINE5455	Advanced Rock Cutting Technology
MINE5555	Blasting Technology

5040
Mining and Mineral Engineering Graduate Diploma Course

Graduate Diploma
GradDip

The Graduate Diploma course in Mining and Mineral Engineering serves two purposes. It can provide a professional introduction to the mining industry for graduates in Science, Applied Science or Engineering and it is a qualifying course for entry to the Master of Applied Science and Master by Research programs.

The Graduate Diploma will be awarded after successful completion of one year full-time or two years part-time study. The course is a blend of lecture and laboratory work and an appropriate choice of the laboratory work and project can lead to some specialisation in either mining engineering or minerals engineering. When appropriate, some sections of the course may be offered as a unit over a short period to permit mineral industry personnel to attend on a part-time basis.

The level of the Graduate Diploma is designed to be equivalent to a four-year honours degree and on that basis up to 9 credit points of undergraduate subjects may be substituted for the topics shown where appropriate to the skills of the student concerned.

Full-time Program		Credits
MINE0130	Principles of Mining	2
MINE1114	Mining Engineering	6
MINE1224	Mining Engineering Technology	6
or		
MINE3224	Mineral Beneficiation Technolog y	6
MINE1324	Mining Laboratory and Project	8
or		
MINE3224	Mineral Engineering Laboratory and Project	8
MINE2340	Mineral Economics	3
MINE3114	Mineral Beneficiation	3
MINE7140	Mineralogical Assessement	1
MINE7341	Mineral Process Engineering	2
		30

Part-time Program
This should be discussed with the Head of Department. In principle, the part-time program should be completed in two years by taking approximately 15 credit points in each year. MINE1224 and MINE1324, or MINE3224 and MINE3324 would be taken in the second year.

Electives
Subjects with a value of up to 6 credit points taken from within the School of Mines may be substituted for those listed above, subject to approval by the Course Director. Subjects from other courses in the University may also be chosen by agreement with the appropriate Head of School.

Key Centre for Mines

The Key Centre for Mines is a joint initiative of the Universities of New South Wales and Wollongong, funded by the Department of Employment, Education and Training. The purpose of the Key Centre for Mines is to provide a full range of educational and research services to the Minerals Industries.

Particular emphasis is being placed on continuing education, distance learning and industry based research and development.

The industry sector being addressed by the Key Centre for Mines covers the exploration, extraction, and primary processing of mineral resources.

Mining Management Graduate and Graduate Diploma Courses

8057
Master of Mining Management
MMinMgmt

5057

Graduate Diploma in Mining Management
GradDipMinMgmt

The courses are designed to give mining personnel the opportunity to extend their career paths into management levels. Candidates will be able to select course work modules from Business Management and Science and Technology Streams. The delivery of the course work modules has been designed to enable the participation of professional staff in the minerals industries no matter how remote the location of their particular operation. This delivery will either be in the form of one week short courses, with follow-up assignments, or by correspondence only. Each module is of 3 credits value. In normal circumstances no more than two modules may be undertaken by correspondence.

It is anticipated that candidates will come from a wide range of educational and training backgrounds. The normal entry qualification for the Graduate Diploma is a relevant three-year degree or equivalent. This may be demonstrated by equivalent experience and/or the holding of a position of appropriate responsibility. The normal entry qualification for the Masters Degree is a relevant four-year degree or equivalent. This may be demonstrated by equivalent experience and/or the holding of a position of appropriate responsibility. A preliminary program is available for candidates who do not fully meet the normal requirements.

Five modules are required for the GradDipMinMgmt with a minimum of two from either the Business Management or the Science and Technology Streams. For the Master of Mining Management it is necessary to complete eight modules, with a minimum of three from either stream. The Master's program also includes an industry-based project equivalent to one third of the course. The courses will be structured in a way that allows movement between the two programs in some circumstances; a graduate of the GradDipMinMgmt course may be able to continue to a MMinMgmt by completing a further three modules and the industry-based project.

Assessment is by assignment for most modules but may be by formal examination. Examination of the correspondence components of the course is undertaken at a number of regional centres.

Science and Technology Modules (subjects)

KCME1102 Safety in the Mining Industry
KCME1103 Drilling and Blasting
KCME1107 Computing for Geologists and Mining Engineers
KCME1302 Mine Ventilation
KCME2101 Strata Control
KCME2104 Application of Computers in the Mining Industry
KCME2105 Geostatistics and Mine Planning
KCME4102 Placer Technology
KCME4301 Environmental Management for the Mining Industry*

Business Management Modules (subjects)

KCME3201 Financial Management**
KCME3202 Management Perspectives**
KCME3203 Economic Decision Making**
KCME3204 Management of Innovation**
KCME3205 Strategic Planning**
KCME3206 Mineral Law
KCME4201 Export Marketing for the Minerals Industry
KCME4202 Mine Evaluation and Project Assessment
KCME4203 Mine Management
KCME4301 Environmental Management for the Mining Industry*

Industry-Based Project

(Master of Mining Management candidates only)

KCME1300 Mining Management Project 12 credits

* May be taken as either a Science and Technology or a Business Management Module.
** May be offered by correspondence.
Unless otherwise stated all modules are of 3 credit value.
Equivalent or additional courses can be added at the discretion of the Head of the School of Mines.

Undergraduate Study

Department of Mining Engineering

APSE0002 Social Issues in Applied Science S1

The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

MINE0110 Stress Analysis in Mining 1 S2 L1 T2

Concepts of stress and strain. Mohr's circle diagrams. Introduction to elastic theory. Simple beam and column theory. Introduction to computer methods of stress analysis in mining.

MINE0120 Stress Analysis in Mining 2 S1 L1 T2

Prerequisite: MINE0110

Statics in mining systems. Bending moments, shear force and torsion. Combined stresses, calculation of principal stresses and strains. Brittle behaviour and anistropy. Time-dependent properties and creep. Computer methods of stress analysis.

MINE0130 Principles of Mining S1 L2

Mining Engineering terminology and definitions. Drilling techniques for production blasting and exploration. Explosives and rock fragmentation processes. Mine development, access to mineral deposits and their exploitation. Surface and underground techniques. Methods of working coal and metalliferous deposits. Methods of ground support. Offshore mining; the ventilation and drainage of mines; mine transport and materials handling. Mine safety engineering.

MINE0210 Mining, Minerals and Environment S2 L2 T1

Mineral deposits - metallic, non-metallic and fuels. Elements of prospecting and exploration. Basic mining techniques - mine development, mineral extraction and abandonment of mines. Mining services. Unit operations of mineral processing and extractive metallurgy. The engineer and society. Professional ethics. Community relationships. Alternative land uses. Disposal of mine waste and its commercial exploitation. Mine lease rehabilitation and restoration. Pollution monitoring and control. Environmental impact statements. Legislative controls on mining and on mineral exports.

MINE0310 Descriptive Engineering S1 L1 T1

Aspects of engineering technology required for a full understanding of the mining engineering course. Internal combustion and compression ignition engines, portable diesel power. Gearboxes, automatic transmissions. Flexible couplings, bearings, gear trains, belt drives, hydrokinetic and hydrostatic drives. Hydraulic circuits. Glands, seals, stuffing boxes. Rotary pumps and reciprocating pumps. Compressed air generation and reticulation. Track-laying vehicles. Braking systems - drum, disc and wet plate. Boilers and power generation. Electrical control and drive systems for mining machinery. Basic ergonomics for machine controls.

MINE0410 Technical Communication S2 L1 T2

Introduction to engineering drawing - Australian standards, first and third angle projections, isometric drawing. Engineering sketches, presentation of oral and written data, engineering graphics. Meetings and staff training. Report writing - analysis of experimental data and presentation of graphs and figures.

MINE0440 Mining Economics S1 L2 T2

Aspects of micro- and macro-economics. Theory and practice of resource sampling. Valuation of mineral properties and mining projects including reserve calculation by traditional and geostatistical methods. Geological reserves and mining reserves. Interaction of grade, tonnage, mining recovery and mining method. Financing of mining ventures. Types of mining companies - private, public, no-liability. State ownership and participation. Investment decision analysis - cash flow models, sensitivity analysis. Marketing of mineral commodities.

MINE1040 Underground Coal Mining F L1 T1

Prerequisites: MINE1130 and MINE1140, MINE1231, MINE1830.

Effect of surface improvements and structural geology on mine layout. Influence of coal seam properties on choice of extraction height and working section. Coal properties related to machine extraction. Pillar and coalface layouts to optimise strata control. Face and roadway support systems. Mechanised extraction: cutting machines, their stability and steering, armoured face conveyors and stage loaders, coal clearance systems, coal bunkerage. Mechanisation problems in thin, thick, steep and faulted seams. Multi-seam layouts. Limitations on face advance rate. Logistics of high-speed extraction - supplies, manpower, rapid transfer of face equipment. Packing and stowing. Hydraulic mining. Supervision and performance criteria.

MINE1130 Mining Methods F L2

Prerequisite: MINE1420

Technical and environmental considerations for mining by surface or underground methods. Permanent mining facilities and mine development. *Metalliferous deposits:* underground and surface mining. Sublevel open stoping, sublevel caving, cut and fill stoping, other underground mining methods. Pillar recovery. *Coal and lignite deposits:* occurrence in Australia. Surface mining methods - considerations of terrain, mining of single, multiple, thin, thick and steeply inclined seams. Underground mining methods - use of panels, pillared, shortwall and longwall mining of thin, thick, multiple and steeply inclined seams. Abandonment of mines.

MINE1140 Geotechnical Engineering F L1 T1

Prerequisites: MINE1231, MINE1232.

Stresses around mine openings: magnitude and distribution, determination by analytical methods, analogue and mathematical modelling, in situ measurements. Energy changes caused by excavations. Initiation and propagation of failure in rock structures. Stability of excavations: natural and artificial supports, permanent and temporary supports. Design of support systems. Stability of rock slopes. Ground control measurements. Rockbursts. Outbursts in coal. Mining subsidence, nature effects, prediction and control.

MINE1231 Geomechanics A **S1 L1.5 T1.5**

Prerequisite: MATH1032. Co-requisite: MINE4330.

Rock mass, rock material and discontinuities. Geomechanical properties of discontinuities - orientation, spacing, persistence, roughness, apertures and filling. Rock mass classification. Rock strength and deformability, concepts and definitions, common laboratory strength tests, measurement of deformability by static tests, dynamic measurements, influence of time on rock deformation. Strength criteria for isotropic and anisotropic rock material, shear behaviour of discontinuities, behaviour of rock masses containing discontinuities. Pre-mining state of stress and its measurement.

MINE1232 Geomechanics B **S2 L1 T1**

Prerequisite: MATH1032 Co-requisite: MINE4330.

Soil description and classification, engineering behaviour of soils, basic definitions in soil mechanics, effective stress concept, shear strength of soils, soil permeability, flow of water in soils, consolidation, stresses in soil from external loading, design of shallow foundations, compaction, compaction control, pavement and haul-road design, lateral earth pressures, soil slope stability, expansive and dispersive soils, filter design.

MINE1320 Fluid Mechanics and Thermodynamics **F L1 T1**

Prerequisites: MINE0110, MECH1300, PHYS1002, MATH1032. Co-requisite: MATH2001.

Fluid properties, fluid statics, fluid flow - laminar and turbulent. Continuity equation, energy equation, momentum equation. Flow measurement. Pumps and pump characteristics. Energy losses in pipelines and open channels. Boundary layer theory. Dimensional analysis. Thermodynamic systems - states, processes and properties. Energy of a system, first and second laws of thermodynamics. Reversibility, ideal gas laws, cycles for heat engines, heat pumps, compressors and refrigerators, psychrometrics.

MINE1330 Mine Transport **S2 L2 T1**

Transport requirements for minerals, waste, supplies and people. Mine winding systems for shafts and drifts. The mechanics of hoisting. Mine ropes and chains. Winding cycle diagrams and calculations. Surface and underground haulage arrangements. Secondary transport systems. Rope haulage, aerial ropeways, monorails, belt conveyors, locomotive haulage. Track mounted, crawler and trackless methods. Elements of soil vehicle mechanics applied to mining equipment. Primary systems. Chain, screw and bucket conveyors and elevators. Shaker and vibratory conveyors. Hydraulic and pneumatic transport methods. Chutes and bunkers. Design of transport systems.

MINE1420 Mine Development **F L1**

Prerequisite: MINE0210.

Infrastructure requirements for mines and mining communities. Prospecting, exploration, mine feasibility studies, statutory requirements. Surface requirements and layout for winding, ventilation, drainage, mine services, administration, welfare. Mine working drawings. Provision of primary underground access by shaft, drive, drift, decline and incline, adit, raise, winze. Development through water-bearing and unconsolidated ground. Explosives applied in mine development. Development by tunnelling machine. Equipping shafts. Ground support during development. Emergency egress requirements. Development of surface metalliferous and coal mines. Spoil and waste disposal, land restoration and other environmental considerations. Preparation of Environmental Impact Statements.

MINE1440 Surface and Offshore Mining **F L1 T1**

Prerequisite: MINE1130.

Surface mining of tabular and other deposits, general methods, current trends. Planning and design of surface mines; reserves, scale of operations, surface facilities. Stripping ratio, pit limit determination by manual and computer-based methods, phase plans, operating layouts, scheduling. Mining systems: equipment selection, type, capacity and fleet size, operational costs, maintenance. Slope stability: pit walls, spoil piles, ground water control. Surface rehabilitation. Stream and offshore dredging for metals, minerals, gemstones and construction materials. Evaluation of marine deposits. Dredge design and operation. Beach sand mining. Deep sea mining. International agreements and law. Project.

MINE1530 Power Supply in Mines **S1 L1 TI**

Prerequisite: MINE0310, MINE1320, PHYS2920, ELEC0802.

Electric power distribution, mine cables, switchgear. Flameproofing and intrinsic safety, fault protection. Oil hydraulic power. Fluid characteristics. Components and circuits. Pumps, motors, valves. Speed and torque control. Compressed air: generation, distribution, applications and equipment, compressors. Control theory, automatic control in mining.

MINE1630 Excavation Engineering

Rock drilling and boring. Percussive, rotary, hybrid and exotic methods. Drilling patterns for shafts, headings, faces and benches. Classification of chemical explosives and their application. Detonation. Misfire procedures. Alternative explosive agents. Special blasting techniques including presplitting, profiling, trenching, casting and demolition. Environmental considerations, handling and storage of explosives, vibrations. Nuclear blasting. Rock fragmentation by machine. Principles of rock cutting mechanics. Drag picks and free rolling cutters. Hydraulic mining. Water jet cutting. Thermal, electrical, ballistic and other novel fragmentation techniques. Rock cutting tool materials. Effect of tool metallurgy on wear and fracture resistance. Methods of assessment rock cuttability. The design of cutting arrays for machine mining.

MINE1720 Microcomputers in Mining **S1 L1 T1**

Types of microcomputers, components, operating systems. Spread sheets, data bases and word processors. Software applicable to mining. Use of microcomputers for control, monitoring and data acquisition.

MINE1730 Computer Applications in Mining **F L1**

Prerequisite: MINE1720.

Simulation of mining problems. Application of selected programs to exploration, operations, economics and design.

MINE1740 Mining Legislation **S2 L2**

An appreciation of the laws relating to mining practice and to safety and health in mines.

MINE1830 Mine Ventilation and Drainage F L2 T1

Prerequisites: MINE1320, MINE1420. Co-requisite: MINE4330.

Mine ventilation - practice in mines, forces causing airflow, resistance of workings and distribution of mine air, network analysis, fans and their operation, auxiliary ventilation calculations, economic size of airways. Ventilation surveys. Mine gases - hazards, occurrence, detection, monitoring and control. Airborne dust - physiological effects, sampling, measurement and analysis, sources and control. Mine climate - physiological effects, air cooling power, factors affectring mine climate and control. Ventilation planning - airflow requirements based on gaseous, airborne dust and heat pollutants.

Mine drainage - engineering hydrology, sources of mine water, forecasting water inflows, drainage and dewatering, pumps and pumping.

MINE1840 Underground Metalliferous Mining F L1 T1

Prerequistes: MINE1130.

Production, development and resource scheduling. Main development, slope development. Cyclic and continuous production systems - slope, haulage, hoisting; use of stockpiles and multi-face production systems. Optimum ore fragmentation, material flow in passes. Pillar recovery. Optimum fill selection. Preparation and placement of mine fills. Bulkhead design, fill dewatering. Ground support during stoping. Practice in Australasia. Mine design project.

MINE1930 Mine Survey Camp S2 T2.5

Exercises in surveying at one or more mines, in close collaboration with mining company mine surveying personnel.

MINE1940 Tunnel Engineering and Shaft Sinking F L1 T1

Not available to students who have completed MINE1640.

Scope for tunnels. Site investigation. Primary excavation in soft and hard ground. Drilling and blasting. Tunnelling shields, full face boring, partial face machines. Debris disposal. Temporary and permanent support. Ground stability. Sub-aqueous tunnels. Cut and cover tunnels, immersed tubes. Compressed air working. Environmental considerations. Tunnel services, ventilation, drainage and lighting for road and all-rail tunnels. Shaft sinking in different ground conditions. Ground treatment before excavation. Shaft lining.

MINE2140 Mine Economics and Planning S1 L2 T2 S2 L1 T1

Prerequisite: MINE1130, MINE2230.

Resource sampling, reserve calculations by traditional methods and by geostatistics, feasibility studies including calculation of capital costs and operating costs, company taxation. Feasibility study project. Project financing - equity, debt, leasing, non-recourse financing, joint ventures. Company types and structures, capitalisation, documents of incorporation and of annual reports. Commodity marketing, metal exchanges, producer pricing, price forecasting. Mining law, mineral ownership, federal and state responsibilities, royalties. Projectr control, contracts, insurance. Operating cost systems, discounted cash flow techniques appllied to mine expansion and system modification. Replacement of mine plant.

MINE2230 Mine Feasibility Studies S2 L1

Elements of mineral project cash flow. Application of numerical discounted cash flow techniques to economic analysis of mineral projects. Parameter sensitivity calculations.

MINE2240 Operational Management F1 L1 T1

Approaches to management study: managerial functions, objectives and decision making, organisation concepts, elementary industrial psychology, work measurement and appraisal, industrial relations, communication, negotiations, recruitment, selection and training of personnel. Operations research, control networks, decision analysis, linear programming, queueing theory, simulation, purchasing and stores policy, management accounting and budget controls, reliability engineering, maintenance procedures, personnel and materials management.

MINE2340 Mineral Economics F L1

Business cycles. Theory of wages. Types of mine, contracts. London metal exchange. The economics of processing after the mine lease. National stockpiles. Depletion of world resources. Prediction techniques for supply and demand. Type of company, statutory duties of directors.

MINE3040 Mine Safety Engineering F L1 T1

Safety precautions against outbursts. Methane drainage. Fires and explosions in coal and metalliferous mines, explosible dust. Spontaneous combustion. Water hazards in mines and precautions against inundation. Mine rescue and recovery. Noise measurement, hearing hazards and control. Mine lighting. Poisons and general toxic hazards. Radiation hazards. Loss control, accidents, accident investigations, safety programs. Safety and health legislation.

MINE4140 Minerals Industry Project F T5

Candidates are required to submit a disseration or thesis on a mining, minerals engineering or other topic approved by the Head of Department. The work may take the form of an engineering analysis, experimental investigation, theoretical study or design project. Candidates may be required to present themselves for oral examination on the subject of their submission.

MINE4240 Industrial and Research Seminars F L1

The program includes two types of seminar. One deals with research work being undertaken or recently completed by members of the School of Mines. The other involves engineers and scientists from industry, other University schools and research establishments discussing projects of special or topical interest in mining and allied fields.

MINE4330 Mining Laboratory F T2

Co-requisites: MINE1231, MINE1232.

A program of laboratory experiments for Year 3 students requiring the submission of appropriate laboratory reports related to the syllabus areas of the the co-requisite subjects.

MINE4540 The Mining Engineering Profession In Society

Prerequisite: APSE0002.

The numerous sections of society with which mining engineers may interact and their diverse expectations; the potential for divided loyalty, mistrust and conflict. The consequences of

mining engineers being employed as professionals; codes of ethics and their effectiveness; scepticism about the attitude of 'limited responsibility'. Possible future controls of the profession and industry. *One* of the following:- (a) The potential impact of an international policy of sustainable development on the mineral industry and how it may be implemented. *or* (b) A systematic process of decision-making, illustrated by assessment procedures for major projects and raising the issue of who would be involved. *or* (c) How responsible people outside the mineral industry see key problems associated with the industry in Australia. The subject will be taught via tutorials and a mini-project.

MINE7140 Mineralogical Assessment S1 L1

Assessment of the physical and chemical properties of economic minerals. Significance of the textures of minerals on the selection of mineral beneficiation processes. Destructive and non-destructive testing of bore cores. Factors influencing effective comminution and liberation.

MINE7250 Chemical and Extractive Metallurgy 1 S2 L2 T1

Metallurgical thermodynamics and kinetics. Review of the First Law of Thermodynamics, Thermochemistry, and material balance calculations. Review of the Second Law, free energy function, statistical interpretation of entropy, and Third Law. Phase equilibria in a one component system. Reactions involving gases, and gases with pure condensed phases. Graphical representation of equilibria. Ellingham diagrams and Kellog predominance area diagrams. Tabulation of thermodynamic data and sources of data. Introduction to heterogeneous kinetics, reactions of a solid particle with a gas.

MINE7341 Mineral Process Engineering S1 L2

The necessity for minerals beneficiation. Mineralogical assessment. Comminution: fracture, liberation, size-criteria, energy-size relationships. Crushing, grinding and attrition. Screening and classification, cyclones. Concentration processes, density, electrical, magnetic and other physical methods. Interfacial phenomena. Surfactants. Flotation. Liquid-solid separation: flocculation, thickening, agglomeration, filtration. Materials balances.

MINE7342 Minerals Engineering Processes F L1 T2

Beneficiation requirements. Scope of mineral processing. Sampling and mineralogical assessment. Comminution, fracture, liberation, size criteria, energy-size relationships. Crushing and grinding. Screening and classifying. Fluid dynamics of suspensions. Attrition. Concentration processes: density, electrical, magnetic and other physical methods. Cyanidation, amalgamation, leaching, solvent extraction and ion exchange. Interfacial phenomena. Surfactants. Flotation. Liquid-solid separation: flocculation, thickening, agglomeration, filtration. Drying. Materials balances.

MINE7350 Chemical and Extractive Metallurgy 2 S1 L2 T1.5

Metallurgical thermodynamics. Thermodynamic behavious of solutions, activity of a component in solution, Gibbs-Duhem equation, free energy of solution, properties of ideal and non-ideal solutions, integration of Gibbs-Duhem equation and relationship to activity determinations, regular solutions and a quasi chemical model of solutions. Free energy-composition and phase diagrams of binary systems, alternative standard states, relationship among phase diagrams, free energy and activities. Thermodynamics of interfaces. Equilibrium between phases of variable composition, Gibbs phase rule. Solutions containing several solutes. Estimation of activities in ternary systems. Galvanic cells. Structure and thermodynamic properties of slags.

MINE7440 Mineral Process Technology F L1 T1

Physics and chemistry of surfaces. Measurement of surface properties. On-stream and laboratory analysis and measurements. Laboratory and pilot testing. Flowsheet design. Equipment selection. Plant layout. Monitoring and control systems. Process evaluation. Storage and blending. Materials handling. Waste disposal and pollution control. Waste treatment. Process simulation. Marketing.

MINE7451 Advances in Pyrometallurgy S1 or S2 L2

Advances in pyrometallurgy relasted to extraction and refining processes used for recovery of ferrous and non-ferrous metals.

MINE7452 Advances in Hydrometallurgy S1 or S2 L1 T1

A critical analysis of: recent industrial and research developments in extraction metallurgy: major problems that are the subjects of current research and development in extractive metallurgy; the variety of methods available for research and development.

MINE7460 Mineral Process Chemistry S1 L4 S2 L2

Sources of equilibrium stability data, methods of presenting in graphic forms thermochemical data for application to interpreting the chemical reactions and mechanisms of aqueous process. Overall schemes of metal extraction. Analysis and resolution in the processing and metalliferous raw material. Effects of minor components on overall scheme and effects of mineralogy on process performance. Analysis of testwork methods. Process chemistry of the smelting and refining of ferrous, non-ferrous and recycled materials. Fundamental principles of metal extraction and plant practice. Analysis of recent research and industrial development in hydrometallurgy. Thermodynamic and kinetic considerations in electrometallurgy. Electrochemical reactor and cell designs. Electrochemistry in industrial processes.

MINE7480 Technical Decision Making S1 or S2 L1 T1

A systematic approach to technical decision-making involving problem analysis, identification of options, data collection, selection of criteria, application of criteria and implementation. Case studies in decision-making based on specific, topical projects in industry.

Department of Applied Geology

Field tutorials are an essential part of these subjects and are held during weekends and/or recesses. Dates and costs are available during the first week of the subject. Attendance is compulsory.

GEOL1101 Geological Processes **S1 L3 T3**

Prerequisites:

HSC Exam Score	*Range Required*
2 unit Mathematics or*	*55-100*
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*
2 unit Science (Geology) or	*53-100*
2 unit Science (Biology) or	*53-100*
4 unit Science	*1-50*
3 unit Science	*90-150*

Stream 1

Constitution of the Earth: The Solar System. Minerals and rocks. The origins of igneous metamorphic and sedimentary rocks; plutonism and volcanism. The geological cycle, geological time. Structural geology, origins of faults and folds. Plate tectonics. Continental drift. Field tutorials are compulsory.

OR

Stream 2

Available only with permission of the Head of School.

A program of projects and independent study of selected aspects of geology. Assessment includes practical and theory examinations.

GEOL1201 Geological Environments **S2 L3 T3**

Prerequisites: GEOL1101.

Palaeontology, evolution of life. Principles of stratigraphy. Economic geology. The evolution of ocean basins; sea-floor spreading and sea-level changes. Climates of the past. Gravity, isostasy, seismology and earthquake prediction. Quaternary geology, enery resources. Field tutorials are compulsory.

GEOL2011 Mineralogy & Igneous Petrology **S1 L2 T3 Field 1**

Prerequisite: GEOL1201.

Mineralogy. Principles of optical crystallography and the use of the polarizing microscope. Chemical and physical properties of rock forming minerals. Mineral identification. *Igneous Petrology.* Occurrence, classification and origin of igneous rocks. Fractional crystalization and differentiation. Partial melting. Simple binary melting diagrams. Igneous petrology relating to plate tectonics. *Practical.* Macroscopic and microscopic examination of rock forming and ore minerals and igneous rocks in the field and the laboratory.

GEOL2022 Petrology & Structural Geology **S2 L3 T2 Field 1**

Prerequisite: GEOL2011.

Sedimentary Petrology. The influence of transportation, deposition and diagenesis on the composition, texture and structure of detrital sedimentary rocks. The non-classic sedimentary rocks including phosphates, evaporites; ferruginous and silceous deposits. *Metamorphic Petrology.* Origin and classification of metamorphic rocks as an aid in understanding common mineral assemblages. Petrographic studies of common metamorphic rocks. Field studies. *Structural Geology.* Origin, classification and description of structural elements and analysis of simple fracture systems. Tectonics and tectonic analysis.

GEOL2031 Sedimentology & Palaeontology **S1 L3 T2 Field 1**

Prerequisite: GEOL1201.

Sedimentology. Flow regimes and bedding forms, sedimentary structures. Modern and ancient sedimentary environments of deposition: alluvial, nearshore, shelf and deep sea, in both terrigenous clastic and carbonate/evaporite domains. The facies concept: lateral and vertical relationships between depositional environments and associated lithofacies within developing sediment wedges. *Palaeontology.* Morphology and geological significance of invertebrates including Foraminifera, Brachiopoda, Mollusca, Coelenterata, Arthropoda, Protochordata and Echinodermata. Introductory paleobotany, biogeography, ichnology (trace fossils) and biostratigraphy.

GEOL2041 Geological Computing **S1 L2 T1**

Prerequisite: GEOL1201.

Operating systems and hardware. FORTRAN programming; text editing; control language for VAX and PC's. Examples of computing applied to geological problems.

GEOL2042 Geological Statistics **S2 L2 T1**

Prerequisite: GEOL2041.

Application of the mathematical techniques listed below to geological data processing and analysis. Analysis of variance. Introduction to matrix algebra. Directional data. Regression analysis, trend surface analysis; time series analysis; Markov chain analysis. Introduction to nonparametric statistics. Introduction to multivariate statistics. *Practical work* based on the use of SPSSX, Minitab and other library programs.

GEOL2051 Introductory Geophysics **S1 L2 T1**

Prerequisite: GEOL1101.

Principles of gravity, geomagnetism, palaeomagnetism, geothermy and seismology and their relation to shape, internal constitution and dynamic processes of the earth. Introduction to radiometric, gravity and magnetic exploration methods.

GEOL2062 Geological Surveying **S2 L2 T1**

Prerequisite: GEOL1101.

Photogeology. The use of air photos for geological mapping and geomorphological evaluation of land. Techniques and principles of photo-interpretation and multi-band photography. Photo-interpretation of folds, faults, joints, bedding, limestone, intrusive igneous volcanic rocks, alluvial fans, terraces, slopes, landslides, coastal and tropical landforms. Relationships between geology, drainage, soil and vegetation, orebody expression gossans, colouration halos. An introduction to remote sensing. *Geological Surveying.* Levels, tachometers and theodolites. Field techniques. Precision of angular measurements. Stadia surveying. Levelling. Field computations. Closed and open traverses. Coordinates and their computation.

GEOL2072 Environmental Geology **S2 L2 T1**

Prerequisite: Nil.

Environmental Geology: Hydrodynamics of pollutants and water quality principles. Domestic, industrial and radioactive waste disposal, deep well injections. Geological hazards and urban planning. Environmental impacts of dams, mineral exploration, mining and impact statement techniques. Water resources lay and pollution. Land use conflicts. *Hydrogeology*. The hydrological cycle; confined and unconfined groundwater. Hydrological characteristics of rocks and their measurement. Pump tests. Aquifer boundaries. Exploration for groundwater development and monitoring groundwater resources. Groundwater flow tests. Case studies from the Great Artesian Basin and the Murrumbidgee area. *Coastal Geology*. Properties of sedimentary populations. Sampling practice and analysis of measured data. Geological implications of sediment parameters. Coastal environmental assessment. Shoreline processes. Geological evolution of the inner continental shelf.

GEOL2092 Geochemistry **S2 L2 T1**

Prerequisite: GEOL1201.

Geochemistry. Accuracy, precision and quality of geochemical data. Graphical display of analyses. Norms. The distribution of elements in terrestrial rocks. Nature and origin of meteorites and tektites. *Aqueous Geochemistry*. Redox potentials in nature. Oxidation/reduction and sediment formation. Solubilities, metal transport and ore deposition. The growth of minerals from solution and the development of mineral textures. Particular aqueous geochemical systems.

GEOL3011 Mineralogical Techniques **S1 L3 T2 Field 1**

Prerequisite: GEOL1201.

Principles of X-ray powder diffractometry and the use of X-ray powder cameras and diffractometers. Elementary stereology. Laboratory methods of mineral separation. Mineral characterization.

GEOL3021 Igneous and Metamorphic Processes **S1 L2 T1.5 Field 0.5**

Prerequisite: GEOL2011.

Igneous Petrology. Origin of silicate liquids. High pressure and low pressure fractionation. Liquids and fluids. Nature of the Upper Mantle. The use of trace elements and isotopes as petrogenetic indicators. Practical petrography and literature studies of igneous suites. Field study. *Metamorphic Processes*. Metamorphic reactions. Isograds. Mineral assemblages as geobarometers and geothermometers. Fluids in metamorphosism. Fabric Relationships of deformation and recrystallization*. Metamorphic petrology of Australia. Practical macroscopic and microscopic study of metamorphic suites from different tectonic regimes.

* Pressure, temperature, timepaths and Tectonic setting of metamorphism in the earth's crust.

GEOL3031 Stratigraphy & Basin Analysis **S1 L2 T2 Field 2**

Prerequisite: GEOL2031.

Stratigraphy. Geological evolution of the Australian continent. Depositional regions within and adjacent to continents, island arcs and ocean basins. Development of the Precambrian craton. Palaeozoic-Mesozoic evolution of eastern Australian mobile belt. Intracratonic basins of western and southern Australia and development of divergent margins. The northern collision zone. Palaeontology. Processes and theories of evolution. Theories of biological classification.

GEOL3052 Exploration Geophysics **S2 L2 T1 Field 1**

Prerequisite: GEOL1201.

Introduction to seismic, electrical and electromagnetic and methods of geophysical exploration. Data interpretation and application of these methods for mineral petroleum, coal and groundwater exploration and engineering projects.

GEOL3072 Engineering Geology **S2 L2 T1**

Prerequisite: Nil.

Rock and soil masses and their engineering behaviour. Influence of composition and fabric. Discontinuities in rocks and soils and their analysis for engineering purposes. Mechanical properties and their measurement. Stress-strain theory. Examples of Engineering Geology applications.

GEOL3082 Structural Geology **S2 L2 Field 1**

Prerequisite: GEOL2022.

Structural Geology. Structural analysis at the microscopic, mesoscopic and macroscopic scales. Structural analysis using Bermagui, Cooma and Broken Hill Terrains. Folds, faults and foliation development. Strain analysis, deformation mechanisms and the relationship between deformation and metamorphism.

GEOL3092 Exploration Geochemistry **S2 L2**

Prerequisites: GEOL2092 and GEOL3101.

Principles and techniques of soil drainage and rock geochemistry as applied to mineral exploration.

GEOL3101 Ore Deposits **S1 L3 T2 Field 1**

Co-requisite: GEOL2022 or GEOL3011.

Metallic Resources: Classification and origin of the ore deposits, geochemical processes, research methods. Orthomagmatic, hydrothermal, porphyry, volcanic-sedimentary, Mississippi Valley type, chromium, iron, managanese ores, residual and mechnical ores. Introduction to mineral exploration. Laboratory study of hand specimens, thin sections and polished sections of various ore types; study of selected mining areas representing various types; study of selected mining areas representing various genetic types of ore. *Economic Mineralogy*. Nature of reflected light. Ore textures and their interpretation. Phase relations and paragenesis of ore minerals. Practical work in optical properties of ore minerals, hardness and reflectivity measurements: study of selected ores and ore minerals under the microscope including textural studies.

GEOL3102 Fossil Fuels & Non-metallic Resources **S2 L3T2 Field 1**

Prerequisites: GEOL2011 and GEOL2031.

Coal Geology. Nature and properties of coal. Methods of testing and analysis. Introduction to coal petrology. Origin of coal seams and coal-bearing sequences. Coalfield exploration and coal mining geology. Geological factors in coal preparation

and use. Geology of oil shale. *Petroleum Geology.* Geological factors critical to the occurrence of oil and natural gas. Geochemistry of hydrocarbons and formation fluids; techniques of petroleum exploration. Assessment and development of reserves. Typical petroleum occurrences in Australia and overseas. *Non-metallic Minerals.* Occurrences and economic use of non-metallic and industrial minerals including limestone, silica, asbestos and construction materials. *Clay Mineralogy.* The structure and properties of the clay mineral groups including the kaolinites, illites, smectites, chlorites, mixed layered and fibrous clay minerals. Techniques for the identification of the clay inerals. Clay-water systems and ion exchange. Chemical weathering and the origin of the clay minerals. Industrial uses of clays and bauxite.

GEOL3111 Earth Materials 3 **S1 L2 T4**

Prerequistie: GEOL1201.

(Available in 1992 only)

Mineralogy. Principles of X-ray powder diffractometry and the use of X-ray powder cameras and diffractometers. Elementary stereology. Laboratory methods of mineral separtation. Mineral characterization. *Geochemistry.* Accuracy, precision and quality of geochemical data. Graphical display of analyses. Norms. The distribution of elements in terrestrial rocks. Nature and origin of meteorites and tektites. *Aqueous Geochemistry.* Redox potentials in nature. Oxidation/reduction and sediment formation. Solubilities, metal transport and ore deposition. The growth of minerals from solution and the development of mineral textures. Particular aqueous geochemical systems.

GEOL3121 Earth Environments 2 **S1 L3 T3**

Prerequisite: GEOL2121 (note: it is desirable that students taking this unit have also taken GEOL2331).

(Available in 1992 only)

Stratigraphy. Stratigraphic classification. Biological and physical methods of correlation. Introduction to radiogenic methods of age determination: 14C, K/Ar, Rb/Sr, Nd/Sm, U/Th/Pb and fission track methods. Definition of international stratigraphic boundaries, stratotypes and reference points. Types of sedimentary basins and continental margins. The development of the Precambrian craton of Australia. The geological evolution of eastern Australia, particularly the late Paleozoic and Mesozoic history of the Tasman Mobile Belt. Intracratonic basins of western and southern Australia and the effects of the dispersal of Gondwanaland. Geological evolution of the northern margin of the Australian plate, particularly the Mesozoic to Recent of Papua-New Guinea. *Palaeontology.* Theories of biologic classification. Processes and theories of evolution. The origin and early history of life. Functional morphology. Practical application of palaeontology. *Field Mapping.* Geological report writing and cartography. *Field work* of up to seven days is a compulsory part of the subject.

GEOL3130 Mathematical Geology 2 **S1 L2 T1**

Prerequisite: GEOL2230.

(Available in 1992 only)

Application of the mathematical techniques listed below to geological data processing and analysis. Analysis of variance. Introduction to matrix algebra. Directional data. Regression analysis, trend surface analysis; time series analysis; Markov chain analysis. Introduction to nonparametric statistics. Introduction to multivariate statistics. *Practical work* based on the use of SPSSX, Minitab and other library programs.

GEOL3141 Mineral and Energy Resources 1 **S1 L3 T3**

Co-requisite: GEOL2211 or GEOL3111.

(Available in 1992 only)

Metallic Resources: Classification and origin of the ore deposits, geochemical processes, research methods. Orthomagmatic, hydrothermal, porphyry, volcanic- sedimentary, Mississippi Valley type, chromium, iron, managanese ores, residual and mechanical ores. Introduction to mineral exploration. Laboratory study of hand specimens, thin sections and polished sections of various ore types; study of selected mining areas representing various types; study of selected mining areas representing various genetic types of ore. *Economic Mineralogy.* Nature of reflected light. Ore textures and their interpretation. Phase relations and paragenesis of ore minerals. Practical work in optical properties of ore minerals, hardness and reflectivity measurements: study of selected ores and ore minerals under the microscope including textural studies. *Field work* of up to three days is a compulsory part of the subject.

GEOL3211 Earth Materials 4 **S2 L3 T3**

Prerequisite: GEOL2211.

(Available in 1992 only)

Clay Mineralogy: The structure and properties of the clay mineral groups including the kaolinites, illites, smectites, chlorites, mixed layered and fibrous clay minerals. Techniques for the identification of the clay inerals. Clay-water systems and ion exchange. Chemical weathering and the origin of the clay minerals. Industrial uses of clays and bauxite. *Advanced Igneous Petrology.* Origin of silicate liquids. High pressure and low pressure fractionation. Liquids and fluids. Nature of the Upper Mantle. The use of trace elements and isotopes as petrogenetic indicators. Practical petrography and literature studies of igneous suites. Field study. *Advanced Metamorphic Petrology.* Facies series. Metamorphic reactions. Isograds. Mineral assemblages as geobarometers and geothermometers. Fluids in metamorphosism. Fabric. Relationships of deformations and recrystallization. Metamorphic petrology of Australia. Practical macroscopic and microscopic study of metamorphic rocks. *Field work* of up to six days is a compulsory part of the subject.

GEOL3241 Mineral and Energy Resources 2 **S2 L3 T3**

Prerequisite: GEOL2121 or GEOL8220.

(Available in 1992 only)

Coal Geology. Nature and properties of coal. Methods of testing and analysis. Introduction to coal petrology. Origin of coal seams and coal-bearing sequences. Coalfield exploration and coal mining geology. Geological factors in coal preparation and use. Geology of oil shale. *Petroleum Geology.* Geological factors critical to the occurrence of oil and natural gas. Geochemistry of hydrocarbons and formation fluids; techniques of petroleum exploration. Assessment and development of reserves. Typical petroleum occurrences in Australia and overseas. *Non-metallic Minerals.* Occurrences and economic use of non-metallic and industrial minerals including limestone, silica, asbestos and construction materials. *Sedimentary Basin Analysis.* Techniques of analysis and data presentation using information from outcrops, boreholes (including geophysical logs) and seismic sections. Construction and interpretation of structural isopachous and lithofacies maps. Seismic stratigraphy. Styles of

semimentation within and structural development of basins in different tectonic regimes. Evolution of sedimentary basins. *Field work* of four days is a compulsory part of the subject.

GEOL3251 Engineering and Environmental Geology **S2 L4 T2**

Prerequisite: Nil.

(Available in 1992 only)

Environmental Geology: Hydrodynamics of pollutants and water quality principles. Domestic, industrial and radioactive waste disposal, deep well injections. Geological hazards and urban planning. Environmental impacts of dams, mineral exploration, mining and impact statement techniques. Water resources lay and pollution. Land use conflicts. *Hydrogeology.* The hydrological cycle; confined and unconfined groundwater. Hydrological characteristics of rocks and their measurement. Pump tests. Aquifer boundaries. Exploration for groundwater development and monitoring of groundwater resources. Groundwater flow tests. Case studies from the Great Artesian Basin and the Murrumbidgee area. *Geomechanics.* Rock and soil masses and their engineering behaviour. Influence of composition and fabric. Discontinuities in rocks and soils and their analysis for engineering purposes. Mechanical properties and their measurement. Stress-strain theory. *Coastal Geology.* Properties of sedimentary populations. Sampling practice and analysis of measured data. Geological implications of sedmient parameters. Coastal environmental assessment. Shoreline processes. Geological evolution of the inner continental shelf. *Field work* of up to three days is a compulsory part of the subject.

GEOL3271 Structural Geology **S2 L1 T1**

Prerequesite: GEOL2211.

(Available in 1992 only)

Advanced Structural Geology. Analysis of structural elements at the microscopic, mesoscopic and macroscopic scales. Detailed studies of the analysis of metamorphic terrains. eg Cooma Complex, Broken Hill. *Field work* of up to four days is a compulsory part of the subject.

GEOL3281 Exploration Geochemistry **S2 L1 T1**

Prerequisites: GEOL3111 and GEOL3141.

(Available in 1992 only)

Principles and techniques of soil drainage and rock geochemistry as applied to mineral exploration.

GEOL3331 Exploration Geophysics S1 L3 and S2 L1 T1

Prerequisite: GEOL1201.

(Available in 1992 only)

Physical properties of rocks and soils. Introduction to seismic, gravity, magnetic, electrical, electromagnetic and radiometric methods of geophysical exploration. Application of these methods in the search for mineral deposits, petroleum, coal and groundwater and in civil and mining engineering projects. Interpretation of geophysical data. *Field work* of up to three days is a compulsory part of the subject.

GEOL4111 Advanced Geological Techniques **S1 L T6**

Geochemical Techniques. Sampling strategy and methodology; preparation of samples for analysis. Modern destructive and non-destructive methods of rock and mineral analysis including spectrophotometry, AAS, ICP, DCP, XRF and electron probe microanalysis.

Geological Data Processing. Application of probability graphs to exploration data. Processing and interpretation of geological data using selected univariate and multivariate statistics; typical case studies in mathematical geology exemplifying these techniques. Practical work based on microcomputer operating systems, word processing, statistical and graphical packages.

Remote Sensing. Principles of various remote sensing techniques including landsat and side-looking airborne radar. Techniques of image enhancement and digital processing. Applications of remote sensing in lithological mapping and tectonic analysis. Integration of remotely sensed data with conventional data sources. Practical work with the interactive computer on image analysis with particular reference to student field study areas.

Field Work: A compulsory tutorial of up to seven days duration providing training in advanced mapping techniques and in the integrated use of multiple sources of field data.

GEOL4121 Professional Practice **S1 L3 T3**

Prerequisites: GEOL3141, GEOL3241.

Project Management: Organization and costing of geological field programs; land tenure, exploration and mining titles; design of drilling, sampling and analysis programs; integration of geophysical methods; use of geological database and modelling systems; estimation of resources and reserves; reporting requirements, liability and ethics in geological practice.

Research and Communication: Literature search and bibliographic indexes; preparation of theses, reports and scientific papers; preparation of maps and other illustrations; presentation of technical material in verbal form; job applications and interview requirements.

Social Issues and the Applied Sciences The subject covers social issues arising from future technological developments and the role that a professional applied scientist can play in influencing future directions. It will be taught by a combination of group activity, case studies and projects and seminars from visiting speakers, some of whom will be from disciplines other than the applied sciences.

Topics to be covered will include: the rights and obligations of consumers and manufacturers with specific applications from the food industry. Issues associated with the restructuring of industries, public transport, port facilities etc. Government protection of manufacturing industries such as automobiles, clothing and chemicals and the impact of this on relationships with our trading partners. The resolution of conflicts of interest over landuse in national parks, wilderness and recreational areas and urban areas. Energy policies and their global implications. The impact of mining on society and the environment. The effects on society of the introduction of new technologies such as home based computer terminals and new materials such as semiconductors. The influence of cartels and the political importance of strategic materials.

GEOL4131 Special Topics in Applied Geology **S1 L, T12**

Instruction by lectures, tutorials and assignments in advanced aspects of a chosen area of geological specialisation.

Programs are offered in a number of specialised fields including Mineral Exploration and Mining Geology, Sedimentary Basin Studies, Geophysics and Engineering Geology. Details of these programs are available from the Head, Department of Applied Geology. The special Topics program would normally be related to the topic of the chosen Field Project and is designed to be a preparatiuon for a future career. Variation from the standard programs is allowed subject to approval from the Head of Department.

GEOL4203 Field Project **S2**

A major field-laboratory project, which generally includes geological mapping, on some aspect of mineral or sedimentary basin resources, engineering or environmental geology or resource geophysics.

Servicing Subjects

These are applied geology subjects taught within courses offered by other faculties.

GEOL4303 Geology Honours

Students with a double major in geology will follow the program set for Year 4 students in the Faculty of Applied Science course, 3000 Applied Geology.

GEOL5100 Geology for Civil and Environmental 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 and environmental engineering.

GEOL5110 Geology for Landscape Architecture

Minerals and rocks. Igneous, sedimentary and metamorphic rocks; their origin and their relationship with the landscape. Geological structures and their graphic representation. Interpretation of geological maps and sections.

GEOL5211 Geology for Mining Engineers 1 **F L1 T1**

Outline of the main brances of geology and their application to Mining Engineering. Introduction to geomorphological processes and resulting landforms. Fundamentals of the atomic structure of minerals including major rockforming minerals and ore minerals, their crystal symmetry, their physical and chemical properties. *Igneous Rocks,* formation, texture, composition and classification of the more important igneous rocks. *Sedimentary Rocks,* processes of formation depositional environment, composition and classification. *Metamorphic Rocks,* metamorphic processes and metamorphic structures, classification and description of metamorphic rocks. Physical properties of rocks including porosity, permeability and capillarity. Weathering processes of rocks and minerals. Deformation of rocks and the resulting effects such as folds, faults, joints and foliation. An introduction to modern theories of tectonism. Integration of geological observations. *Practical Work.* Laboratory work consists of exercises related to the Lecture course: geological mapping including structure contour problems. Study of minerals and rocks in hand specimens. *Field Tutorials.* Two field tutorials are conducted at which attendance is compulsory. Satisfactory reports must be submitted. Total hours: 56. The subject is divided equally between lectures and laboratory work. Field Tutorial hours are additional.

GEOL5301 Introduction to Petroleum Geology **S1 L1.5 T.5**

Prerequisite: Nil.

Introduction to earth science nature and properties of rocks and minerals; sedimentation and sedimentary environments; stratigraphy and the geologic time scale, geologic maps and structures; introduction to plate tectonics.

GEOL5302 Geology of Petroleum Accumulations **S2 L1.5 T.5**

Prerequiste: GEOL5301.

Petroleum generation, migration and entrapment; sedimentary facies and facies sequences; sedimentary petrology and diagenesis: structural geology of petroleum deposits; geology of Australian petroleum fields.

GEOL5311 Geology for Mining Engineers 2 **F L2 T2**

Palaeontology and Stratigraphy: principles of stratigraphy; the use of fossils in stratigraphic correlation and bore logging. *Structural Geology*: elements of structural geology; stereographic projection and fracture analysis applied to mining operations. *Geology of Fuels*: origin and properties of coal, oil, oil shale and natural gas; stratigraphic and structural considerations in exploration and development of coal and petroleum deposits. *Hydrogeology*: principles of hydrogeology: principles of hydrogeology; transmission of groundwater in rocks and soils applied to mining operations. *Ore Deposits*: mineralogy of industrially important metallic and non-metallic minerals; theories of ore formation including secondary enrichment processes. *Exploration Procedures*: theories and application of exploration techniques in mineral and coalfield exploration including geological and geophysical methods. *Field Tutorial*: a geology field excursion is held at the end of Session 1, attendance is compulsory.

GEOL5401 Petroleum Production Geology **S1 L1.5 T.5**

Prerequisite: GEOL5302.

Petroleum exploration and development programs; subsurface maps and sections; geologic characteristics of selected reservoir types: porosity characteristics and recovery effects; coal-bed methane; estimation of petroleum resources.

GEOL6201 Marine Geology 1 **F L1 T2**

Prerequisites: GEOL1101 and GEOL1201.

Sedimentology. Flow regimes and bedding forms, sedimentary structures. Modern and ancient sedimentary environments of deposition, alluvial, nearshore, shelf and deep sea, in both terrigenous clastic and carbonate/evaporite domains. The facies concept: lateral and vertical relationships between depositional environments and associated lithofacies within developing sediment wedges. *Global Geophysics.* Principles of gravity, geo-magnetism, palaeomagnetism, geothermy and seismology and their relation to shape, internal constitution, dynamic processes and major tectonic features of the earth. *Mineralogy and Petrology.* Igneous and sedimentary rock types of the ocean floor and their significance.

Field work of five days is a compulsory part of the subject.

GEOL6231 Coastal Monitoring Techniques **FL1T2**

Prerequisite: Nil

General principles of surveying. Optical and electronic methods of distance and elevation measuring. Coastal position fixing. Co-ordinates systems and their application to coastal mapping. Map projections. Long and short term monitoring of coastal changes. Tides, their measurement and determination of tidal planes. Soundings and bathymetric surveys. Shallow water investigations for seabed and bedrock morphologies. Through its intensive practical approach, the course is designed to give each student an understanding of coastal surveying applicable to a large variety of small scale investigations, from beach to esturine monitoring.

GEOL6310 Marine Mineral Deposits and Oceanic Minerals **S1 L1 T2**

Oceanic minerals and mineral deposits: Resources important to human civilization of a biological, fluid and mineral nature. Mining of ocean resources. Geological aspects of waste disposal and engineering works in the ocean. Tidal energy.

GEOL6311 Marine Geology 2 **F L1 T2**

Prerequisite: GEOL6201.

Clay Mineralogy. Structure and properties of the clay mineral groups including the kaolinites, illites, smectites, chlorites, mixed layered and fibrous clay minerals. Techniques for identification of the clay minerals. Clay-water systems and ion exchange. Chemical weathering and the origin of the clay minerals. *Sedimentary Basin Analysis:* Techniques of analysis and data presentation using information from outcrops, boreholes (including wireline logs) and seismic sections. Construction and interpretation of structural, isopachous and lithofacies maps. Seismic stratigraphy. Styles of sedimentation within the structuring of basins in tensional, compressive and strik-slip tectonic regimes. Basin evolution. *Stratigraphy.* Ocean basin stratigraphy and the environmental and chronological utility of the principal groups of index fossils. Stratigraphical history and correlation of sedimentary rocks in the deep ocean basins and on continental shelves. Changes of sea level. The Quaternary history of the oceans. Reefs and carbonate sedimentation. Deep sea consolidated sediments. Field work not esceeding two days is a compulsory part of the subject.

GEOL6321 Coastal Environmental Assessment **FL1T2**

Prerequisite: Nil

The physical nature of the various coastal environments: their morphology and the relationship between water masses and the sedimentary and benthic characteristics of the bottom. Sampling techniques, analytical methodology and statistical data evaluation. Environmental assessment of Australia and overseas areas. An important aspect of the course is its practical approach: from data gathering, data evaluation and environmental assessment report writing. Practical work in the course involves each student as an active member of a project team.

GEOL6330 Exploration and Seismic Methods **S2 L2 T1**

Geophysics of ocean basins and off-shore areas and the techniques of their study. Seismic refraction, reflection and computational methods, instrumentation of seismic and acoustic sources, recording systems and signal processing. Geological and physical interpretation of results. Practical work on instrumentation, recording and interpretation of field data.

GEOL7221 Surficial Materials and Processes **S2 L3 T2**

Prerequisite: GEOL2111

Clay Mineralogy. The structure and properties of the clay minerals groups including the kaolinities, illites, smecites, cholorites, mixed layered and fibrous clay minerals. Clay-water systems and ion exchange. Chemical weathering and the origin of the clay minerals. Industrial uses of clays and bauxite. *Sedimentary Petrology.* The influence and transportation, deposition and diagenisis on the composition, texture and structure of detrital sedimentary rocks. The non-clastic sedimentary rocks including phosphates, evaporites, ferruginous and silceous deposits. *Hydrology.* The hydrological cycle; confined and unconfined groundwater. Hydrological characteristics of rocks and their measurement. Pump tests. Aquifer boundaries. Exploration for groundwater development and monitoring of groundwater resourves. Groundwater flow tests. Case studies from the Great Artesian Basin and the Murrumbidgee area.

GEOL7321 Geology for Geomorphologists and Pedologists **S1 L1 T1 S2 L2 T2**

Prerequisites: GEOL2111, GEOL2211.

Clay Mineralogy. The structure and the properties of the clay groups, including the kaolinites, illities, smectites, chlorites, mixed layered and fibrous clay minerals. Techniques for the identification of the clay minerals. Clay-water systems and ion exchange. Chemical weathering and the origin of the clay minerals. Industrial uses of clays and bauxite. *Sedimentology.* Properties of sedimentary populations. Sampling practices. Measurement of grain size, grain shape and packing; analyses of measured data. Geological significance of sediment parameters. *Coastal Geology.* The shoreline processes. Littoral and longshore drifts and net sand movement. Coastal engineering works. The estuarine environment; sedimentation, chemical and biological processes, investigation techniques.

GEOL8220 Sedimentology **S1 L1 T1**

Prerequisite: GEOL1201. Excluded: GEOL3121 Earth Environments 2

As for *Sedimentology* in GEOL3121 Earth Environments 1.

GEOL8310 Stratigraphy **S1 L2**

Prerequisite: GEOL8220. Excluded: GEOL3121

As for *Stratigraphy,* in GEOL3121 Earth Environments 2.

GEOL8320 Gravity and Magnetic Methods **S1 L2 T1**

Prerequisites: PHYS1002 and MATH1032. It is desirable that students taking this unit have a background to geology.

Fundamental principles. Field procedures and instruments. Reduction of field data. Regionals and residuals. Effects of sources of simple geometrical shapes and generalized two and three-dimensional distributions. Applications. Field work of one day is a compulsory part of the subject.

This subject will not be offered in 1992.

GEOL8330 Seismic Methods **S1 L2 T1**

Prerequisites: PHYS1002 and MATH1032. It is desirable that students taking this unit have a background in geology.

This subject will not be offered in 1992.

Seismic waves. Physical/engineering properties of geological materials. Ray theory is seismic refraction and reflection methods. Instrumentation. Data acquisition and processing. Depth and velocity analysis. Geophysical and geological interpretation. Case history studies. *Field work* of one day is a compulsory part of the subject.

GEOL8340 Electrical Methods **S1 L2 T1**

Prerequisites: PHYS1002 and MATH1032. It is desirable that students taking this unit have a background in geology.

Introductory theory and field practice of resistivity, self-potential, induced polarization and airborne and ground electromagnetic methods. Geological interpretation of field data. Geophysical logging. Field work of one day is a compulsory part of the subject.

GEOL8350 Geological Applications **S1 L1 T1**

Prerequisite: GEOL1201.

A subject of ten weeks' duration. *Structural Geology:* Elements of structural geology, sterographic projection and fracture analysis. *Geology of Fuels:* Origin of coal, oil and natural gas; stratigraphic and structural consideration of oil and coalfields. *Hydrogeology:* Principles of hydrogeology; transmission of groundwater in rocks and soils. *Field work* of one day is a compulsory part of the subject.

GEOL8360 Geophysical and Geological Applications **S2 L1 T2**

Prerequisite: GEOL1201. Excluded: GEOL6330.

Geological interpretation of Geophysical data. Seismic stratigraphy. Coal-seam geometry from high resolution seismic and in-seam data. *Geology of Ore Deposits.* Mineralogy of industrially important metallic and non-metallic minerals. Theories of ore formation including secondary enrichment processes. Available only in program 2503.

GEOL9110 Hydro and Environmental Geology S2 L3 T1

Prerequisite: GEOL5100.

Hydraulics of groundwater in fractured rock, Hydrodynamic dispersion of contaminants in porous and fractured media, sources of contaminants in the groundwater system, monitoring and sampling of contaminants in groundwater, groundwater quality and environmental standards. *Environmental Geology:* Domestic, industrial and radioactive waste disposal, deep well injections. Geological hazards and urban planning. Impact of dams, mineral exploration, mining and impact statement techniques. Land use conflicts. *Coastal Geology:* Properties of sedimentary populations. Sampling practices. Geological significance of sediment parameters. The shoreline's processes, littoral and longshore drifts and net sand movement. Field work of up to two days is a compulsory part of this subject.

GEOL9120 Groundwater Contaminant Transport **S1 L3 T1**

Prerequisites: GEOL9110.

(Available at the commencement of 1993 only)

Hydrogeochemistry: Chemical composition of natural and contaminated groundwater, inorganic and organic chemical principles. Application of chemical thermodynamics. Mineral dissolution and precipitation. Non-equilibrium approaches. Chemical classification of groundwaters and hydrochemical facies in aquifers. Geochemical evolution of groundwater. Application of stable and radioactive isotopes. Computer models. Case studies. Interactions of solid, liquid and gaseous phases. Salt sieving and brine development. Chemical and microbiological reactions in and near boreholes and relevance to borehold performance, deterioration, rehabilitation. Chemical dispersion theories for contaminants, hydrochemical modelling for inorganic and organic contaminant plumes. Practical field measurement and laboratory analysis for determination of hydrochemical parameters, adsorption, desorption, K_d, dispersivity. *Groundwater Modelling:* Types of groundwater models and their physical bases for porous and fractured rock aquifers. Modelling low permeability materials. Analogue, analytical and numerical model forms. Stochastic modelling and characterisation of variability. Modelling multiphase, immiscible fluids, and regional groundwater flow. Applications of modelling to borefield management, saltwater intrusion, mine dewatering, waste disposal and contaminant transport.

Graduate Study

Department of Mining Engineering

Generally these subjects are of three hours' duration per week or multiples of that time.

MINE0014 Exploration Drilling

Drilling equipment and technology. Deep boring. Selection of drilling methods, drill hole surveys. Development and exploitation of mineral resources. Exercises on mine planning.

MINE1114 Mining Engineering

1. Surveying methods to quantify mineral resources. Mine development. Explosives. Shaft sinking, tunnelling, excavation methods. **2.** Advanced mining systems, parameters for applicability and efficiency of mining methods, waste disposal. Non-entry methods, in situ mining. Off-shore mining methods. Rock mechanics, mechanical behaviour of rocks. The Mining Acts.

MINE1224 Mining Engineering Technology

1. Mine ventilation contaminants, toxicity of mineral particles and gases, thermodynamics of mine air, network analyses, air conditioning in mines. Mine safety, health, hygiene, noise. **2.** Mine lighting, electrical power distribution, generation and reticulation of compressed air. Materials handling. Surface and underground haulage systems, design criteria. Mine drainage. Standards specifications. **3.** Feasibility studies. Mine design and layout, separation of functions for maximum efficiency; application of analogue and digital computers. Production control, grade control, administration. Resources allocation, finance, labour, equipment. Size and scope of mining company operations. **4.** Mine support. Mining methods employing fill, fill compressibility. Rock and cemented rock fill. Placement of mixed fills. **5.** Rock mechanics. Stress and strain analysis. The mechanics of strata movement and the distribution of pressure around mine workings. Ground control and methods of support in the workings and the waste. Design of mining excavations. Slope stability. **6.** Subsidence phenomena associated with mine workings. Methods of working and design of structures to minimize damage.

MINE1324 Mining Engineering Laboratory

A selection of advanced laboratory investigations in sampling and valuation, mine support, temporary or long term; mine design and plant related to extraction and servicing functions; rock properties; programming of mining methods and transport; non-entry mining; petroleum engineering; gasification; solvent processes.

MINE1514 Ground Control and Excavation Engineering

1. Natural state of stress in rock masses. Effects of geological structures on the stability of mine working. Stresses and rock movements induced by mining operations. Design of mining systems and layout of workings based upon rock mechanics and functional considerations. **2.** Principles and design of support systems. Inter-relation of temporary, stabilizing and long term support. Support of permanent mining and civil engineering openings. Control of ground in the vicinity of production excavations. **3.** Design and construction aspects of open pit slopes and tailing dams. **4.** Rock-breaking and drilling methods, penetrability and workability of rocks; fracturing. Nature, occurrence and prediction of rockbursts. Mechanics of crack propagation and subsidence.

MINE1524 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.

MINE1534 Environmental Conditions in Mines

The energy equation applied to ventilation, sources of heat in mines, geothermal gradients, thermodynamics, pressure-volume diagrams. Practical aspects of high air temperatures and the control of atmospheric conditions in deep underground mines. Fan design, installation and testing. Psychrometry, ventilation planning. Computer applications. Selected laboratory experiments and network designs.

MINE1544 Rock Excavation and Transportation

Rock fragmentation drilling, blasting large rounds. Loading techniques, shovels, draglines, bucket wheel excavators, dredges, front-end loaders, tractor scrapers. Operating factors, selection procedures, cost estimating. Materials handling, continuous, semi -continuous, batch systems, cost analysis.

MINE3114 Mineral Beneficiation

Prerequisite: MINE7341 or equivalent

Processing economics: mineral processing and its integration with mining, metallurgical and chemical operations. Principles of roasting, leaching, electrolysis, cementation, solvent extraction and ion exchange. Particle mechanics: size, shape, surface area, size distribution functions. Relative and bulk densities. Theory of fracture mechanisms, comminution, energy requirements. Processes of agglomeration. Physical separation methods, electronic sorting, electrostatic and magnetic separation.

MINE3224 Mineral Beneficiation Technology

Prerequisite: MINE3114 or equivalent.

1. Fluid mechanics of mineral pulps, free, hindered and zone settling, thickening, classification, hydrocyclones, dewatering, filtration. Gravity concentration jigging, sink and float, flowing film fluidized beds. **2.** Interfacial phenomena, the structure of solid-water, air-water, solid-air and oil-water interfaces. Experimental techniques, applicable to the study of these interfaces. Electrokinetic theory, electrical double layer interaction. Adsorption mechanisms. Collectors, activators, depressants, modifiers, frothers, flocculants. **3.** Sulphide mineral flotation, xanthate chemistry, oxide mineral flotation, salt mineral flotation. Coal preparation, coal constitution, bore core evaluation, selective preparation, blending for utilization. **4.** Process design. Feasibility studies, extraction processes and environmental conditions. Selection and location of equipment, fluid-solids flow, design of auxiliary units, development and presentation of flow-sheets. Sampling and

experimental techniques, batch, continuous and pilot plant testing. Scale up. Product disposal. Principles of chemical analysis, instrumentation, measurement of variables in mineral processing, controllers, use of computers. Technical management.

MINE3324 Mineral Engineering Laboratory

Prerequisite: MINE3114 or equivalent.

Laboratory investigations may be selected from the following according to availability and specialization: metalliferous ore concentration; coal preparation; beneficiation of non-metallics; processing of mineral fluids.

MINE3514 Mineral Beneficiation Plant Design

Prerequisite: MINE7342 or MINE3114 or their equivalent.

Process design based upon mineral properties; extraction processes and environmental conditions. Selection of technology to be adopted. Basis of feasibility studies. Special considerations for coal preparation and treatment of industrial minerals. Flowsheet planning, solid and fluid flows, auxiliary units, materials handling, product disposal. Experimental techniques used in testing. Scale up procedures. Plant control, automation, use of computers. Management of mineral processing operations.

MINE3614 Minerals Engineering 1 S1 L3 T4

1. Principles of mineral deposition. Constitution of coal. Fuel technology. Coke making. Principles of extractive metallurgy. Beneficiation and utilization of industrial minerals. Materials balances. **2.** Fluid dynamics of mineral pulps. Rheology of fluids and particulate suspensions. Dynamics of particle and bubble motion and collision. Flow through porous media. Fluidized beds. Flow in pipes, open channels and thin films. **3.** Materials handling: Flow characteristics of granular materials. Belt and mechanical conveyors. Stockpiles, bins and hoppers. Blending. Feeders. Distributors. Slurry pumps. Solids pipelines. Sampling theory and practice. **4.** Particle statistics: Concepts of particle size. Size analysis methods. Size distribution functions. Specific surface. Shape factors. Number-, Surfaceand Volume mean sizes. **5.** Interfacial phenomena: Free surface energy. Surface tension. Three phase contact. Electrokinetic theory. Double layer interaction. Chemical and physical adsorption. Experimental techniques. Foams.

MINE3624 Minerals Engineering 2 S1 L4 T4

1. *Comminution.* Fracture. Liberation. Energy-size relationships. Grindability. Conventional comminution equipment. Feed and product characteristics. Open and closed circuit operation. Vibratory and fluid energy mills. **2.** *Screening and classification.* Screening as a process of chance. Screen loading. Factors affecting screen capacities. Types of screen. Probability screens. Optical imaging. Hydraulic, mechanical and cyclone classifiers. **3.** *Physical concentration processes.* Gravity concentration. Jigs, heavy media and flowing films. Electronic and optical sorting. Electrical and magnetic separators. **4.** *Chemical concentration processes.* Leaching. Solvent extraction and ion exchange. Cementation. Cyanidation and amalgamation. **5.** *Flotation.* Collectors, activators, depressants, modifiers, frothers. Conventional and novel cells. Flotation kinetics. Entrainment. Soluble salt flotation. Reverse flotation. Agglomeration and carrier flotation. Selective flocculation and agglomeration. **6.** *Liquid-solid separation and product disposal.* Flocculation. Thickening. Filtration. Drainage. Dewatering by screens and cyclones. Centrifuging. Dryers. Tailings dams. Tailing utilization including mine fill, reclamation. Pollution control.

MINE3634 Minerals Engineering Laboratory S1 T3

A series of laboratory investigations relating to material covered in subjects MINE3614 and MINE3624

MINE3644 Minerals Engineering 3 S2 L4 T4

1. *Process analysis and simulation. partition and efficiency curves. Washability curves. The Mayer curve. Computer models of comminution, sizing and concentration processes. Laboratory and pilot scale testing. Scale up procedures.*
2. *Process design.* Process appraisal, selection of technology based upon mineral properties, extraction processes, energy requirements and environmental conditions. Feasibility studies. Special considerations for coal preparation and treatment of industrial minerals. Process flowsheet planning, equipment selection and details of solid and fluid flows. Engineering flowsheets showing details of major and auxiliary units, materials handling, product disposal, water and electricity, distribution and equipment control.
3. *Instrumentation and control.* Principles of chemical analysis. Laboratory and *in situ* instrumental analysis. Flow and density gauges. Level detectors. Belt weighers. Controllers and control strategies. Automation.
4. *Plant design. Factors influencing selection of site. Plant and site layout. Preparation of technical and commercial specifications and tender documents. Construction scheduling. Environmental aspects. Noise control. Safety.*
5. *Management.* Personnel selection and training. Trade Union organization. Communications and consultation. Management structure and organization. Marketing. Contracts and smelter schedules. Maintenance planning. Accounting and budget control. Purchasing and stores policies.

MINE3654 Minerals Engineering Project S2 T10

Laboratory work to evaluate information necessary for the design of a process for the beneficiation of ore from a metalliferous deposit, preparation of coal or treatment of industrial minerals. Candidate's report to include a process flowsheet, an equipment and materials flowsheet and a plant design layout.

MINE4424 Mineral Industry Analysis S2 L2

Aspects of micro- and macro-economics. Type of companies, private, public, no-liability, State ownership and participation. Financing of mining ventures. Contracts and project assessment. Obsolescence and replacement. Operations research control networks, decision analysis, linear programming, queueing theory, simulation, improvisation. Grade control, estimation of cut-off grades. Includes advanced work in the technical and economic analysis of mining or mineral operators. Cases are selected for examination and analysis; critical review.

MINE4055 Numerical Methods in Geomechanics S1 3

Boundary Value Problems: Equivalent continuum, equilibrium in terms of stresses, boundary conditions, displacement and strain, constitutive relations of elasticity, differential equations.

Finite Elements: Approximate solution and variational principle, stiffness matrix and equivalent nodal force vector, finite elements, assembly and solution of the global system, isoparametric and infinite elements, pre and postprocessing, elastoplasticity, groundwater flow, modelling strategy, programming considerations. Geotechnical applications. Boundary Elements: Basic singular solution, indirect method, direct method, isoparametric and infinite elements, construction and solution of system of equations, programming considerations, geotechnical applications.

MINE4155 Stability of Slopes **S2 3**

Data collection for pit slope design, statistics of defects in rock masses: Length, orientation, spacing, roughness, planar and two wedge failure modes. Tetrahedral wedges, Bishop, Morgenstern-Price and other methods. Physical admissibility. Toppling and other modes of failure, probabilistic slope analysis, effect of persistence, bench and overall slope design. Slope support; cable bolts, anchors and other methods, drainage for improvement of stability. Dams and tailings disposal. Slope monitoring. Continuum and joint seepage of water.

MINE4555 Mining Geomechanics Project **F 6**

Individual project on an investigation related to an actual mining geomechanics problem, the topic to be chosen after consultation with a staff member. A report is required.

MINE5064 Minor Project

This subject will comprise a literature-based review and a thesis presentation requiring interpretative skills. Experimental work is preferable but not essential. Projects may be based on mining, geology, mineral processing or engineering aspects of industrial processes.

MINE5124 Project

A critical literature review and an experimental program or laboratory work to prove an hypothesis or produce a technical report at a professional level. The report must either be a conventional bound thesis or a combination of covered report, program disks and drawing suitable for permanent library storage. Projects may be based on mining, geology, mineral processing or engineering aspects of industrial processes.

MINE5155 Rock Mechanics Measurements **S1 3**

Field measurement of rock mass properties. Controlled postfailure strength and deformation properties of rock. Data collection and analysis. *In situ* stress measurement. Prediction of premining rock stresses. Monitoring rock movement and stress change in underground and surface rock excavations. Seismic techniques in rock mechanics.

MINE5184 Major Project

As for MINE5124 Project, but this will comprise a critical literature review accompanied by a comprehensive experimental program of a substantial nature and an interpretative thesis. The candidate is encouraged to seek industrial support for the practical work.

MINE5255 Strata Control Engineering **S2 3**

Dislocations, stress changes and energy changes in the rock mass around underground excavations. Design of self-supporting, artificially supported and caved underground excavations. Introduction to boundary element methods of stress analysis. Prediction and control of rockbursts and instantaneous outbursts in coal. Analogue modelling of pillar mining. Rock mechanics of longwalls.

MINE5324 Principles of Mining Engineering

Office, workshop, stores and materials handling layout for mines. Layout of shafts, declines and main drives for optimum mineral recovery. Review of underground mining techniques for coal and metalliferous mines with emphasis on cost control and efficient operation. Surface mining techniques, design and layout of haul roads and stripping benches. Dragline and shovel operation. Effect of ventilation requirements and drainage on mine layouts. Scheduling for equipment transfer, maintenance and installation (e.g. longwall face transfers, underground crusher stations, dragline overhaul). Computer software for mine and plant maintenance and management.

MINE5355 Mine Fill Technology **S2 3**

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.

MINE5455 Advanced Rock Cutting Technology **S2 3**

Mechanics of rock cutting by picks, discs, toothed roller cutters and button cutters. Machine applications. Tool materials and wear. Selection of cutting systems. Rock cuttability assessment. Rock cutting machine design for coal and competent rock. Case studies.

MINE5555 Blasting Technology **S2 3**

Historical development of commercial explosives. Description of various explosives and their compositions. Explosive properties. Initiation of explosives. Delay systems in firing. Explosive accessories. Handling explosives on site. Safety in firing blasts and precautions against extraneous electricity. Procedure in misfires. Rock blasting without drilling holes. Acquisition, storage and transport of explosives. Underwater blasting. Underwater vibrations from blasting. VCR blasting.

MINE5655 Rock Slope Stability **F 2**

Economic aspects in the design of rock slopes in open cut mines. Failure of rock slopes and controlling factors. Stability of temporary rock slopes. Probabilistic analysis.

MINE5755 Subsidence Engineering **F 2**

Trough subsidence resulting from the extraction of bedded mineral deposits. Parameters influencing subsidence. Subsidencerelated phenomena causing damage to structures at or below the surface. Measurement and empirical prediction. Theories and modelling of subsidence. Control of subsidence.

MINE9174 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.

MINE9364 Equilibrium Concepts in Water Systems

The application and limitations of chemical thermodynamics in water systems. Aqueous inorganic process systems including water treatment and minerals processing. The effects and control of pollution. Thermodynamic diagrams such as InE pH, potential pH, temperature pH and concentration pH are developed as an aid to assessing system energetics. Sources and estimation of thermodynamic data. Kinetics and mechanism in relation to aqueous system energetics. Analysis of kinetic data.

MINE9374 Hydrogeochemistry S1 L1.5 T1.5 C3

Chemical composition of natural and contaminated groundwater, inorganic and organic chemical principles. Application of chemical thermodynamics in groundwater systems; data sources. Development of Eh pH, activity and other diagrams to assess system stabilities and mineral dissolution and precipitation. Non-equilibrium approaches. Chemical classification of groundwaters and hydrochemical facies in aquifers. Geochemical evolution of groundwater along flow paths in a variety of porous and fractured rocks for saturated and unsaturated zones. Application of stable and radioactive isotopes. Computer models to evaluate chemical patterns. Case studies of significant groundwater basins; Great Artesian Basin. Interactions of solid, liquid and gaseous phases. Salt sieving and brine development. Chemical and microbiological reactions in and near boreholes and relevance to borehole performance deterioration, rehabilitation. Chemical dispersion theories for contaminants, hydrochemical modelling for inorganic and organic contaminant plumes. Practical field insitu chemical parameter measurement, sampling, laboratory analysis, laboratory and field experiments for determination of hydrochemical parameters, adsorption, desorption, Kd, dispersivity.

MINE9415 Advanced Rock Mechanics S1 3

Field measurement of rock mass properties. Controlled post-failure strength and deformation proerties of rock. Data collection and analysis of rock mass and support response. In situ stress measurement. Prediction of pre and post-mining rock stresses and deformations. Monitoring rock movement and stress change in underground and surface rock excavations. Seismic techniques in rock mechanics. Dislocations, stress changes and energy changes in the rock mass around underground excavations.

Department of Applied Geology

GEOL9010 Hydrogeology S1 L1.5 T1.5 C3

Surface and sub-surface methods of geological and geophysical investigation; groundwater exploration of confined and unconfined aquifiers. Geological and hydraulic characteristics of rocks; aquifer boundaries, groundwater storage and quality. Hydraulics of wells. Hydrogeological systems analysis, including computer methods, mapping techniques and groundwater resources evaluation. Hydrogeology of arid and semi-arid zones. Case history studies of groundwater fields.

GEOL9011 Hydrogeology G S1 L1.5 T1.5 C3

Hydrologic and hydrochemical cycles, catchment hydrogeology and principles of groundwater flow. Elements of groundwater chemistry, will hydraulics, pumping tests, hydrogeological environments and exploration for groundwater. Groundwater engineering, drilling technologies, geophysical bore logging, dewatering of excavations, groundwater resource evaluation.

To be taken by 8020 students.

GEOL9020 Geopollution Management S1 L1 T1 C3

GEOL9320 Geopollution Management S1 X C3

Material properties and hydrodynamic factors influencing surface and subsurface flow of pollutants in rocks and soils. Dispersion theory and modelling for pollutants in aquifers. Water quality and the problems of standards. Use of field instruments for quality determination. Geological and technological factors in waste disposal: domestic and industrial wastes, including the Rocky Mountain Arsenal Well case study, deep well injection methods. Management of radioactive wastes, waste disposal problems in limestone areas. Case studies of aquifer pollution and practical measures for preventing pollution. Rational planning of water resources for industrial and domestic use.

GEOL9030 Geological Engineering S1 L1.5 T1.5 C3

Geomechanical properties of intact rock. Geomechanical properties of discontinuities and rock masses. Weathering processes and geotechnical consequences. Engineering classidicaiton of rock masses. Excavation - rippability, mechanical excavation of tunnels, surface and tunnel blasting. Rock support for shallow underground structures. Dam engineering, dam size geology, embankment zoning, foundation treatment and grouting, materials selection and specificaiton, dispersive soils and filter design. Foundations on rock, buildings, temporary supprt of open excavations.

GEOL9040 Fundamentals of Geomechanics S1 L1.5 T1.5 C3

GEOL9340 Fundamentals of Geomechanics S2 X C3

Engineering mechanics, limit equilibrium, equilibrium of multiple-bodies, stress and strain in two and three dimensions, equations of equilibrium and compatibility. Isotropic and anisotropic elasticity, plastic and viscous yield criteria and potential surfaces. Stereographic projection methods for rock mechanics. Geomechanical properties and classification of soils and rocks. Laboratory and field testing techniques for soils and rocks. Deformability and strength properties of rocks and shear strength of rock discontinuities. Stresses about rock openings and beneath point loads. Stress measurement in rocks.

GEOL9060 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.

GEOL9070 Engineering Geophysics S1 L2 T1 C3

Shallow seismic refraction: elastic theory, sources and equipment. Determination of fracture index, rippability. Applications to damsites, highways, depth of weathering, material quality. Seismic reflection. Sparker and boomer profiling, side scan sonar with application to coastal harbours, sewer outfalls. Electrical methods, direct current geoelectric theory, resistivity sounding and profiling with applications to determination to bedrock depth, location of water table, clay filled dykes, shear zones. Magnetic, electro-magnetic and gravity methods as applied to engineering problems. Geophysical well logging: resistivity, self-potential, gamma ray and sonic logs applied to determination of rock properties and location of clay-filled joints. Field tutorials: Short field tutorials are included.

GEOL9080 Groundwater Geophysics S1 L1.5 T1.5 C3

Fundamentals and theory of the gravity, magnetic, electrical, electro magnetic and seismic geophysical methods. Relationships between geophysical and hydrogeological properties of earth materials. An introduction to geophysical well logging. Applications of geophysics to regional and detailed groundwater exploration and development, including surface and airborne techniques. In particular: location of water table, stratigraphic detail, determination of bedrock depth, water quality, porosity and pollution plumes, salinity mapping, saltwater-fresh water interface, fracture and cavity detection.

GEOL9090 Computing for Groundwater Specialists S1 L1.5 T1.5 C0

Introduction to FORTRAN programming, mainframe, microcomputer operation systems, databases, spreadsheets, statistical and graphical packages with applications relating to groundwater processes.

GEOL9100 Remote Sensing of Groundwater Resources S1 L1.5 T1.5 C3

The physics of various remote sensing techniques; interpretation of conventional aerial photography in exploration; infra-red remote sensing techniques; side-looking airborne radar; theory and applications of Landsat imagery; 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 database as applied to exploration. Remote sensing for hydrogeological mapping, recognition of aquifers and recharge, discharge zones, salinity mapping. Application of Landsat. TM. SPOT, RADAR and integrated information systems.

GEOL9114 Groundwater Research Project S2 C12

Research investigation consisting of one or more of; modelling, laboratory experiments, field work related to hydrogeology and groundwater management.

GEOL9124 Groundwater Project S2 C9

Study of similar content to GEOL9114 but at a smaller scale.

GEOL9444 Project in Engineering Geology C6

Study of similiar content to GEOL9464 but at a much smaller scale.

GEOL9454 Project in Engineering Geology C9

Study of similiar content to GEOL9464 but at a smaller scale.

GEOL9464 Project in Engineering Geology C15

The project is a research investigation consisting of field and laboratory work in any of the disciplines. Engineering Geology, Environmental Geology, Hydrogeology.

GEOL0110 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 looking 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.

GEOL0300 Computing and Statistics for Geologists SS L2 T1 C3

Computer hardware for geological data processing; peripheral devices; operating systems; VAX VMS, IBM VM/XA, MS DOS, UNIX; programming in Fortran and C; statistics for geologists; data base packages and macros.

GEOL0310 Image Processing of Spatial Data Sets SS L2 T1 C3

Data sources and formats, remotely sensed, geophysical, geochemical and topographic. Image display systems; data pre-processing, image rectification, spatial filtering and enhancement techniques. Statistical analysis, classification and image display as a tool for data integration.

GEOL0320 Geostatistical Ore Reserve Estimation SS L2 T1 C3

Geological data bases, digital core logging. Regionalised variables; definition of the variogram, variogram modelling; volume-variance relationships; geostatistical simulation. The use of commercial ore reserve and mine planning packages.

GEOL0330 Conceptual Models for Exploration Geology SS L2 T1 C3

The development and use of ore deposit models as a guide for exploration. Examples drawn from the major categories of deposit such as epithermal gold, greenstone-associated gold, vein-type uranium, porphyry coppers, volcanogenic massive sulphides, carbonate and shale-hosted lead-zinc and ultramafic hosted nickel sulphides. Exploration strategies and tactics; risk analysis and prospect evaluation.

GEOL0340 Geochemical Exploration Techniques SS L2 T1 C3

Regolith development and element mobility. Principles of exploration geochemistry and its role in mineral exploration.

Detailed consideration of soil, rock and drainage sampling interpretation techniques. consideration of appropriate analytical techniques. Problems related to Australian and other regional environments examined on the basis of case histories.

GEOL0350 Exploration Geochemical Data Processing **SS L2 T1 C3**

Graphical analysis of exploration geochemical data using boxplot, stem-and-leaf display and quantile plotting techniques; identification of anomalous observations. Correlation of geochemical variables; principal component analysis and identification of geochemical processes. Regression analysis and adjustment of background populations in geochemical data. Discriminant function analysis and classification of geochemical populations. Spatial filtering and definition of geochemical anomalies and regional distribution patterns of elements. Introduction to robust statistical methods. New developments in geochemical data processing.

GEOL0360 Remote Sensing Applications in Geoscience **SS L2 T1 C3**

The physics of various remote sensing techniques. Consideration of various sources of imagery; Landsat TM, SPOT, aircraft scanners etc. Spectral properties of rocks, soils and vegetation. Geological applications of visible, infra-red, thermal and multi-parameter microwave imagery in resource exploration, tectonic studies, geological hazard recognition and environmental monitoring. Mapping and data integration methodologies.

GEOL0370 Fundamentals of Exploration Geophysics **SS L2 T1 C3**

This subject is designed to give geoscientists an overview of geophysical methods. The following methods are discussed in terms of physical principles, applications, data acquisition and interpretation methodology: electrical resistivity, induced polarisation, continuous wave electromagnetics, transient electromagnetics, seismic refraction, seismic reflection, gravity, magnetics and radiometrics.

GEOL0380 Electrical Methods in Geophysical Exploration **SS L2 T1 C3**

The relationships between geology and electrical geophysical properties; basic theory of resistivity, induced polarisation and electromagnetic methods. Evaluation of applications, survey design, instrumentation, data acquisition, interpretation and productivity. Computer methods of interpretation are emphasised by the extensive use of hands-on microcomputer tutorials. An introduction to recent advances in electrical geophysics: inversion, multi-electrode array resistivity, spectral induced polarisation, transient electromagnetics and ground probing radar.

GEOL0390 Data Processing for Fossil Fuel Resources **SS L2 T1 C3**

Sedimentary basin analysis for special emphasis on the geology of coal deposits; coal deposit evaluation, data acquisition, computer processing, analysis and display.

GEOL0304 Data Processing Project 1 **SS C6**

A minor project equivalent to 6 hpw study for one session which will require the student to carry out detailed processing and analysis of a comprehensive data set for an exploration project that may relate to the students field of employment.

GEOL0314 Data Processing Project 2 **SS C12**

A research project equivalent to 12 hpw study for one session which require the student to carry out detailed processing, analysis and integration of a multi-attribute data set for an exploration project that may relate to the students field of employment.

GEOL0004 Special Program Applied Geology

For programs 8020, 8021 and 8094

GEOL0005 Research Thesis Applied Geology - Full-time

For programs 1000 and 2000

GEOL0006 Research Thesis Applied Geology - Part-time

For programs 1000 and 2000

Key Centre for Mines

KCME1102 Safety in the Mining Industry **C3**

The course includes the following: safety management; hazard and risk analyses, safety hazard identification, management techniques (MORT STEP), safety audits; statistics: HAZOP - management and maintenance of change risk analysis; cost benefit analysis; attitudes to safety in mining; safety and personal problems; effective training; accident and injury report/recovery; ergonomics and safety engineering; prevention of traumatic injury; work stress; environmental factors; monitoring and protection; personal protective equipment; safety policies and programs; action plans.

KCME1103 Drilling and Blasting **C3**

Drilling methods, types of drills, types of bits and other accessories, drilling economics maintenance schedules for drills and accessories; history and theory of explosives, explosive types; new developments and applications; blast design and secondary blasting; controlling ground vibration; airblast and flyrock; blasting economics; controlled blasting; precautions against extraneous electricity; misfires and deteriorated explosives safety and legislation for storage; transportation and handling of explosives.

KCME1107 Introductory Computing and Statistics for Geologists and Mining Engineers **C3**

Computer hardware for geological data processing; peripheral devices; operating systems; VAXVMS, IBM, VM/XA, MS DOS, UNIX; programming in Fortran and C; statistics for geologists and mining engineers; data base packages and macros.

KCME1300 Mining Management Project **C12**

A study of either an administrative or technical nature with relevance to the management of a mining or mineral

processing operation. This may be based on simulated or actual situations but projects of relevance to the candidates employment will be encouraged. As far as is possible projects will be designed in consultation with the mining industry.

KCME1302 Mine Ventilation and Environment C3

The course includes the following topics: ventilation network analysis and simulation; fan selection; role of booster fans; ventilation of long headings; recirculation; gases from diesel engines and their control; methane and its control in underground coal mines; dust in mine air and its control; mine climate and its control; ventilation planning.

Subject to be delivered as a short course consisting of 35 hours of class contact and additional tutorials equivalent to a further 7 hours of class contact.

KCME2101 Strata Control C3

This course presents to the practising engineer the latest developments in the field of strata mechanics and develops a sound design background to enable the carrying out of efficient mining operations for increased productivity consistent with safety. The course covers the fundamentals of strata mechanics together with advanced topics including engineering technology and rock mechanics aspects of coal mining strata control. Emphasis will be given to the various design aspects of mine structures, such as mine pillars, gate roads and long wall mining. The role played by instrumentation in providing for the safe design of the mine opening will be addressed. Special sessions will be devoted to rock and cable bolting techniques and powered support design.

KCME2104 Application of Computers in the Mineral Industry C3

Geostatistical ore reserve estimation on a personal computer; computerised open-pit design and planning; mine system simulation using GPSS/PC. An expert system for the mineral industry. Mine ventilation planning on a personal computer, using Lotus 123 spreadsheet to solve mining problems.

KCME2105 Geostatistics and Mine Planning C3

When to apply geostatistics; brief review of univariate statistics; bivariate statistics and correlation; exploratory data analysis; measures of spatial correlation: the variogram, the covariance; variogram calculation and how to obtain a good variogram; random function models and stationarity; desirable properties of estimators; estimation of variance; dispersion variance and uses; optimal weighted average estimator, ordinary kriging; recoverable reserve estimation, problems and solutions; application examples, coal, copper, gold; blast-hole kriging for ore-waste selection; geotechnics and the environment.

KCME3201 Financial Management C3

The course is delivered by correspondence and covers the following topics: financial management, an overview; accounting concepts and the accounting process; financial statements; public sector accounting; corporate accounting; the interpretation of financial statements; the recording of costs; management cost information (1); management cost information (2); the budgeting process.

KCME3202 Management Perspectives C3

The course is delivered by correspondence and covers the following topics: what is management?; managing individuals; managing groups; managing organisations; managing information; managing operations; managing decision making.

KCME3202 Economic Decision Making C3

The course is delivered by correspondence and covers the following topics: introduction to economic concepts demand; supply and the market consumers; firms and market structures; welfare economics and government intervention; international economics; macroeconomics and national income analysis; national economic policy benefit - cost analysis and expenditure decisions; business finance.

KCME3204 Management of Innovation C3

The course is delivered by correspondence and covers the following topics: innovation and innovators; technology and innovation; opportunity analysis; marketing and innovation; the business plan; management of innovation; innovations in corporations; maintaining innovations.

KCME3205 Strategic Planning C3

The course is delivered by correspondence and covers the following topics: the nature and scope of strategic management; the practice of strategic management; the mission of the organisation; analysing organisational resources; formulating strategic objectives; generating strategic alternatives; evaluating strategic alternatives; strategic implementation; assessing strategic performance.

KCME3206 Mineral Law C3

Topics to be covered with course include: definitions of 'minerals'; common law; ownership; Aboriginal land rights; miners' rights and claims; exploration titles; production titles; private land/Crown land; administrative processes; environmental protection and royalties. These topics will be illustrated by reference to a number of case histories.

KCME4102 Placer Technology C2

Sources of placer minerals; natural processes producing concentration of placer minerals; nature of placer deposits; trends in placer exploration; placer sampling; reserves calculations; mining methods; processing methods; project evaluation; environmental implications and pollution control technology.

KCME4201 Export Marketing for the Mining Industry C3

Marketing as applied to the mineral industry. Sources and types of market-related information. Particular international market characteristics; political, social and economic. Trade barriers, cartels, regional and sub-regional economic groupings. Marketing to Asia. Buyer behaviour, private and government sectors. Design, conduct and analysis of surveys of overseas markets for mineral products. Factors related to particular mineral commodities. The recognition of export opportunities. Stages in the development of a market strategy. Market decision making under conditions of uncertainty. The relationship between corporate and marketing strategy for mineral products. Value added mineral products and export marketing. Sources of assistance for export marketing.

KCME4202 Mine Evaluation and Project Assessment **C3**

Topics to be covered in the course are: valuation tools and techniques; vValuation reports; preliminary investigation; asset determination; impact of financing options; published assessments; feasibility studies; valuation of exploration tenements; residual values of property and plant; variations to value.

KCME4203 Mine Management **C3**

The subject covers general management functions, planning, organisation, control, communication, command, coordination, production functions, marketing, financial aspects, personnel, purchasing, public relations, environmental matters, contracts and stock market requirements and implications.

KCME4301 Environmental Management for the Mining Industry **C3**

Topics addressed are: environmental regulation as a constraint on business operations; environmental planning and management as a component of overall business planning; financial costs and benefits of environmental management and their timing; environmental risks and uncertainty; integrated design strategies; emission control technologies; formal environmental impact assessment procedures, including public submissions and hearings; lease and licence conditions; compliance with planning and pollution control legislation; developing and using environmental operations manuals; in-house environmental training programmes; corporate environmental audit procedures; liaison with public and community groups; particular EPM applications in mining, oil, manufacturing, petrochemical, civil engineering and infrastructure, building and construction; coastal management and other industries; EPM issues and concerns in Asia-Pacific nations and the region as a whole. Subject to be delivered as a short course consisting of 35 hours of class contact and additional tutorials equivalent to a further 7 hours of class contact.

Department of Safety Science

Head of Department
Professor J. Cross

Administrative Assistant
Mrs B. Littlewood

Safety Science is actively concerned with the application of engineering, behavioural and health sciences to the improvement of occupational health and safety. Safety Science considers the interface between people and technology with a particular emphasis on design to improve the health, safety and efficiency of people at work and in their other activities.

This brief is extremely broad, incorporating areas of study such as ergonomics, biomechanics, occupational disease, toxicology, educational psychology and engineering safety.

The Department offers postgraduate courses leading to the award of the degrees of Master of Safety Science, **8671**, Master of Engineering Science (Industrial Safety), **8545**, Graduate Diploma in Safety Science, **5480**, and Graduate Diploma in Ergonomics, **5485**. There is also a qualifying course **6347**, which allows non-graduates with extensive appropriate work experience to enter the courses leading to a graduate diploma. There are no undergraduate courses in safety science but undergraduate students may take individual subjects from the graduate diploma and masters courses where these are appropriate to their undergraduate course or career.

The Department is active in research in the areas of ergonomics, biomechanics, safety engineering, safety management, and occupational toxicology. Opportunities are available for graduate research leading to the degrees of Master of Science, **2775**, Master of Engineering, **2695**, and Doctor of Philosphy, **1665**.

Staff

Monier Professor of Safety Engineering and Head of Department

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

Professor of Mechanical Engineering

**Noel Levin Svensson, AM, MMechE, PhD *Melb.*, CEng, CPEng, FIEAust, MIMechE

Senior Lecturer

*Edward Maxwell Nicholls, MD BS *Adel.*, FACOM
Ronald Rosen, MSc *N.Z.*, PhD *N.S.W.*, CPhys, FInstP, FAIP, FIPSM, MACPSEM

Lecturers

Dianne Heather Gardner, BA *Adel.*, MPsychol(Applied) *N.S.W.*
Keith Post, BE PhD *N.S.W.*
Roger Roy Hall, BSc *A.N.U.*, MSc *N.S.W.*, FES, MIES
Kamal Kothiyal, MSc MTech PhD *I.I.T. Delhi*

Senior Research Assistant

David Gavin Lloyd, BScEng *N.S.W.*

Professional Officer

Kamal Yatapanage, MSc *N.E.*, PhD *Macq.*

Tutor

Boban Markovic, MSc PhD *N.S.W.*

Administrative Assistant

Barbara Littlewood

Visiting Fellow

Neil Leon Adams, BSc PhD *N.S.W.*, MESA, MHFS, MAITD, MICOH

*Conjoint appointment with the Faculty of Medicine.
**Conjoint with Faculty of Engineering.

Course Outlines

8545
Master of Engineering Science (Industrial Safety)

MEngSc

The Master of Engineering Science degree is obtained by satisfactory completion of 30 credits points of study, 12 of which represent a project. The degree is normally completed by one year of full-time study or two years of part-time study. Part time students may undertake the project at their place of work.

Candidates may undertake interdisciplinary studies and, subject to approval, are able to take subjects from any school in the Faculty, other faculties of the University and other universities or institutions. By means of this system, programs of studies best suited to the needs of the candidates may be selected.

Before enrolment an applicant should submit an intended program for approval by the school or division offering the majority of the credits to ensure that the prerequisite background held is adequate for all subjects including those taken in other schools or institutions.

Entry to the Master of Engineering Science course requires a degree at Honours level, or at Pass level to a superior standard in a four-year course in Engineering or other approved discipline. This is defined as an average of 65% over the last two years of a full-time course (or last three stages of a part-time course) taken in minimum time. If the degree concerned is not in an acceptable discipline, or was of less than four years full-time study, a bridging or qualifying program is required. This is normally arranged by enrolment in the appropriate graduate diploma with the possibility of transferring to the Masters program after completion of requirements prescribed by the Faculty. Students undertake 9 credits points of compulsory subjects, and 9 credit points of electives. The electives may be taken from any School in the Faculty, subject to the agreement of the Head of School and the Head of the Department of Safety Science. This enables students to extend their specialist knowledge in their own discipline, to undertake additional general management subjects or to extend their studies into the broader area of occupational health, safety and management.

Core Subjects

		Credits
SAFE9213	Introduction to Safety Engineering (M)	3
SAFE9343	Innovation - Productivity and Safety	3
SAFE9352	Hazard and Risk Analysis	3

Project

Students must undertake an investigative project of 12 credit points value. Projects may be based on studies carried out at a students place of work, or in the laboratories of the Department, or at any other place by arrangement with the Head of the Department. A range of instrumentation is available in the Department, and liaison can be arranged with industry if students do not have a suitable project at their place of work.
Each student is required to present a progress report at regular seminars which all project students are expected to attend. Generally there are at least two such seminars in each Session.

Electives

Students may choose postgraduate electives either from the Master of Safety Science course or from other schools in the University. A full list of subjects can be obtained from the various faculty handbooks. The subjects listed below are a selection of subjects related to safety from other schools.

A Selection of Elective Subjects from other Schools

		Credits
CIVL9726	Construction Law and Professional Practice	3
ELEC9211	High Voltage Technology	3
ELEC9212	Partial Discharges in Electrical Insulation	3
ELEC9410	Robotics Automation and3 Productive Technique	
IROB5701	Industrial Relations A	3
MANF9310	Factory Design and Layout	3
MANF9400	Industrial Management	3
MANF9410	Inspection and Quality Control	3
MANF9602	Engineering Economics Analysis	3
MECH9321	Acoustic Noise 1	2
MECH9322	Acoustic Noise 2	2
MECH9400	Mechanics of Fracture and Fatigue	3
MINE1224	Mining Engineering Technology	3
MINE1534	Environmental Conditions in Mines	3

		Credits
MINE9164	Atmospheric Pollution and Control (Theory)	3
MNGT0373	Organisational Design	2

Other Subjects from AGSM by arrangement

8671

Master of Safety Science
MSafetySc

Candidates are required to complete a program totalling 45 Credit points made up of 24 Credit points of compulsory subjects, 12 Credit points of electives and a 9 Credit point project. Students are also required to demonstrate either a satisfactory standard of understanding of all the preliminary subjects listed below, or to pass those subjects in addition to the 45 credit programme. This enables students from a wide range of disciplines (such as engineering, science, medicine, physiotherapy and education) to reach an adequate standard of comprehension for studying the compulsory subjects.

Preliminary Subjects

		Credits
ANAT6151	Introductory Functional Anatomy	3
SAFE9012	Statistics for Health and Safety Scientists	2
SAFE9011	Principles of Engineering Mechanics	3
SAFE9122	Computing for Safety Science	3
SAFE9142	Organisational Communication for Safety	3

Core Subjects

Core subjects, totalling 24 credits, represent the central theme of Safety Science and are compulsory.

		Prerequisites	Credits
CMED9701	Occupational Disease	ANAT615	3
SAFE9211*	Introduction to Safety Engineering	SAFE901	3
SAFE9224	Principles of Ergonomics	SAFE9012	3
SAFE9232	Introduction to Occupational Health and Safety Law		3
SAFE9242	Human Behaviour & Safety Science		3
SAFE9261	Occupational Health & Hygiene	CMED9701	3
SAFE9342	Management for Safety	SAFE9242	3
SAFE9352	Hazard and Risk Analysis	SAFE9012	3

* Students with an engineering or physics background may take SAFE9213 which covers similar material as SAFE9211.

Electives

Students are required to take at least 12 credit points from the list below.

		Prerequisites † Exclusions	Credits
BIOM9541	Mechanics of the Human Body		3
CHEM7325	Toxicology, Occupational & Public Health	Basic Chemistry	6
HEAL9411	Epidemiology	SAFE9012	2
LAWS5020	Industrial Safety & Health Law	SAFE9232	4
SAFE9424	Applied Ergonomicst	SAFE9224 at Credit Level	3
SAFE9523	Machines & Structures Safety	SAFE9011 SAFE9211	3
SAFE9531	Community Noise Control		2
SAFE9533	Electrical Safety	SAFE9211	3
SAFE9543	Management of Dangerous Materials	SAFE9211 Chemistry	3
SAFE9544	Transport Safety		3
SAFE9553	Radiation Protection	SAFE9211 †BIOM9028	3
SAFE9561	Occupational Health Practice	CMED9701 & SAFE9261	3
SAFE9563	Assessment of the Workplace Environment	SAFE9261 & SAFE9211	3
SAFE9573	Fire and Explosion	SAFE9211	3
SAFE9583	Ventilation	SAFE9011 & SAFE9211	3

Students may select as electives up to two graduate subjects offered by other Schools in the University, subject to the approval of the School concerned and the Head of the Department.

The following is a selection of approved subjects:

CMED9600	Disability
CMED9604	Alcohol and Drug Related Problems
CMED9609	Health and Illness Behaviour
IROB5701	Industrial Relations A
MANF9400	Industrial Management
MEED9108	Program Evaluation and Planned Change
MEED9125	Planning, Conducting and Evaluating Educational Workshops
MEED9202	Educational Process in Small Groups

Project

Project Students are required to undertake an investigative project and to present a satisfactory report. The project will normally be of 9 credits value (SAFE9609). In special circumstances, for example when a student enters the course with substantial advanced standing in the coursework, a superior Project Report of 18 Credits value (SAFE9618) may be permitted. Projects may be based on studies carried out at a student's place of work, or in the laboratories of the Department, or at any other place by arrangement with the Head of the Department. A range of instrumentation is available in the Department and liaison can be arranged with industry if students do not have a suitable project at their place of work. Each student is required to present a progress report at regular seminars which all project students are expected to attend. Generally there are at least two such seminars in each Session.

5480

Graduate Diploma In Safety Science
GradDip

The Graduate Diploma in Safety Science Course consists of three major components, totalling 30 credits points. They are preliminary subjects, core subjects and elective subjects. Some subjects must be taken in a prescribed sequence. Prerequisites are shown in the Table below. Equivalent prerequisites may be acceptable.

Preliminary Subjects

To broaden the base of their previous tertiary studies, students take up to three preliminary subjects from the list below. The selection of these subjects is determined according to previous qualifications and experience. Thus engineers are usually required to include Introductory Functional Anatomy, and students from a health sciences background include Principles of Engineering Mechanics. Students are expected to enter the course with a basic understanding of mathematics, physics and Chemistry. Where this is lacking students must undertake a bridging course.

		Credits
ANAT6151	Introductory Functional Anatomy	3
SAFE9012	Statistics for Health & Safety Scientists	2
SAFE9011	Principles of Engineering Mechanics	3
SAFE9122	Computing for Safety Science	3
SAFE9142	Organisational Communication for Safety	3

Core Subjects

Core subjects, totalling 18 credits, represent the central theme of safety science **and are compulsory.**

		Prerequisites	Credits
CMED9701	Occupational Disease	ANAT6151	3
SAFE9211*	Introduction to Safety Engineering		3
SAFE9224	Principles of Ergonomics		3
SAFE9232	Introduction to Occupational Health & Safety Law		3
SAFE9242	Human Behaviour & Safety Science		3
SAFE9261	Occupational Health & Hygiene	CMED9701	3
SAFE9352	Hazard and Risk Analysis	SAFE9012	3

* Students with an engineering or physics background may take SAFE9213 which covers similar material as SAFE9211.

Elective Subjects

To complete the requisite total of 30 credit points, students are required to select one or more subjects from the list of Electives or Core Subjects presented for the MSafetySc programme. In special cases a 3 credit point Report in Safety Science SAFE9603 may also be taken.

5485

Graduate Diploma In Ergonomics
GradDip

Like the Safety Science courses, the Graduate Diploma in Ergonomics is multidisciplinary and is designed to accept students from a range of backgrounds. There are therefore some preliminary subjects which are chosen according to the student's first degree. Most health professionals would need to study Principles of Engineering Mechanics but not Introductory Functional Anatomy, while engineers and physicists would study Introductory Functional Anatomy but not Principles of Engineering Mechanics. Statistics for Health and Safety Scientists would be taken only by students who have not completed a suitable statistics subject in their first degree. The course consists of three major components totalling 30 credit points: Preliminary subjects, Core subjects and Electives. All students must take 15 credit points from the Core subjects, with the remainder being selected from the Preliminary and Elective subjects. Some subjects must be taken in a prescribed sequence. Prerequisite subjects are shown below; equivalent prerequisites may be acceptable.

Preliminary Subjects

Selection of these subjects depends on entry qualifications, and is subject to approval by the Head of the Department.

		Prerequisites	Credits
ANAT6151	Introductory Functional Anatomy		3
SAFE9011	Principles of Engineering Mechanics		3
SAFE9012	Statistics for Health & Safety Scientists		2
SAFE9142	Organisational Communication for Safety		3

Core Subjects

Core subjects, totalling 15 Credits, represent the central theme of ergonomics, and are compulsory.

CMED9701	Occupational Disease	ANAT6151	3
PSYC7110	Advanced Ergonomics	SAFE9224	3
SAFE9211*	Introduction to Safety Engineering *or*	SAFE9011	3
SAFE9224	Principles of Ergonomics	SAFE9012	3
SAFE9242	Human Behaviour & Safety Science		3
SAFE9424	Applied Ergonomics	SAFE9224 at Credit Level	3

* Students with an engineering or physics background may take SAFE9213 which covers similar material as SAFE9211.

Elective Subjects

		Prerequisites	Credits
BIOM9541	Mechanics of the Human Body	ANAT6151 & SAFE9011*	3
CMED9701	Occupational Disease	ANAT6151	3
SAFE9531	Community Noise Control		2
PSYC7103	Applied Experimental Psychology		2
PSYC7104	Applied Cognitive Psychology		2
SAFE9211	Introduction to Safety Engineering	SAFE9011*	3
SAFE9342	Management for Safety	SAFE9242	3
SAFE9523	Machines and Structures Safety	SAFE9011 & SAFE9211	3
SAFE9544	Transport Safety		3
SAFE9603	Special Project in Safety Science	SAFE9224	3

* Or equivalent subjects.
Notes: The subject SAFE9603, Special Project in Safety Science, involves the solution of a practical ergonomics problem. Students may also select as electives, other graduate subjects from the Master of Safety Science course or other subjects offered by other schools, subject to approval by the School concerned and by the Head of the Department. A list of approved electives is available.
Not all elective subjects are available every year.

Graduate Study

SAFE9011 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, buoyancy, ship stability. Hydraulic and pneumatic systems. Applications in biomechanics, safety and ventilation.

SAFE9012 Statistics for Health and Safety Scientists C3

The subject is designed to provide an introduction to the theory of statistics and to those statistical techniques which are relevant to planning and management of health and safety services. The subject covers statistical methods which are a prerequisite to the study of epidemiology, risk management, ergonomics and behavioural studies. Topics include analysis of frequency distributions elementary probability theory, Binomial, Normal and Poisson distributions, elementary sampling theory, statistical decision theory and Hypothesis testing, t test, Chi-square test and elementary correlation theory. Illustrative data is drawn from statistics relevant to health and safety. SAFE9122Computing for Safety ScienceC3

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 health and safety related problems and/or to calculate related parameters.

SAFE9142 Organisational Communication for Safety C3

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

SAFE9211 Introduction to Safety Engineering C3

Prerequisite: SAFE9011 or equivalent.

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.

SAFE9213 Introduction to Safety Engineering M C3

The treatment of the following topics covers similar material as SAFE9211, but assumes a basic knowledge of differential calculus. The following workplace topics are considered; safety management, ergonomics, equipment design and task consideration, machine guarding, electrical safety, fire and explosion, management of dangerous materials, ventilation, radiation protection, noise and vibration control, environmental safety, transport safety, safety issues in different industries.

SAFE9224 Principles of Ergonomics C3

Prerequisite: HEAL9011 or equivalent.

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.

SAFE9232 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.

SAFE9242 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 organisational change.

SAFE9261 Occupational Health and Hygiene C3

Prerequisite: CMED9701.

This subject deals with practical considerations of monitoring and maintaining a healthy and injury free workforce. Topics include: The role and training of an occupational hygienist; workplace monitoring; sampling, accuracy and precision; environmental monitoring including air sampling and analysis of particulates, respirable particles, toxic dusts and gases, hazardous gas identification. Air quality control methods, ventilation. Electromagnetic radiation and the eye; cold and heat stress; vibration; toxicology, routes of entry - distribution and reactions. Personal protection; Biosafety, AIDS, hepatitis B, Legionnaire's disease; Sick buildings. Medical screening and biological monitoring.

SAFE9342 Management for Safety C3

Prerequisite: SAFE9242 Management models and structure.

The structure and responsibilities of a safety manager. Integrating 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. The safety practitioner as change agent.

SAFE9343 Innovation, Productivity and Safety C3

This subject is designed to equip engineers with the knowledge and skills needed to combine good project design and management at a technical level with positive leadership and effective person management at the human interaction level. The emphasis will be on the integration of human and technical capabilities and constraints into a total operating system in which safety, quality and productivity have been incorporated as system goals and functions. Topics to be covered include: Behaviour of people in organisation, Individuals, groups and organisations: Attitudes; Motivation; Leadership and morale; Conflict and its resolution; Group dynamics; Planning for innovation and change; Dealing with human problems, including resistance to change; Human capabilities and limitations in the physical, perceptual and cognitive reactions with the operating system.

The cost benefit of fail-safe design (in relation to human operators) vs post design training. Operator efficiency and operator safety. The human barriers to designing and operating the system with these joint priorities.

Recent advances in defining and controlling human error and their implications for equipment design and for management and training systems.

SAFE9352 Hazard and Risk Analysis C3

Prerequisite: HEAL9011 Assumed knowledge: MATH2841 or equivalent.

Causes of accidents and defensive strategies; energy storage and transfer; epidemiology of accidents; reduction of loss from accidental injury; human factors; the environment and accidents. Introduction to risk management; quantification of risk: risk benefit concepts. 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.

SAFE9424 Applied Ergonomics C3

Prerequisite: SAFE9224 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.

SAFE9523 Machines and Structures Safety C3

Prerequisite: SAFE9011 and SAFE9211.

Strength of materials, materials failure. 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, fracture, pressure vessels, non-destructive testing.

SAFE9531 Community Noise Control C3

Introduction; sound and sound propagation; sound power, sound pressure, decibels; sound perception, psycho-acoustics; loudness, annoyance, phones and dB(A); hearing conservation; acoustic measuring and analysising instruments-sound level meters, filters analysis, 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. Noise control in industry.

SAFE9533 Electrical Safety C3

Prerequisite: SAFE9211 OR SAFE9213.

Effects of current flow and electric and magnetic fields; elementary circuit representation, typical supply situations; likely dangerous conditions; static electricity; hazardous locations; standards and codes of practice; treatment of electric shock. Electrical causes of fire and explosion; prevention of electrical accidents.

SAFE9543 Management of Dangerous Materials C3

Prerequisite: SAFE9211.

Assumed knowledge: 1st year Chemistry Atmospheric dispersion of gaseous and particulate materials. Protection against dangerous materials for operators and other personnel. 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. Treatment of wastewaters. Relevant legislation. Field excursion.

SAFE9544 Transport Safety C3

This subject aims to provide students with an introduction to nature and scope of road safety and provide an understanding of the interdisciplinary and integrated approach required to implement improvements in roads and traffic safety. Subject areas include identification of road safety problems, strategic planning, road and road environment safety, ergonomics, signals, signs, lighting, road user safety, knowledge, attitudes, compliance and practices, vehicle and equipment safety, road safety school education, road safety campaigns and program evaluation.

SAFE9553 Radiation Protection C3

Prerequisite: SAFE9211 or SAFE9213.

Principles and practices of radiation protection for both ionising and non ionising radiation. Radiation physics, detection and measurement; background radiation; biological effects of radiation; dose limits; technical controls for radioactive sources and irradiating apparatus. Codes of safe practice; radiological monitoring and personal dosimetry; storage, transport and disposal of sources; environmental impact; administrative

controls; emergency procedures; control of non-ionising radiation. Practical work and site visit.

SAFE9561 Occupational Health Practice **C3**

Prerequisite: CMED9701 and SAFE9261.

This subject provides an opportunity for experiential learning in topics related to Occupational Health Practice. Students will visit six diverse industrial sites and centres for occupational health control. Before each visit the student must be aware of the possible health problems specific to that site or centre. A nominated preceptor will be available at each site or centre. Reports on each of these visits will be required; two reports must be substantial. Students enrolled in the Master of Safety Science or Diploma in Safety Science courses, who have paramedical qualifications will be best suited for this subject.

SAFE9563 Assessment of the Workplace Environment **C3**

Prerequisite: SAFE9261 and SAFE9211 or SAFE9213.

Experimental design and practical measurements of the physical and chemical components of the workplace and general environment with reference to their impact upon health and safety. One quarter of the subject is allocated to formal lectures which outline measurement methods, experimental strategies and reporting procedures which are useful for constructing successful measurement programs. In the remaining time students design and carry out a number of practical measurement programs to access and report on the environment in terms of parameters such as noise, toxic dusts, flammable gases, floor friction, strength of materials forces associated with manual tasks, temperature, humidity and radiant heat, lighting, radiation, electromagnetic fields, and vibration.

SAFE9573 Fire and Explosion **C3**

Prerequisite: SAFE9211 or SAFE9213.

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.

SAFE9583 Ventilation **C3**

Prerequisite: SAFE9011 and SAFE9211.

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.

SAFE9603 Special Report in Safety Science **C3**

Only for students enrolled in the Graduate Diploma courses.

SAFE9609 Project **C9**

SAFE9612 Project **C12**

SAFE9618 Project Report **C18**

Servicing Subject Descriptions

Undergraduate Study

Accounting

ACCT1501 Accounting and Financial Management 1A — **S1 or S2 L2 T2.5**

Prerequisite: Nil.

This is the first unit in a sequence of subject dealing with aspects of the practice of financial reporting, and reviewing the analytical and investigative tools and processes used within the discipline of accounting. The basic accounting process, whereby financial data from source documents are recorded, processed, summarised and adjusted (in terms of a given set of accounting

concepts) culminating in the preparation of financial reports. Design of accounting systems and incorporation of internal controls. Accounting for cash debtors, inventories and property, plant and equipment. Uses and limitations of traditional financial reports.

ACCT1511 Accounting and Financial Management 1B — **S1 or S2 L2 T2.5**

Prerequisite: ACCT1501.

The second unit in a sequence of financial accounting subjects including the definition and recognition of assets, liabilities, revenues and expenses, partnerships, joint ventures and corporations. Financing decisions and financial Management. Financial statement analysis. Aspects of the contemporary institutional and regulatory environment of external financial reporting. Alternative accounting systems incorporating different measurement unit. Capital maintenance and valuation concepts. Overview of accounting for investments. Preparation of simple funds statement.

ACCT2522 Accounting and Financial Management 2A — **S1 L2 T2.5**

Prerequisite: ACCT1511. Excluded: ACCT2532.

The design and operation of management accounting systems, including product costing systems and budgeting planning and control systems. In particular, attention is focused on the theoretical and practical implications of management accounting system design on organisational functioning, with emphasis on both manufacturing and service organisations. Involves the use of spreadsheet modelling and the use of personal computer.

ACCT2542 Accounting and Financial Management 2B — **S2 L2 T2.5**

Prerequisite: ACCT1511. Excluded: ACCT2552.

The third financial reporting unit after 1501 and 1511 with a consideration of more complicated transactions and events as well as the accounting problems in certain specific industries. The contracting cost and other frameworks for the analysis of financial reporting.; More advanced aspects of accounting for shareholders' equity, liabilities and assets including interperiod company tax allocation and lease accounting. Accounts of a company. Profit and Loss account, balance sheet, and summary of sources and applications of funds. Application of computer technology to financial accounting problems.

Biochemistry

BIOC2312 Principles of Biochemistry and Molecular Biology **F L2.5 T3.5**

Prerequisites: BIOS1011 and BIOS1021, CHEM1101 and CHEM1201 or CHEM1002. Excluded: CHEM2929.

The chemical properties of amino acids, peptides and proteins, carbohydrates, nucleic acids and lipids and biological roles of these compounds. The nature and function of enzymes. The intermediary metabolism of carbohydrates, lipids and nitrogenous compounds. The relationship between structure and function of enzymes, other proteins, hormones and biological membranes, metabolic networks and control mechanisms. The molecular mechanism of gene expression and protein synthesis. Regulation of gene expression. Recombinant DNA technology and protein engineering. Introduction to biotechnology. Photosynthesis. Practical work to complement the lectures.

Biological Science

BIOS1011 Biology A **S1 L2 T4**

Prerequisite:	*HSC Exam Score Range Required*
2 unit Science (Physics) or	*53-100*
2 unit Science (Chemistry) or	*53-100*
2 unit Science (Geology) or	*53-100*
2 unit Science (Biology) or	*53-100*
3 unit Science or	*90-150*
4 unit Science	*1-50*

The biology of cells; their structure as seen with light and electron microscopes; how they move; take in and excrete substances their chemistry and use of energy. Inheritance and mutations; genes and how they work. The theory covered in the lectures and tutorials is illustrated by observation and experiment in laboratory classes.

The course guide must be purchased during enrolment week. Equipment required for practical classes is listed in the Course Guide and must be purchased before session starts.

BIOS1021 Biology B **S2 L2 T4**

Prerequisite: BIOS1011 (however, students without this prerequisite may seek the permission of the Co-ordinator of First Year Biology to enrol). Excluded BIOS021.

The evolution, diversity and behaviour of living things and the ways in which they have adapted to varying environments. Emphasis on the structure and function of flowering plants and vertebrate animals, and their roles in Australian ecosystems. The theory covered in lectures and tutorials is illustrated by observation and experiment in laboratory classes, which include dissection of a toad and a rat.

BIOS2021 Introductory Genetics **S2 L2 T4**

Prerequisites: CHEM1201 or CHEM1002, BIOS1011, BIOS1021. Co-requisite: BIOC2312. Excluded WOOL3803, 45.601.

Genome Structure and life cycles in prokaryotes and eukaryotes: DNA, gene mapping, cytogenics. Genetic transmission, mutation, recombination. Gene regulation, interaction and development. Genetic variation and evolution of molecules, populations and species: Mating, selection, migration, population size, mutation, environment. Applications, including humans and genetic engineering.

Students are not admitted to Level III Biological Science units without special permission of the Head of School unless Chemistry CHEM1002 or both CHEM1101 and CHEM1201 have been completed.

BIOS2031 Biology of Invertebrates **S2 L2 T4**

Prerequisites: BIOS1011 and BIOS1021. Excluded: 45.201.

A comparative study of morphology, taxonomy and functional biology of invertebrate animals. Emphasis is placed on the major groups (Anthropods and Molluscs) and on marine forms.; Practical classes and a compulsory field camp illustrate the lecture material.

BIOS2051 Flowering Plants **S2 L2 T4**

Prerequisites: BIOS1011 and BIOS1021. Excluded 43.111, 45.111.

Basic plant biology including cell structure, plant morphology and anatomy, water and sugar transport, seed structure and physiology, plant growth and development aborescence, leaves and photosynthesis, roots, microorganisms and nutrition, evolution of land plants and plant taxonomy. Practical work: plant anatomy and light microscopy; collection of numerical data and a statistical analysis, plant identification.

BIOS2061 Vertebrate Zoology **S1 L3 T3**

Prerequisites: BIOS1011, BIOS1021. Excluded: 45.301.

A comparative study of the Chordata, with particular reference to the vertebrates, including morphology, systematics, evolution and natural history, with reference to selected aspects of physiology and reproduction. Practical work to supplement the lecture course. Field excursions as arranged.

BIOS3061 Environmental Botany **S1 L2 T4**

Prerequisites: BIOS1011 and BIOS1021. Excluded: 43.142.

Study of soil and atmospheric environments in which plants live and their interaction with the environment. Interactions at scales ranging from the microenvironment to the ecosystem; energy and mass transfer over these scales is investigated and modelled. Impacts of global change on vegetation. Exchange of greenhouse gasses between atmosphere and biosphere.

BIOS3101 Australian Ecosystems and Community Analysis

Prerequisite: BIOS2051, GEOG1012, GEOG1031 or BIOS2011. Excluded: 43.152.

This unit examines methods for detection and analysis of spatial pattern in the distribution of organisms and communities. Geological history of the Australian environment

and biota is reviewed. Selected habitat types are examined in detail with issues related to their distribution, species composition and functioning. Participation in field work is essential.

BIOS3111 Population and Community Ecology **S1 L2 T4**

Prerequisite: BIOS1021 and MATH1032 or Both MATH1011 and MATH1021. Excluded: 45.152.

Factors regulating dynamics of interacting populations, renewable resource management, ecosystem stability, cycles and chaos, simulation modelling in ecology, niche theory, competition, habitat selection, community structure, species diversity, island biogeography, ecological gradients. Succession following disturbance (fire, mining, or logging). Participation in field work is essential.

Biotechnology

Biotechnology is a Department within the School of Applied Bioscience.

BIOT3011 Biotechnology A **S1 L3 T3**

Prerequisites: BIOS2312 and MICR2018.

The basic principles involved in the operation of microbial processes on an industrial scale. Includes: the selection, maintenance and improvement of micro-organisms; the influence of physical and chemical factors on the microbial environment; the control of environmental factors; the effects of operational patterns on batch and continuous flow cultivation; aeration and agitation; scale-up and microbial processes; air and media sterilisation; the harvesting, purification and standardisation of products; the principles involved in microbial processes for chemical, pharmaceutical and food production, microbial waste treatment and environmental control. The laboratory component includes manipulation of micro-organisms, laboratory-scale fermenter operation, microbial enzyme isolation, visits to industrial fermentation plants and industrial seminars.

BIOT3021 Biotechnology B **S2 L2 T4**

Prerequisite: BIOT3011.

Application of principles of biotechnology to the analysis and design of microbial processes of industrial relevance (antibiotics, microbial enzymes, single cell protein from carbohydrates and hydrocarbons, fermented foods and beverages, amino acids and vitamins, microbial polysaccharides, activated sludge and photosynthetic processes for waste treatment, microbial teaching of low-grade minerals). Emphasis on quantitative approach; mass and heat balance calculations, kinetic and thermodynamic analysis, detailed equipment design and specification, process design and layout, process simulation, plant location, application of optimisation techniques. the economics of microbial processes are considered and comparison made with alternative modes of production or treatment. The economics of agroindustry in Australia using microbial processes. Marketing of fermentation products, clinical trials required, legal constraints, patent right. Technical and economic feasibility studies, and a design project.

BIOT3031 Microbial Genetics **S1 L2 T4**

Prerequisites: BIOS2011, BIOS2021, BIOC2312, MICR2011. Excluded: MICR3021.

This unit is suitable for students majoring in Microbiology, Biochemistry, Biotechnology or Genetics. It deals with major aspects of the genetics of bacteriophage, bacteria and yeast. Topics include plasmids and transposable genetic elements, gene transfer, mutagenesis and DNA repair, mutants, bacteriophage genetics, gene closing (vectors, recombinant DNA techniques) and genetics of nitrogen fixation.

BIOT3100 Fermentation Processes **S2 T2**

Factors governing the use of micro-organisms in industrial processes, including the selection, maintenance and improvement of micro-organisms, the control of environmental factors, batch and continuous flow operational patterns, product recovery, process optimisation and waste disposal. Demonstrations of the operation and control of fermenter systems and of microbial process simulation.

BIOT4073/BIOT4083 Biotechnology (Honours)

Advanced formal training in selected areas of biotechnology and participation in one of the school's research projects.

BIOT4093 Biological Process Engineering **F L2 T4**

Prerequisite: MICR2201.

Structure of Metabolism: Growth of an undifferentiated organism as a physico-chemical process leading to quantification of growth processes. Structure and function of a single cell. The structure of metabolic processes. Energy metabolism balances. Small metabolite production. Macro-molecule production. Co-ordination and control of cellular processes. *Industrial Bio-processes:* A review of bio-process industries. The selection, screening and maintenance of commercial cultures. The optimisation of bio-processes. Batch and continuous fermentations. Enzyme engineering, single cell protein. Biodeterioration and microbiological stability. Sanitation. Fermentation practice. *Microbial Dynamics and Energetics:* Principles used in the quantification of complex systems. Quantification of biomass and the growth process. Balanced growth. The Monod model and further extensions of the model. Uncoupling of growth processes. Quantification of product formation. Distributed, segregated, unstructured and structured models. Stochastic models. Overall energetics of growth processes. Entropy and free energy relationships in complex reaction sequences. Principles and requirements of driven reactions. The energetics of cell processes and the prediction of yields and metabolic heat evolution.

Chemistry

CHEM1002 Chemistry 1 **F L3 T3**

	HSC Exam Score Range required
Prerequisite 2 unit Mathematics or	*55-100*
3 unit Mathematics or	*1-50*
4 unit Mathematics	*1-100*
and	
2 unit Chemistry or	*53-100*
3 unit Science or	*90-150*
4 unit Science or	*1-50*
2 unit Physics	*53-100*

Stoichiometry and solution stoichiometry. Atomic and molecular structure. Changes of state, phase diagrams, gases, liquids, solids, solutions. Thermodynamics, equilibrium constants, acid-base and solubility. Oxidation and reduction. Kinetics. Molecular geometry, hybridization of orbits. Periodicity of physical and chemical properties of elements and compounds. Organic chemistry including stereoisomerism.

CHEM1101 Chemistry 1A **S1 L3 T3**

	HSC Exam Score Range required
Prerequisite 2 unit Mathematics or	*55-100*
3 unit Mathematics or	*1-50*
4 unit Mathematics or	*1-50*
and	
2 unit Chemistry or	*53-100*
3 unit Science or	*90-150*
4 unit Science or	*1-50*
2 unit Physics	*53-100*

Stoichiometry and solution stoichiometry. Atomic and molecular structure. Changes of state, phase diagrams, gases, liquids, solids, solutions. Thermodynamics. Equilibrium constants, acid-base and solubility. Oxidation and reduction. Kinetics.

CHEM1201 Chemistry 1B **S2 L3 T3**

Prerequisite: CHEM1101 Chemistry 1A

Molecular geometry, hybridization of orbitals. Periodicity of physical and chemical properties of elements and compounds. Organic chemistry, including stereoisomerism.

Note: The two subjects CHEM1101 and CHEM1201, taken sequentially, are equivalent to CHEM1002.

CHEM1302 Introductory Chemistry **F L3 T3**

	HSC Exam Score Range Required
Prerequisites 2 unit Mathematics or	*55-100*
3 unit Mathematics or	*1-50*
4 unit Mathematics	*1-100*

Stoichiometry and solution stoichiometry. States of matter, changes of state, phase diagrams, gases, liquids, solids, solutions. Thermodynamics, enthalpy, entropy, free energy. Oxidation and reduction, electrode potentials. Kinetics. Atomic and Molecular structure, equilibrium constants, acid-base and solubility. Periodicity of physical and chemical properties of elements and compounds. Organic chemistry, including stereoisomerism.

Note: CHEM1002 is the normal prerequisite for Level II Chemistry. However, students who perform very well in CHEM1302 will be permitted to continue on to Level II Chemistry ;with the permission of the Head of School of Chemistry.

CHEM1401 Introductory Chemistry A **S1 L3 T3**

	HSC Exam Score Range required
Prerequisites 2 unit Mathematics or	*55-100*
3 unit Mathematics or	*1-50*
4 unit Mathematics	*1-100*

Stoichiometry and solution stoichiometry. States of matter, changes of state, phase diagrams, gases, liquids, solids, solutions. Thermodynamics, enthalpy, entropy, free energy. Oxidation and reduction, electrode potentials. Kinetics.

CHEM1501 Introductory Chemistry B **S2 L3 T3**

	HSC Exam Score Range required
Prerequisites CHEM1401 Introductory Chemistry A or	
2 unit Mathematics or	*55-100*
3 unit Mathematics or	*1-50*
4 unit Mathematics	*1-100*
and	
2 unit Chemistry or	*53-100*
3 unit Science or	*90-150*
4 unit Science or	*1-50*
2 unit Physics	*53-100*

Atomic and molecular structure, equilibrium constants, acid-base and solubility. Periodicity of physical and chemical properties of elements and compounds. Organic chemistry including stereoisomerism.

Note: The two subjects CHEM1401 and CHEM1501, taken sequentially, are equivalent to CHEM1302.

CHEM1807 Chemistry 1ME

Prerequisite: As for CHEM1501.

Stoichiometry. Atomic and molecular structure. Chemistry of materials. Thermochemistry. Kinetics. Equilibrium. Oxidation and reduction, electrochemistry and corrosion of metals. Introduction to organic chemistry, structure and properties of polymers, fuels and lubricants. Surface chemistry.

CHEM2011 Physical Chemistry **S1 or S2 L3 T3**

Prerequisites: CHEM1002 or CHEM1101 and CHEM1201 and MATH1042, or MATH1032, or MATH1011 and MATH1021. Excluded: 2.002A

First, second and third laws of thermodynamics. Applications of thermodynamics. Chemical and phase equilibria. Solutions of electrolytes and nonelectrolytes. Principles and applications of electrochemistry. Reaction kinetics. order and molecularity; effect of temperature on reaction rate. Surface and colloid chemistry.

CHEM2021 Organic Chemistry **F or S2 L3 T3**

Prerequisite: CHEM1002 or CHEM1201. 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. Introduction to the application of spectroscopic methods to structure determination.

CHEM2031 Inorganic Chemistry and Structure **S1 or S2 L3 T3**

Prerequisite: CHEM1002 and CHEM1101 and CHEM1201. Excluded: 2.042C

Experimental basis for theories of electronic structure of atoms and molecules. Concepts and consequences of quantum theory. Structure, energetics and bonding in the solid state. Principles of co-ordination chemistry. Occurrence, preparation, properties and reactions of selected compounds of transition and main group elements.

CHEM2041 Chemical and Spectroscopic Analysis **S1 or S2 L3 T3**

Prerequisite: CHEM1002 or both CHEM1101 and CHEM1201 and MATH1042, or MATH1032, or MATH1011 and MATH1021. Excluded: 2.002D and 2.003H.

General procedures in analytical science, accuracy, propagation of errors, precision. Analytical equilibrium chemistry, titrimetric and gravimetric analysis. Solvent extraction. Electroanalytical methods. Chromatography. Optical spectroscopy, instrumental aspects of all major spectroscopic methods.

CHEM2828 Organic and Inorganic Chemistry for Chemical Engineers **L2**

Prerequisites: CHEM1002 or both CHEM1101 and CHEM1201.

Discussion of selected types of organic reactions to provide a broad cover of the chemistry of aliphatic and aromatic compounds. Survey of the structures, energetics, bonding, reactions and physical properties, and applications, of selected compounds of main group elements and of lanthanide and *d*-block transition elements.

CHEM2929 Fundamentals of Biological and Agricultural Chemistry **S1 L2 T4**

Prerequisites: CHEM1002 or CHEM1101 and CHEM1201. Excluded: 2.013L, BIOC2312.

Aspects of the chemical and physical properties of materials important in biological systems. Amino acids, peptides and introduction to protein structure. Chemistry of monosaccharides, disaccharides and polysaccharides. Fats. Trace elements. Common heterocyclic systems of biological importance. Insecticides. Colour. chromatography.

CHEM3021 Organic Chemistry **S1 L3 T3**

Prerequisite: CHEM2021. Excluded: 2003B.

Synthesis and reactions of the Principal types of aromatic heterocyclic systems. Stereochemistry. Synthesis and reactions of carbocyclic systems. Application of spectroscopic methods (eg nuclear magnetic resonance, mass spectrometry) to determination of organic structures.

CHEM3121 Synthetic Organic Chemistry **S2 L2 T4**

Prerequisite: CHEM3021. Excluded: 2.013B.

Modern functional group transformations with particular reference to positional and stereochemical control. Pericyclic reactions and photochemistry; Woodward-Hoffman rules. Principles of planning organic synthesis; disconnection approach.

CHEM3311 Environmental Chemistry **S2 L3 T3**

Prerequisite: CHEM2011 and CHEM2041. Excluded: 2.043A.

Physical chemistry of the environment. The chemistry of water in the environment; rivers, estuaries and oceans. The chemistry of the atmosphere: Photolysis, primary and secondary pollutants. The distribution of elements in ecosystems. Analysis of naturally occurring species and pollutants.

CHEM3321 Applied Organic Chemistry **S2 L2 T4**

Prerequisite: CHEM3021. Excluded: 2.003L.

Polymerization processes and synthetic polymers; initiators, chain transfer agents, retarders. Pigments and dyestuffs; Basis of colour in organic compounds. Oxidation and reduction processes; theory and industrial importance.

CHEM3829 Organic Chemistry **S1 L2 T4**

Prerequisite: CHEM2021.

The spectroscopic identification of organic compounds, free radical chemistry and electro-organic processes, various aspects of the organic industrial processes such as industrial synthesis based on petrochemicals, and organometallic reactions of industrial interest. Selected topics from the dyestuff, pharmaceutical and agricultural industries.

CHEM3926 Instrumental Methods of Food Analysis **S2 L1 T2**

Treatment of theory and practice of modern instrumental methods of analysis, with strong emphasis on the analysis of food constituents. A Variety of Spectroscopic and chromatographic techniques are discussed.

CHEM3929 Food Chemistry **S1 L2 T4**

Treatment of the chemistry of important food constituents. Topics discussed include Proteins, carbohydrates, fats and oils, vitamins, natural and synthetic pigments, essential oils and flavours, importance of water in foods.

Civil Engineering

CIVL0616 Structures **S1 L1 T2**

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. Deflection at a single load. Shock loads. Theory of centrally loaded column and eccentrically loaded columns.

Commerce and Economics

ECON1101 Microeconomics 1 **S1 or S2 L2 T1.5**

Prerequisite:	*HSC Minimum mark required*
Contemporary English or	*60*
2 unit English General or	*60*
2 unit English or	*53*
3 unit English	*1*

Economics as a social science; scarcity, resource allocation and opportunity cost. An introductory analysis of consumer behaviour. The economics of firms and markets: production and costs; the classification and analysis of markets. Efficiency concepts and market failure. The gains from international trade and the impact of trade restrictions. Economic growth and structural change.

ECON1102 Macroeconomics 1 **S1 or S2 L2 T1.5**

Prerequisite: ECON1101.

Introduction to the analysis of aggregate output, employment and economic growth and their relationship to the policy issues of unemployment, inflation and the balance of payments. Social accounting and aggregate income and expenditure analysis. Introduction to macroeconomic models of income determination; consumption and investment functions. The role of money and financial institutions; interactions between goods and money markets in equilibrium and disequilibrium situations. Analysis of recent Australian macroeconomic experience.

ECON2101 Microeconomics 2 **S1 L2 T2**

Prerequisite: ECON1102, ECON1203. Excluded: ECON2103, ECON2121.

Choice theory, including intertemporal choice, labour supply Extensions of price theory. The theory of production, costs and supply. Market structures including oligopoly models. Introduction to general equilibrium and welfare analysis. Externalities.

ECON2103 Applied Microeconomics **S2 L2 T1.5**

Prerequisite: ECON1102, ECON2101, ECON2121.

Structural change in the Australian economy. The effect of different market structures on firms and consumer welfare. The consequences of market failure and the effects of government regulation. Investment decisions in the public and private sectors, including the estimation of future benefits, revenues and costs, the measurement of consumer and producer surplus. The economics of non-renewable and other resources. Australia's international trade and investment and the effects of restrictions on international trade and investment.

ECON2104 Applied Macroeconomics **S1 L2 T1.5**

Prerequisite: ECON1102, ECON2122. Excluded: ECON2102.

Economic growth and fluctuations in Australia. Inflation, unemployment and balance of payments issues. Fiscal, monetary, exchange rate and income policies. Changes in the structure of the Australian financial system and its links with the international monetary system. Effects of restrictions on capital markets.

ECON2108 Industry Economics and Australian Industrial Policy **S2 L2 T1**

Prerequisite: ECON2101 or ECON2103 or ECON2121.

Structure of industry; inter-relationships between the role of the business firm and industrial structure; multinational corporations; factors affecting size, structure and performance such as economies of scale, barriers to entry, vertical integration, diversification and mergers, patents, the development and transmission of technology; industrial policy in Australia with special reference to competition policy, foreign investment and mergers, and some specific industry policies eg on motor vehicles, electronics, steel, petroleum.

ECON2109 Economics of Natural Resources **S1 L2 T1**

Prerequisite: ECON2101 or ECON2121 or ECON2103. Excluded: ECON2107

An introduction to the exploitation of natural resource systems examined within an economic framework, particularly forestry, fisheries, water, oil and other minerals. Policies required to ensure fisheries, water, oil and other minerals. Policies required to ensure improved management without overexploitation of these renewable and non-renewable resources under different property-right regimes.

ECON2117 Economics of Tourism **S1 L2 T1**

Prerequisites: ECON1102.

Macro and micro economic environments. Factors affecting international and domestic tourism. Tourism forecasting models. Economic analysis of projects. Cost/benefit and related procedures. Implications of tourism developments for the community in general.

ECON2127 Environmental Economics and Cost-Benefit Analysis **S2 L2 T1**

Prerequisite: ECON1101. Excluded: ECON2107.

Main elements of environmental economics and cost benefit analysis as it relates to the assessment of environmental issues. topics will include: pollution and pollution policy; environmental cost-benefit analysis and economic methods for measuring costs and benefits; species extinction and irreversibility; environmental ethics and discounting; the environment and developing countries; and the sustainable economy.

ECON3115 Economics of Developing Countries **S1 L2 T1**

Prerequisite: ECON1102.

Aspects of economic development in the less developed countries. Characteristics of those countries and the policies available to them, simplified models of under-development, phenomenon of structural change in the development process, role of industrialisation in promoting structural change, international relationships of developing countries and strategies of development based on industry or agriculture. Applications to Asian experiences in economic development.

Electrical Engineering

ELEC0802 Electrical Power Engineering **S1 L/T3**

Prerequisite PHYS1002 or equivalent (PHYS2920 or 6.851 for students in Course 3140).

The course deals with the principles and practice of electrical power apparatus, particularly the transformer, the dc motor and the ac motor. It also covers some of the electronic power converters for power supplies and for control of electrical machinery. The course commences with the basic circuit theory and phasor algebra relevant to the analysis of the above systems and then proceeds to the consideration of distribution of electrical power. It then covers the operation, analyses and characteristics of transformers, dc motors, ac motors and a few semiconductor power converter circuits. Rating and thermal consideration electrical apparatus are also treated.

ELEC0805 Electronics for Measurement and Control **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.

Banking and Finance

FINS2613 Business Finance 2 A **S1 or S2 L2 T1**

Prerequisite: ACCT1511, ECON1102 and ECON1203.

The essential aspects of financial decision-making in business including: factors influencing capital expenditure decisions; alternative approaches to valuation; factors affecting the formulation of the capital structure; influence of the capital market environment.

Information Systems

INFS1602 Computer Information Systems 1 **S1 or S2 L2 T1**

Prerequisite: ECON1202 or ECON1201 or approved studies in computer science.

Information systems and the organisation, architecture of typical commercial application systems, the systems lifecycle, the systems analysis/design task, tools and techniques of the systems analyst, documentation techniques, internal controls and interfacing with the edp auditor, file design concepts, logic and computer hardware, commercial computer programming.

INFS2603 Computer Information Systems 2 **S2 L2 T1**

Prerequisite: INFS1602. Excluded: INFS3606.

System analysis and design: requirements analysis and specification, logical and physical design of business systems, specification and updating of files, man-machine dialogue procedures. Comparison of design methodologies - top-down and evolutionary.

Industrial Relations and Organizational Behaviour

IROB1701 Industrial Relations 1A **S1 or S2 L2 T1.5**

Prerequisite:	*HSC minimum mark required*
Contemporary English	*60*
2 unit English (General) or	*60*
2 unit English or	*53*
3 unit English	*1*

Multi-disciplinary introduction to a range of important concepts and issues in Industrial relations. Political, social, economic, legal, historical and psychological aspects of the evolution and operation of modern employer/employee relations with material drawn from both Australian and overseas experience. The nature and implications of: strikes, lockouts and other forms of industrial conflict and alienation; the structure and policies of State and Federal trade unions, the State labor councils and such peak organisations as the Australian Council of Trade Unions; the employer industrial relations function and the structure and policies of employer associations; processes of work rule determination, such as collective bargaining, mediation, conciliation and compulsory arbitration; labour movements; and the role of the various arbitration tribunals and government instrumentalities with respect to industrial relations.

Legal Studies and Taxation

LEGT7711 Legal Environment of Commerce **S2 or S2 L2 T1**

Prerequisite:	*HSC minimum mark required*
Contemporary English or	*60*
2 unit English (General) or	*60*
2 unit English or	*53*
3 unit English	*1*

The Australian legal system and areas of substantive law relevant to commerce including contract, business organisation, employment, commercial arbitration, advertising, trade regulation, civil compensation, discrimination.

LEGT7731 Legal Regulation of Marketing and Distribution **S1 or S2 L2 T1**

Prerequisite: Nil.

The regulation of restrictive trade practices and sales promotion. The legal framework of marketing strategy with special reference to anti-competitive practices including collusive activity, exclusive dealing, price discrimination, resale price maintenance, mergers and monopolisation and consumer protection law including misleading and deceptive advertising and other unfair practices. Consumer credit; product liability; protection of intellectual property.

Manufacturing Management

Manufacturing Management is a course offered by the School of Mechanical and Manufacturing Engineering.

MANF0400 Production Management **F L2 T1**

Prerequisite: MATH2021, MATH2841.

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, e.g. mathematical programming, queuing theory, inventory models, simulation.

MANF0401 Production Management A **S1 L3**

Prerequisite: MATH2021, MATH2841 or MATH1011, MATH1021, FIBR2201.

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.

MANF4610 Operations Research **F L2 T1**

Prerequisite: MECH1500, MATH2001, MATH2839. 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.

Marketing

MARK2012 Marketing Fundamentals **S1 L2 T2**

Conceptual framework for developing an understanding of marketing including the marketing process, marketing environment and marketing planning. Coverage of product, service, consumer, industrial global and social aspects of marketing. Introduction to the marketing, marketing segmentation, positioning and product differentiation.

MARK2052 Marketing Research **S2 L2 T2**

Sources and types of marketing information relevant to marketing management. Problem definition and research design, questionnaire design, sampling, data collection, interpretation and reporting. Management control of research including briefing, evaluation of proposals and distinction between research results and marketing implications. Use of continuous research and new developments in market research.

MARK3073 Brand Management **S2 L2 T2**

An overview of marketing planning for products and services with a focus on planning at the brand level. Marketing concepts such as segmentation, differentiation, positioning and product lifecycle will be re-examined from a strategic perspective. The marketing mix will be expanded to address strategies of new product development, pricing, distribution and promotions management. Case analysis will be introduced to develop strategic thinking.

MARK3083 Strategic Marketing Management **S1 L2 T2**

Concepts introduced in previous subjects will be broadened to address issues at the business unit level. Corporate mission, competitive stance of the organisation, pricing policies, trade relations, internal marketing and logistics will be addressed. The management of organisational resources such as financial and human resources are considered using, for example, portfolio analysis. Decision support systems are also examined.

Mathematics

MATH1011 General Mathematics 1B **S1 L4 T2**

Prerequisite:	*HSC Exam Score Range Required*
2 unit Mathematics or*	*60-100*
2 and 3 unit Mathematics or	*61-150*
3 and 4 unit Mathematics	*61-200*

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.

**the required score may vary slightly from year to year.*

MATH1021 General Mathematics 1C **S2 L4 T2**

Prerequisite: MATH1011. Excluded: MATH1032, MATH1042.

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.

MATH1032 Mathematics 1 **F L4 T2**

Prerequisite:	*HSC Exam Score Range Required*
2 unit Mathematics or*	*67-100*
2 and 3 unit Mathematics or	*100-150*
3 and 4 unit Mathematics or	*100-200*

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

**the required score may very slightly from year to year*

MATH1042 Higher Mathematics 1 **F L4 T2**

Prerequisite:	*HSC Exam Score Range Required*
2 and 3 unit Mathematics or	*145-150*
3 and 4 unit Mathematics	*186-200.*

As for MATH1032 Mathematics 1, but in greater depth.

MATH2009 Engineering Mathematics 2 **F L2 T2**

Prerequisite: MATH1032.

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.

MATH2021 Mathematics 2 **F L1 T1**

Prerequisite: MATH1032 or MATH1042 or MATH1021 CR.

Differential equations, use of Laplace tranforms, 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, eigenvalues; introduction to numerical methods.

MATH2100 Applied Mathematics 2 Vector Calculus **S1 or S2 L1.5 T.5**

Prerequisite: MATH1032. Excluded: MATH2110.

Properties of vectors and vector fields; divergence, gradient, curl of vector; line, surface and volume integrals. Gauss and Stokes' theorems. Curvilinear co-ordinates.

MATH2120 Applied Mathematics 2 Mathematical Methods for Differential Equations **S1 or S2 L1.5 T.5**

Prerequisite: MATH1032. Excluded: MATH2130.

Introduction to qualitative and quantitative methods for ordinary and partial differential equations. The following topics will be treated by example. Ordinary differential equations: linear with constant doefficients, first-order systems, singularities, boundary-value problems, eigenfunctions, Fourier series. Partial differential equations: characteristics, classification, wave equation, heat equation, Laplace's equations, separation of variables methods.

MATH2819 Statistics SA **F L1.5 T.5**

Prerequisite: MATH1032 or MATH1021. Excluded: MATH2841, MATH2801, MATH2821, MATH2901, MATH2921, BIOS2041.

Probability, random variables, independence, binomial. Poisson and normal distributions, transformations to normality, estimation of mean and variance, confidence intervals, tests of hypotheses, contingency tables, two sample tests of location, simple and multiple linear regression, analysis of variance for simple models.

MATH2849 Statistics SE1 **S1 or S2 L1.5 T.5**

Prerequisite: MATH1032 or MATH1042. Excluded: 10.361.

Introduction to probability theory, random variables and distribution functions; the binomial, Poisson and normal distributions in particular. Standard sampling distributions including those of chi-square and t.

MATH2859 Statistics SE2 **S1 or S2 L1.5 T.5**

Prerequisite: MATH2849.

Estimation by moments and maximum likelihood; confidence interval estimation. The standard tests of significance with a discussion of power where appropriate.

An introduction to linear regression, auto-regression. Probability limit, law of large numbers and central limit theorem. Multivariate normal distribution. Stochastic processes in discrete and continuous time; Poisson and Gaussian processes.

MATH3021 Mathematics 3 **F L1 T1**

Prerequisite: MATH2021.

Vector calculus; special functions; convolution theorem and applications; complex variable theory; Fourier integrals; Laplace transforms with application to ordinary and partial differential equations.

Mechanical Engineering

Mechanical Engineering is a course offered by the School of Mechanical and Manufacturing Engineering.

MECH0130 Engineering Drawing and Descriptive Geometry **S1 or S2 L1 T3**

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.

MECH0330 Engineering Mechanics **SS L2 T2**

Prerequisites: As for MECH 1300 Engineering Mechanics 1. Excluded: MECH1300, MECH0440.

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.

MECH0440 Engineering Statics **S1 or S2 L2 T1**

Prerequisites: As for MECH1300 Engineering Mechanics. Excluded: MECH1300, MECH0330.

Composition and resolution of forces, laws of equilibrium. Friction. Statics of rigid bars, pin-jointed frames and beams. Simple states of stress. Static of fluids.

MECH1110 Graphical Analysis and Communication **S2 L1 T2**

Excluded MECH1110, MECH0130.

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

MECH1300 Engineering Mechanics 1 **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 take 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.

MECH1500 Computing 1M **S2 L/T3**

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

MECH2300 Engineering Mechanics 2A **S1 or S2 L2 T1**

Prerequisite: PHYS1002, PHYS1919 or 1.951, MECH1300, MATH1032 OR MATH1042.

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

MECH2310 Engineering Mechanics 2B **S1 or S2 L/T2**

Co-requisite: MECH2300.

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

MECH2600 Fluid Mechanics 1 **F L1 T1**

Prerequisite: PHYS1002 or 1.951 or PHYS1919, MECH1300, MATH1032 or MATH1042. Co-requisite: MECH2800.

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

MECH2700 Thermodynamics 1 **F L1 T1**

Prerequisite: PHYS1002 or 1.951 or PHYS1919, MECH1300, MATH1032 or MATH1042.

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.

Microbiology and Immunology

MICR2011 Microbiology 1 **S2 L2 T4**

Prerequisite: BIOS2011. Co-requisites: BIOS2312 and BIOS2021. Excluded: MICR2201.

This subject is mandatory for students wishing to major in program 4400 Microbiology, it is also offered as a single unit elective. Material presented in the prerequisite unit is taken as "assumed knowledge". An essential component of this course is training in scientific methods, particularly designing and reporting experiments and use of the scientific literature.

The general nature, occurrence and structure of bacteria, fungi, viruses, micro-algae and protozoa; methods for laboratory study of these organism. Principles and applications of modern bacterial taxonomic techniques, characteristics and behaviour of elected groups of bacteria. Bacterial growth in

batch and continuous culture; biosynthetic and bioenergetic mechanisms of bacteria and eukaryotic protista. Interactions of micro-organisms with their environments.

MICR2201 Introductory Microbiology **S1 L2 T4**

Prerequisites: Nil.

An optional ;unit for students enrolled in courses of the Faculties of applied Science, Arts, Engineering, Law and Science. It is not available for those who wish to major in any of the science programs offered by the Schools of Biochemistry, Biological Science of Microbiology and Immunology; nor for students enrolled in the Food technology courses in the Faculty of Applied Science. It is an introduction to the science of Microbiology and does not require any previous knowledge of biology; bridging instruction is given in the first week of the course for students in this category.

The general nature, occurrence and importance of micro-organisms; an systematic review of the eukaryotic protista (microalgae, protozoa and fungi), prokaryotic protista (bacteria) and viruses. Relationships between micro-organisms and their environment; their impact on man through medical, industrial and environmental applications. Methods for handling bacteria and other micro-organisms; initial training in scientific method through designing and reporting experiments.

MICR2218 Microbiology

This course is solely for students enrolled in the Food Technology BSc course 3060 and 3070 in the Faculty of Applied Science.

Physics

Physics Level I Units

PHYS1002 Physics 1 **F L3 T3**

Prerequisite:	*HSC Exam Score ;range Required*
2 unit Mathematics or*	*67-100*
3 unit Mathematics or	*1-50*
4 unit Mathematics	*1-100 or*
and (for PHYS1002 only)	*10.021B*
2 unit Science (Physics) or	*57-100*
2 unit Science (Chemistry) or	*60-100*
3 unit Science or	*90-150*
4 unit Science or	*1-50*

Co-requisite: MATH1021 or MATH1032

*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, veenergy 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.

PHYS1022 Introductory Physics 1 **F L3 T3**

Prerequisite: Nil. Co-requisite: MATH1011 and MATH1021 or MATH1032.

Principally for students majoring in the life and health sciences disciplines. Topics at an introductory level.

The methods of physics, describing motion, the dynamics of a particle, conservation of energy, kinetic theory of gases, properties of liquids, vibrations and waves, electricity and conduction in solids, ions and ionic conduction, magnetism and electromagnetic induction, alternating current, atomic nature of matter, X-rays, the nucleus and radio-activity, geometrical optics, optical instruments, wave optics, microscopes and their uses.

Physics Level II Units

PHYS2001 Mechanics, and Computational Physics **S1 L3 T1**

Prerequisite: PHYS1002 and MATH1032 or MATH1042. Co-requisite: MATH2100. Excluded: PHYS2999, PHYS2021.

Harmonic motion, systems of particles, central force problems, Lagrang's equations, coupled oscillations, travelling waves, pulses, energy and momentum transfer, computer operating systems, introduction to FORTRAN, libraries and software packages, used of computers to solve problems in physics.

PHYS2011 Electromagnetism and Thermal Physics **S2 L3 T1**

Prerequisite: PHYS1002, MATH2100. Co-requisite: MATH2100. Excluded: ELEC2013, PHYS2999.

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.

PHYS2021 Quantum Physics and Relativity **F L1.5 T.5**

Prerequisite: PHYS1002, MATH1032. Excluded: PHYS2989.

Wave-particle duality. Operators, postulates of quantum mechanics. Applications - steps, barriers and tunnelling. H atom. Orbital, spin angular momentum, magnetic moment. Spin orbit interaction. Molecules, LCAO, rotation and vibration. Introduction to statistical mechanics. The nucleus - properties, forces, models, fission and fusion. Special theory of relativity, simultaneity, time dilation, length contraction, momentum and energy.

PHYS2031 Laboratory **F T3**

Prerequisite: PHYS1002, MATH1032. Excluded: PHYS2920.

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.

PHYS2920 Electronics **S1 L1 T2**

Prerequisite: PHYS1002 or PHYS1022. Excluded: PHYS2032.

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

Physics Level II Units

PHYS3021 Statistical Mechanics and Solid State Physics **S1 L3 T1**

Prerequisite: PHYS2011, PHYS2021.

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

PHYS3060 Advanced Optics **S2 L1.5 T.5**

Co-requisite: PHYS2001.

Review of geometrical optics, including ray tracing, aberrations and optical instruments: physical optics, including Fresnel and Fraunhofer diffraction, transfer functions, coherence, and auto and cross correlation: applications of optics, including fibre optics, lasers and holography.

PHYS3110 Experimental Physics B1 **S1 T4**

Prerequisite: PHYS2031.

Selected experiments and projects. Advanced experimental techniques and open ended projects in the areas covered in PHYS3041 Experimental Physics A together with projects involving electron and nuclear magnetic resonances, low temperature physics and super-conductivity. Fourier optics, holography.

PHYS3120 Experimental Physics B2 **S2 T4**

Prerequisite: PHYS2031.

As for PHYS3110 Experimental Physics B1.

PHYS3410 Biophysics **S1 L2 T1**

Prerequisite: PHYS2011, PHYS2021.

Thermodynamics in biology, electrochemical potentials, Donnan equilibrium, irreversible processes, diffusion and applications to biological systems. Membrane potentials. Nernst potential. Goldman and Nernst-Planck equation, generalised approach. Active transport. Membrane structure. The nerve impulse, activation and inactivation, Hogkin and Huxley equations. Muscle, contractive process, thermodynamics. Ecological ensemble theory, global thermodynamics interaction of species, ecological associations.

PHYS3710 Lasers and Applications **S1 L1.5 T.5**

Interaction between light and matter, fundamental properties of laser amplifiers and oscillators, giant pulse generation, ode locking and Q switching, specific laser systems including gas lasers and semiconductor lasers, applications of lasers.

Surveying

SURV0441 Surveying for Engineers **S2 L2 T2.5**

Principles of surveying; co-ordinate systems, levelling, linear and angular measurement. Traversing, tacheometry and electron distance measurement. Areas and Volumes. Horizontal and vertical curves. Control, underground and construction surveys. Outline of photogrammetry.

Graduate Study

Accounting

ACCT5940 Accounting and Financial Management A **S1 L2 T1**

Prerequisite: Nil.

An introduction to financial accounting and reporting for companies. Financial information systems design; internal controls. Traditional and alternative concepts and measures. Thinking about accounting.

ACCT5956 Management Planning and Control **S2 L3**

Prerequisite: ACCT5996 or IROB5901 or ACCT5989 or equivalent.

Planning and control processes in organisations, and the involvement of management and management support personnel with them. Topics include: 'formal' and 'organisations' - some alternative perspectives and descriptions; planning and budgeting - theoretical perspectives and organisational descriptions; organisation structures and structuration; control processes in organisations - some alternative perspectives; participation as a mode of organisational control; accounting control systems - some alternative perspectives; designing management accounting systems - prescription or organisational choice?; categorising and evaluation the literatures on management planning and control.

Anatomy

ANAT6151 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, cental and peripheral nervous systems, circulatory, respiratory, gastrointestinal, endocrine and urogenital systems

Biomedical Engineering

BIOM9541 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.

Biological Science

BIOS3014 Ecological Studies in Arid Lands Management **S2 L2 T4**

Prerequiste: Degree with background in bioscience or equivalent.

Techniques in ecological studies of animal communities. Adaptations to an arid environment - environmental and social determinants. Behaviour, diet and condition of native and feral animals. Competition between native and introduced herbivores. Strategies in the management of arid zone wildlife. Concurrent studies in relevant units in the School of Biological Science are prescribed to cover aspects of vegetation description and plant environment interactions.

Chemistry

CHEM7325 Toxicology, Occupational and Public Health **F L1 T3**

Important classes of toxic materials found in the environment; treatment of pesticide residues, industrial chemistry of various types, toxic gases, mould metabolites and bacterial toxins occurring 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.

Civil Engineering

CIVL8803 Project (GradDip) **C3**

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

CIVL9402 Transport, Environment, Community **SS**

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.

CIVL9726 Legal Studies and Professional Practice **S1 C3**

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

CIVL9790 Stability of Slopes **S1 C3**

Stability of natural and constructed slopes in civil and mining engineering. Stability analysis; stabilisation 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.

CIVL9847 Water Resources Policy SS C3

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

CIVL9849 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.

CIVL9851 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.

CIVL9855 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.

CIVL9857 Sewage Treatment and Disposal S2 C3

CIVL8857 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.

CIVL9858 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.

CIVL9861 Investigation of Groundwater Resources 2 S1 C3

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

CIVL9868 Public Health Science S1 C3

Impact of water and wastewater treatment on disease transmission. Monitoring methods used for pathogens and indicator organisms, structure and degradation of large molecules, biochemical pathways of anabolism and catabolism and the characterisation of micro-organisms.

CIVL9870 Hydraulics and Design of Water and Wastewater Treatment Plants SS C3

Co-requisites: CIVL9856, CIVL9857 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.

CIVL9872 Solid Waste Management S2 L2 T1 C3

CIVL8872 Solid Waste Management (external) S2 C3

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

CIVL9875 Hydrological Processes 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.

CIVL9880 Groundwater Modelling S1 C3

Groundwater modelling of porous media, fractured rock and low permeability materials. Analogue, numerical analytical models. Matrix structure and inverse methods, stochastic modelling and characterisation of variability, Modelling Multiphase Fluids and regional groundwater flow. Applications to borefield management, salt water intrusion, mine dewatering, geotechnical problems.

CIVL9881 Hazardous Waste Management S2 C3

CIVL8881 Hazardous Waste Management (external) S2 C3

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

CIVL9909 Project C9

CIVL8909 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.

CIVL9886 Environmental Engineering Science 3 SS C3

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

contaminant behaviour in soils. Classification of soils and improvement of the engineering properties of soils related to waste management. Introduction to hydrogeology. Management of waste projects: basic management concepts; management of environmental studies, investigations and design projects; management of operating waste facilities.

CIVL9887 Advanced Topics in Waste Management **SS C3**

Prerequisites: CIVL9872, CIVL9881.

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

CIVL9984 Environmental Engineering Science 1 **SS C3**

CIVL8884 Environmental Engineering Science 1 **SS C3**

Microbial structure and function; introduction to epidemiology and biochemistry; monitoring methods used for pathogens and indicator organisms; biological treatment principles. Fundamentals of dispersion common to all environmental media (air, water, soil). Aspects of soil chemistry relevant to contaminant behaviour in soils. Classification of soils and improvement of the engineering properties of soils. Introduction to hydrogeology.

Community Medicine

CMED9600 Disability

Epidemiology of disabling physical and mental conditions; the nature of disability and handicap (including developmental disability); perceptions of handicap; disabled persons' consumer movement and organisation; sociology of disability; social inequality and disability; rehabilitation; community and specialist rehabilitation services; relevant legislation, government services, special needs of disabled persons - health accommodation and the physical environment, transport, work, income support, legal rights and public policy.

CMED9604 Alcohol and Drug Related Problems

Concepts of drug dependence, including pharmacological aspects; management of these problems in primary care; rehabilitation programmes, smoking cessation; weight control; social and psychological factors and their impact on the family; drug problems and their impact on the community; public ;health aspects; population indices and surveillance; control programmes; legislation; law enforcement; medical and legal aspects of drug dependence.

CMED9609 Community Genetics

Brief discussion of essentials of human genetics ;and new development; role of genetics in community health; individuals at risk; genetic disorders including congenital, chromosomal and single-gene defects, their causes and distribution in different populations; health services comprising genetic counselling, screening, carrier detection, pre-symptomatic diagnosis, prenatal diagnosis, and laboratory investigation, and their planning and funding; support groups as related to types of genetic disorder; basic training of genetics in medicine; education and prevention; social, moral and ethical issues involved in the provision of genetic services.

CMED9701 Occupational Disease **S2 L3 C3**

Prerequisite: ANAT5151 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.

Computer Science and Engineering

COMP9311 Data Base Systems **C3**

Prerequisite: Knowledge of storage structures. Excluded: 6.659G, LIBS0823.

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, hierachic/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.

Electrical Engineering

ELEC9211 High Voltage Technology **C3**

Assumed knowledge: ELEC4202 or equivalent.

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.

ELEC9212 Partial Discharges in Electrical Insulation C3

Assumed knowledge: ELEC4202 or ELEC4215 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.

ELEC9336 Digital Communication Networks C3

Excluded: ELEC9337, ELEC4351, ELEC4352.
Introduction to data communication. Analog versus digital transmission. Transmission media. LAN's; WAN's, ISDN. Protocols: IEEE standards for LAN's: fibre optic networks; satellite networks. OSI reference model. Some design issues and examples: topics include error detection and correction; routing and congestion control; internetworking; connection management; data representation and coding; file management; electronic mail.

ELEC9410 Robotics, Automation and Productivity Technology C3

Principles of Robotics relevant to trends in automating the manufacturing process. Such aspects as arm configurations, dynamics and control with relevant sensing methods; assembly and control together with trends in artificial intelligence for Robotics are discussed.

Banking and Finance

FINS5517 Portfolio Analysis and Management S1 or S2 L3

Prerequisite: FINS5513 and Pre- or Co-requisite: FINS5512.
Management of equity and fixed interest portfolios using modern market-based methods of risk control. Derivative instruments; forwards; futures; options; swaps; FRA's etc. Equity investments; valuation; diversification; portfolio insurance; program trading; international diversification and hedging; performance measurement.; Fixed interest portfolios: term structure; duration; convexity; gap analysis; hedging. Alternative assets.

Graduate School of the Built Environment

GSBE1101 Community Noise Control S1 L1 T1 C2

Introduction; sound and sound propagation, sound power, sound pressure, decibels; sound perception, psychoaccoustics 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.

Health Services Management

HEAL9411 Epidemiology L2

Principles and methods of epidemiologic investigation of both communicable and non-communicable diseases including descriptive, analytic and experimental epidemiology. the distribution and dynamic behaviour of disease in the population; data collection, collation and analysis; consideration of screening surveys; longitudinal and case-control studies, etc. The uses of epidemiology in planning, operation and evaluation of health services.

Information Systems

INFS5957 Operations Research for Management 1 S2 L3

Prerequisite: ACCT5996 and approved Quantitative Methods background or equivalent. MCom(Hons) degree course candidates-approval of Head of School of Information Systems.
Application of mathematical and statistical techniques to the solving of management problems with some emphasis on short term forecasting. The structuring of the decision problem, mathematical model construction, mathematical programming, probability and statistical decision theory, inventory and queuing theory. Simulation models and applications with particular reference to models of business organisations.

Industrial Relations and Organizational Behaviour

IROB5701 Industrial Relations A S1

Prerequisite: Nil.
Concepts and issues in Australian 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 industrialisation and change; origins and operations of industrial tribunals at the national and state levels; their instrumentalities; nature of industrial conflict and procedures for conflict resolution such as arbitration and bargaining; national wage policy.

IROB5901 Organizational Behaviour A S1 or S2

Exclusions: IROB5906.
The aim is to provide insights into factors that shape the organisation of work, the worker and managerial responses and action. Theories of organisational behaviour will be

examined with a view to their application. Perception and learning; commitment and motivation, conflict and control. Issues the individual level will include orientation to work, participation and stress. The design of work and reward structures, work group processes and organisational culture and change will be included.

Landscape Architecture

LAND9010 Conservation Studies

An investigation of the concepts of environmental heritage concerning aspects of landscape architecture and conservation issues. The application of environmental heritage in the fields of planning and design. Investigation of case studies of the natural and cultural environment. Projects to investigate problems of planning and managing heritage environments. Methods of conservation analysis with an emphasis on Australia environments and their history.

LAND9111 Landscape Planning **S1 L2 T1**

Introduction to the discipline of landscape planning. Explores a range of basic methods and techniques for the collection, analysis, and valuation of landscape resource data. Application of this knowledge in the development of simple landscape planning models. Participation in a planning exercise applying these skills and knowledge using simple computing techniques.

LAND9213 Land Systems and Management **S2 L1 T2**

An investigation of resources and their management in relation to a range of land use types with an emphasis on an ecological approach. Subject material includes consideration of management of cultural as well as natural landscapes. Studies of specific examples relating to the effects of human impacts are included. Methods of conservation and rehabilitation are considered. Field excursions are included.

Legal Studies and Taxation

LEGT5511 The Legal Environment of Business **S2 L3**

Prerequisite: Nil.

An introduction to the Australian legal system; the legal framework of business regulation; areas of substantive law relevant to commerce including the general principles of the law of contract, specialised commercial transactions, the regulation of restrictive trade practices and sales promotion.

LEGT5541 Company Law **S1 L3**

Prerequisite: LEGT5511.

The law relating to business organisations, including partnerships, joint ventures, trading trusts, and companies incorporated under the Companies New South Wales Code. Primary focus: company law and, in particular, the company as a corporate entity; capital; control and management; liquidation.

Librarianship

LIBS0815 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.

LIBS0817 Information Storage and Retrieval Systems **F**

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 cuing tutorials. Choice criteria for on-line and batch systems. Testing, analysis and evaluation of systems. Advanced technologies for information storage and retrieval.

Mechanical and Manufacturing Engineering

MANF9310 Factory Design and Layout **C3**

Assumed knowledge: MANF3309 or MANF9300 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, queuing theory applications. By process: travel charts and computer programs for optimisation. Group technology. Practical aspects; provision of services and amenities; layout visualisation methods.

Note: a project forms a substantial proportion of the assessment for this subject.

MANF9400 Industrial Management **C3**

Definitions of management; evolution of management thought, classical, quantitative and behaviourial schools; interactions between organisations and their environment. The planning process; strategic and tactical planning, developing planning premises, nature of managerial decision making, quantitative aids, management by objectives. Organisational structures; coordination and spans of control, the informal organisation, authority delegation and decentralisation, groups and committees, managing organisational change and conflict. Motivation, performance and satisfaction leadership, interpersonal and organisational communication, staffing and the personnel function. The control process; budgetary and non-budgetary methods of control, use of management information systems.

MANF9410 Inspection and Quality Control **C3**

Economics of measurement; advanced measuring and inspection methods; non-destructive testing; quality control

systems: sampling by attributes and variables; standardisation; case studies; process capability and variability; machine tools acceptance testing; alignment procedures.

MANF9602 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 optimisation of particular models, eg replacement, capital rationing. Measures of profitability.

MECH9321 Acoustic Noise 1 **C2**

Excluded:MECH4341.

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

MECH9322 Acoustic Noise 2 **C2**

Prerequisite: MECH4322 or equivalent. Excluded: MECH9321.

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

MECH9400 Mechanics of Fracture and Fatigue **C3**

Excluded MECH4400.

Theories of fracture; failure modes. Ductile, brittle fracture. Mechanics of crack propagation, arrest. Measurement of static fracture properties. Fatigue crack initiation, propagation. Engineering aspects of fatigue.

Marketing

MARK5903 International Marketing **S1 or S2 L3**

Prerequisite: MARK5913.

Note: Different prerequisites apply or MCom(Hons) degree course.

Character and dimension of the political, economic, modernisation (including administrative and social aspects affecting international marketing; the dynamic relationship between the environmental aspects and international domestic marketing. Operational aspects of international marketing; nature of competition marketing structure and channels, trade barriers, etc., as well as international, regional, sub-regional economic groupings with emphasis on marketing in Asia, particularly Japan.

MARK5905 Marketing Strategy **S1 or S2 L3**

Prerequisite: MARK5913.

Note: Different prerequisites apply for MCom(Hons) degree course.

Plays an integrating role, enabling the student to consider the implication of the specialised courses for the problem of formulating marketing strategy. While the teaching method centres on the use of Australian cases, students are expected to read widely in the relevant journals and to contribute insights from this reading to discussions.

Medical Education

MEED9108 Program Evaluation and Planned Change **S2 L2**

Designed to help participants develop skills in planning, conduct and evaluation of educational programs. Includes: preparation of a detailed proposal for evaluation of a program; various decisions and activities undertaken in program evaluation; processes of innovation and change.

MEED9125 Planning, Conducting and Evaluating Educational Workshops **S1 L1**

In an attempt to develop their skills in all aspects of conducting workshops, participants are guided to formulate a plan for workshop for their colleagues in an important educational area, with opportunity to practise various techniques for enhancing active participation, and subsequently to conduct the workshop, evaluate its process and outcomes, and report on it.

MEED9202 Educational Process in Small Groups **S1 L2**

How people operate as members and leaders of groups; conditions underlying effective group work in educational planning, teaching and learning, and the provision of health care; basic concepts of group structure. Stress on experiential learning, observation of group process, improving skills in facilitating group learning and designing appropriate learning activities.

Australian Graduate School of Management

MNGT0204 Money and Financial Policy.

Recommended: MNGT0200 or consent of instructor.

How and why the government sets monetary and interest rate policy, and how corporations respond in financial markets. An evaluation of current controversies about domestic and international monetary policy, including the effects of deregulation and financial innovation on theory and practice. Examples drawn from several countries.

MNGT0373 Organisational Design

Prerequisite: MNGT0270 or consent of instructor.

Extends the structural analysis of organisations introduced in 85.0270 or equivalent. Topics include power, informal organisation, management-by-objectives, entrepreneurship, compliance systems and structural change dynamics. Situational factors considered include the product life cycle and technology. Problems discussed include oligarchy, idfficulties flowing from large size and from capital intensive, vertical integration.

MNGT0385 Business-Government Relations

The relationship between business and government in Australia in historic and comparative contexts. Recent critiques of the political and social role of corporations, the emerging business government issue agenda, developments in the institutional pattern mediating business-government relations. Evolution of the public affairs function.

Town Planning

PLAN0911 The Organisation of Town Planning

Aims, means and consequences of town planning in Australia. Aims of planning: organisation of the environment in respect of space and time, interrelationship of functions, equity of resource distribution, human satisfaction, the nature of the planning approach. Means of planning: overview of the planning process, laws related to planning, planning assessment procedures, environmental management at different levels, decision-making processes financiers', firms' and private decisions, changes in public values, public participation, political and economic constraints. Consequences of planning: illustrative case studies, evaluation of planning methodology and procedures.

Psychology

PSYC7103 Applied Experimental Psychology

A discussion of the perceptual and attentional mechanisms that limit our ability to obtain information and the implications for such practical areas as ergonomics and selection. Topics include psychophysics and signal detection performance on vigilance tasks.

PSYC7104 Applied Cognitive Psychology

A discussion of the cognitive factors that limit our ability to process information, methods used to cope with these limitations and the implications for such practical areas as training and artificial intelligence. Topics include memory, reasoning and problem-solving and performance on motor tasks.

PSYC7110 Advanced Ergonomics

Prerequisite: PSYC7109.

The application of ergonomic principles and methods to the design and analysis of work tasks involving a high cognitive component, such as those involving human-computer interaction.

Centre for Remote Sensing

REMO9580 Image Analysis in Remote Sensing **C3**

Prerequisites: MATH2849 and MATH2859.

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.

REMO9581 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.

Social Science

SOCI5306 Technology, Gender and Working Life

Judy Wajcman

Technology as a social and political phenomenon. Responses to technolgoy both in the present (eg the microprocessor, nuclear energy debates) and in the past (eg Luddism). The way particular schools of social theory have conceived of technology: Marx, Weber, Frankfurt school and other relevant theoretical perspectives. Other topics include: micro-electronic technology and the labour process; nuclear energy; technology and sexism; weapons technology; and alternative technology.

SOCI5316 Urban Studies

Alex Kondos

Sociological theories and research o the pre-industrial and contemporary city provide competing and sometimes contradictory accounts and explanations of the way the city is organised, by whom and for whose benefit. This subject examines critically the principal approaches to the study of the city with particular, emphasis on the Australian context.

Surveying

SURV9107 Special Topic in Surveying B **C3**

A special subject taken by an individual student or a small group of students by private study in conjunction with tutorial sessions with the member(s) of staff in charge of the subject.

SURV9211 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.

SURV9213 Physical Meteorology **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, infra-red and microwaves). Remote sensing of atmospheric parameters.

SURV9532 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.

SURV9600 Principles of Remote Sensing **S1 L2 T1 C3**

History and development. Definition and physics of basic electromagnetic radiation quantities. Basic-energy matter relationship. Spectral signatures of surfaces. Atmospheric considerations and the reduction of atmospheric effects. Sensor concepts including film and electro-optical sensors. An introduction to data processing and enhancement, including image interpretation procedures.

SURV9602 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.

SURV9604 Land Information Systems **SS L2 T1 C3**

Land information as maps and records. Methods of data collection. Integrated surveys and co-ordinate systems. Legal boundaries. Land tenure. Identifiers. Computerisation of land information. Data input methods. Data storage methods. Data processing and manipulation, including management, searching, existing data base languages, and interactive data editing. Data output, including computer graphics, line printer maps, and digital plotters. Application of Arc-Info LIS software.

SURV9605 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.

SURV9608 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.

Graduate Study

Conditions for the Award of Higher Degrees

First Degrees

Rules, regulations and conditions for the award of *first degrees* are set out in the appropriate **Faculty Handbooks.**
For the list of undergraduate courses and degrees offered see Table of Courses by Faculty (Undergraduate Study) in the Calendar

Higher Degrees

The following is the list of *higher degrees, graduate diplomas and graduate certificates* of the University, together with the publication in which the conditions for the award appear.
For the list of graduate degrees by research and course work, arranged in faculty order, see **Table of Courses (by faculty): Graduate Study** in the Calendar.

For the statements Preparation and Submission of Project Reports *and* Theses for Higher Degrees *and* Policy with respect to the Use of Higher Degree Theses **see later in this section.**

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	Medicine
Doctor of Philosophy	PhD	Calendar and all handbooks
Master of Applied Science	MAppSc	Applied Science
Master of Architectural Design	MArchDes	Architecture
Master of Architecture	MArch	Architecture
Master of Archives Administration	MArchivAdmin	Professional Studies
Master of Art	MArt	College of Fine Arts
Master of Arts Administration	MArtAdmin	College of Fine Arts
Master of Art Education	MArtEd	College of Fine Arts
Master of Arts	MA	Arts and Social Sciences University College
Master of Art Theory	MArtTh	College of Fine Arts

Higher Degrees (continued)

Title	Abbreviation	Calender/Handbook
Master of Biomedical Engineering	MBiomedE	Engineering
Master of Building	MBuild	Architecture
Master of the Built Environment	MBEnv	Architecture
Master of the Built Environment (Building Conservation)	MBEnv	Architecture
Master of Business Administration	MBA	AGSM
Master of Chemistry	MChem	Science*
Master of Clinical Education	MClinEd	Medicine
Master of Cognitive Science	MCogSc	Arts and Social Sciences
Master of Commerce (Honours)	MCom(Hons)	Commerce and Economics
Master of Commerce	MCom	Commerce and Economics
Master of Community Health	MCH	Medicine
Master of Computer Science	MCompSc	Engineering
Master of Construction Management	MConstMgt	Architecture
Master of Education	MEd	Professional Studies
Master of Education in Creative Arts	MEdCA	Professional Studies
Master of Educational Administration	MEdAdmin	Professional Studies
Master of Engineering	ME	Applied Science Engineering University College
Master of Engineering *without supervision*	ME	Applied Science Engineering
Master of Engineering Science	MEngSc	Engineering Applied Science University College
Master of Environmental Studies	MEnvStudies	Applied Science
Master of Fine Arts	MFA	College of Fine Arts
Master of Health Administration	MHA	Professional Studies
Master of Health Personnel Education	MHPEd	Medicine
Master of Health Planning	MHP	Professional Studies
Master of Higher Education	MHEd	Professional Studies
Master of Industrial Design	MID	Architecture
Master of Information Science	MInfSc	Engineering
Master of Landscape Architecture	MLArch	Architecture
Master of Landscape Planning	MLP	Architecture
Master of Laws	LLM	Law
Master of Librarianship	MLib	Professional Studies
Master of Management Economics	MMgtEc	University College
Master of Mathematics	MMath	Science*
Master of Music	MMus	Arts and Social Science
Master of Nursing Administration	MNA	Professional Studies
Master of Optometry	MOptom	Science*
Master of Paediatrics	MPaed	Medicine
Master of Physics	MPhysics	Science*
Master of Project Management	MPM	Architecture
Master of Public Health	MPH	Medicine Professional Studies

Title	Abbreviation	Calender/Handbook	
Master of Psychology (Applied)	MPsychol	Science†	**Higher Degrees (continued)**
Master of Psychology (Clinical)	MPsychol	Science†	
Master of Psychotherapy	MPsychotherapy	Medicine	
Master of Safety Science	MSafetySc	Applied Science	
Master of Science	MSc	Applied Science Architecture Engineering Medicine Science*† University College	
Master of Science *without supervision*	MSc	Applied Science Architecture Engineering	
Master of Science (Acoustics)	MSc(Acoustics)	Architecture	
Master of Science (Industrial Design)	MSc(IndDes)	Architecture	
Master of Science and Society	MScSoc	Arts and Social Sciences	
Master of Social Work	MSW	Professional Studies	
Master of Sports Science	MSpSc	Professional Studies	
Master of Statistics	MStats	Science*	
Master of Surgery	MS	Medicine	
Master of Surveying	MSurv	Engineering	
Master of Surveying *without supervision*	MSurv	Engineering	
Master of Surveying Science	MSurvSc	Engineering	
Master of Town Planning	MTP	Architecture	
Master of Welfare Studies and Practice	MWSP	Professional Studies	
Graduate Diploma	GradDip	Applied Science Architecture Arts and Social Sciences Engineering Science*†	**Graduate Diploma**
	DipClinEd	Medicine	
	DipPaed	Medicine	
	DipEd DipHEd DipIM-ArchivAdmin DipIM-Lib	Professional Studies	
	DipFDA	Science*	
Graduate Certificate	GradCertPhilT GradCertHEd	Arts and Social Sciences Professional Studies	**Graduate Certificate**

*Faculty of Science.
†Faculty of Biological and Behavioural Sciences.

Higher Degrees
Doctor of Philosophy (PhD)

Qualifications

1. The degree of Doctor of Philosophy may be awarded by the Council on the recommendation of the Higher Degree Committee of the appropriate faculty or board (hereinafter referred to as the Committee) to a candidate who has made an original and significant contribution to knowledge.
2.(1)A candidate for the degree shall have been awarded an appropriate degree of Bachelor with Honours from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Committee.

(2)In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3)If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment as a candidate for the degree.

Enrolment

3.(1)An application to enrol as a candidate for the degree shall be lodged with the Registrar at least one month prior to the date at which enrolment is to begin.

(2)In every case before making the offer of a place the Committee shall be satisfied that initial agreement has been reached between the School* and the applicant on the topic area, supervision arrangements, provision of adequate facilities and any coursework to be prescribed and that these are in accordance with the provisions of the guidelines for promoting postgraduate study within the University.

(3)The candidate shall be enrolled either as a full-time or a part-time student.

(4)A full-time candidate will present the thesis for examination no earlier than three years and no later than five years from the date of enrolment and a part-time candidate will present the thesis for examination no earlier than four years and no later than six years from the date of enrolment, except with the approval of the Committee.

(5)The candidate may undertake the research as an internal student i.e. at a campus, teaching hospital, or other research facility with which the University is associated, or as an external student not in attendance at the University except for periods as may be prescribed by the Committee.

(6)An internal candidate will normally carry out the research on a campus or at a teaching or research facility of the University except that the Committee may permit a candidate to spend a period in the field, within another institution or elsewhere away from the University provided that the work can be supervised in a manner satisfactory to the Committee. In such instances the

Committee shall be satisfied that the location and period of time away from the University are necessary to the research program.

(7)The research shall be supervised by a supervisor and where possible a co-supervisor who are members of the academic staff of the School or under other appropriate supervision arrangements approved by the Committee. Normally an external candidate within another organisation or institution will have a co-supervisor at that institution.

Progression

4.The progress of the candidate shall be considered by the Committee following report from the School in accordance with the procedures established within the School and previously noted by the Committee.

(i)The research proposal will be reviewed as soon as feasible after enrolment. For a full-time student this will normally be during the first year of study, or immediately following a period of prescribed coursework. This review will focus on the viability of the research proposal.

(ii)Progress in the course will be reviewed within twelve months of the first review. As a result of either review the Committee may cancel enrolment or take such other action as it considers appropriate. Thereafter, the progress of the candidate will be reviewed annually.

Thesis

5.(1)On completing the program of study a candidate shall submit a thesis embodying the results of the investigation.

(2)The candidate shall give in writing to the Registrar two months notice of intention to submit the thesis.

(3)The thesis shall comply with the following requirements:

(a)it must be an original and significant contribution to knowledge of the subject;

(b)the greater proportion of the work described must have been completed subsequent to enrolment for the degree;

(c)it must be written in English except that a candidate in the Faculty of Arts 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.

*'School' is used here and elsewhere in these conditions to mean any teaching unit authorised to enrol research students and includes a department where that department is not within a school, a centre given approval by the Academic Board to enrol students, and an interdisciplinary unit within a faculty and under the control of the Dean of the Faculty. Enrolment is permitted in more than one such teaching unit.

(4)The candidate may not submit as the main content of the thesis any work or material which has previously been submitted for a university degree or other similar award but may submit any work previously published whether or not such work is related to the thesis.

(5)Four copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of theses for higher degrees.

(6)It shall be understood that the University retains the four copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

Examination

6.(1)There shall be not fewer than three examiners of the thesis, appointed by the Committee, at least two of whom shall be external to the University.

(2)At the conclusion of the examination each examiner shall submit to the Committee a concise report on the thesis and shall recommend to the Committee that one of the following:

(a)The thesis merits the award of the degree.

(b)The thesis merits the award of the degree subject to minor corrections as listed being made to the satisfaction of the head of school.

(c)The thesis requires further work on matters detailed in my report. Should performance in this further work be to the satisfaction of the higher degree Committee, the thesis would merit the award of the degree.

(d)The thesis does not merit the award of the degree in its present form and further work as described in my report is required. The revised thesis should be subject to re-examination.

(e)The thesis does not merit the award of the degree and does not demonstrate that resubmission would be likely to achieve that merit.

(3)If the performance at the further work recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to further examination as determined by the Committee within a period specified by it but not exceeding eighteen months.

(4)The Committee shall, after consideration of the examiners' reports and the results of any further work, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate be permitted to resubmit the thesis after a further period of study and/or research.

Fees

7.A candidate shall pay such fees as may be determined from time to time by the Council.

Master of Applied Science (MAppSc) and Master of Environmental Studies (MEnvStudies)

Qualifications

1. The degree of Master of Applied Science or Master of Environmental Studies by formal course work may be awarded by the Council to a candidate who has satisfactorily complete a program of advanced study.

2. (1) A candidate of the degree shall:

(a) have been awarded an appropriate degree of Bachelor of four full-time years duration (or the part-time equivalent) 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 Applied Science (hereinafter referred to as the Committee), or

(b)(i) have been awarded an appropriate degree of Bachelor of three-full-time years duration (or the part-time equivalent) from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Committee and

(ii) have undertaken appropriate postgraduate studies of the full-time year's duration (or the part-time equivalent) at the University of New South Wales or studies 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 attainments as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.

Enrolment and Progression

3. (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Registrar at least two calendar months before the commencement of the session in which enrolment is to begin.

(2) A candidate for the degree shall be required to undertake such formal subjects including the submission of a report on a project, and pass such assessment as prescribed. The project shall be under the supervision of an academic staff member and shall be assessed by two examiners (for a major project).

(3) The progress of a candidate shall be reviewed at least once a year 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 and 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, eight sessions for a part-time candidate, and ten sessions for an external 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.

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 the recommendation of the Higher Degree Committee of the appropriate faculty (hereinafter referred to as the Committee) to a candidate who as 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) An applicant who submits evidence of such other academic or professional attainments as may be approved by the Committee may be permitted to enrol for the degree.

(3) When the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant, before being permitted to enrol, to undergo such examination or carry out such work as the Committee may prescribe.

Enrolment and Progression

3. (1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Registrar at least one calendar month before the commencement of the session in which enrolment is to begin.

(2) In every case, before permitting a candidate to enrol, the head of the school (or department) in which the candidate intends to enrol shall be satisfied that adequate supervision and facilities are available.

(3) An approved candidate shall be enrolled in one of the following categories:

(a) full-time attendance at the University;

(b) part-time attendance at the University;

(c) external - not in regular attendance at the University and using research facilities external to the University

(4) A candidate shall be required to undertake an original investigation on an approved topic. The candidate may also be required to undergo such examination and perform such other work as may be prescribed by the Committee.

(5) The work shall be carried out under the direction of a supervisor appointed from the full-time members of the University staff.

(6) The progress of a candidate shall be reviewed annually by the Committee following a report by the candidate, the supervisor and the head of the school (or department) in which the candidate is enrolled and as a result of such review the Committee may cancel enrolment or take such other action as it considers appropriate.

(7) No candidate shall be granted the degree until the lapse of three academic sessions in the case of a full-time candidate or four academic sessions in the case of a part-time or external candidate from the date of enrolment. In the case of a candidate who has been awarded the degree of Bachelor with Honours or who has had previous research experience the Committee may approve remission of up to one session for a full-time candidate and two sessions for a part-time or external candidate.

(8) A full-time candidate for the degree shall present for examination not later than six academic sessions from the date of enrolment. A part-time or external candidate for the degree shall present for examination not later than ten academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

Thesis

4. (1) On completing the program of study a candidate shall submit a thesis embodying the results of the original investigation.

(2) The candidate shall give in writing two months notice of intention to submit the thesis.

(3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not such work is related to the thesis.

(5) Three copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of higher degree theses.

(6) It shall be understood that the University retains the three copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

Examination

5. (1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this 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 department); or

(c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or

(d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or

(e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(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 Engineering (ME), Master of Science (MSc) and Master of Surveying (MSurv)
without supervision

Qualifications

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 from the University of New South Wales with at least three years relevant standing in the case of Honours graduates and four years relevant standing in the case of Pass graduates, and at a level acceptable to the Committee.

Enrolment and Progression

3. An application to enrol as a candidate for the degree without supervision shall be made on the prescribed form which shall be lodged with the Academic Registrar not less than six months before the intended date of submission of the thesis. A graduate who intends to apply in this way should in his or her own interest, seek at an early stage the advice of the appropriate head of school (or department) with regard to the adequacy of the subject matter and its presentation for the degree. A synopsis of the work should be available.

Thesis

4. (a) A candidate shall submit a thesis embodying the results of the investigation.

(2) The candidate shall give in writing to the Registrar two months notice of intention to submit the thesis.

(3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not such work is related to the thesis.

(5) Three copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of theses 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 (or department) in which the candidate is enrolled shall certify that it is *prima facie* worthy of examination.

(3) At the conclusion of the examination each examiner shall submit to the Committee 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 department); or

(c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or

(d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or

(e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(4) If the performance at the further examination recommended under (3)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to further examination as determined by the Committee within a period specified by it but not exceeding eighteen months.

(5) The Committee shall, after consideration of the examiners' reports and the results of any further examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate may resubmit the thesis after a further period of study and/or research.

Fees

6. A candidate shall pay such fees as may be determined from time to time by the Council.

Master of Engineering Science (MEngSc)

1. The degree of Master of Engineering Science may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

Qualifications

2.(1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Higher Degree Committee of the Faculty of Engineering (hereinafter referred to as the Committee).

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment.

Enrolment and Progression

3.(1) An application to enrol as a candidate for the degree shall be made on the prescribed form which shall be lodged with the Registrar two calendar months before the commencement of the session in which the enrolment is to begin.

(2) A candidate for the degree shall:

* Or department where a department is not within a school, or schools or departments where the research is being undertaken in more than one school or department.

(a) 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 30 credits. The number of credits allocated for each subject shall be determined by the Committee on the recommendation of the appropriate head of school*.

(4) A candidate's proposed program shall be approved by the appropriate head of school* prior to enrolment. For the purposes of this requirement the appropriate head of school* shall normally be the head of the school* providing the major field of study.

(5) The progress of a candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(6) No candidate shall be awarded the degree until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or four sessions in the case of a part-time candidate. The maximum period of candidature shall be four academic sessions from the date of enrolment for a full-time candidate and eight sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee.

18 Credit Project Report

4.(1) A candidate who undertakes an 18 credit project shall carry out the work on an approved topic under the direction of a supervisor appointed from the full-time academic members of the University staff.

(2) The candidate shall give in writing to the Registrar two months notice of intention to submit a project report.

(3) The project report or thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not such work is related to the thesis.

(5) Three copies of the project report or thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of project reports and theses for higher degrees.

(6) It shall be understood that the University retains the three copies of the project report or thesis submitted for examination and is free to allow the project report or thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the project report or thesis in whole or in part, in microfilm or other copying medium.

Examination of 18 Credit Project Report

5.(1) There shall be not fewer than two examiners of the project report, appointed by the 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.

Fees

6. 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 Environmental Studies (MEnvStudies)

See Master of Applied Science above.

Master of Safety Science (MSafetySc)

Qualifications

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.

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 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 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.

6. A candidate shall pay such fees as may be determined from time to time by the Council. Fees

1. The degree of Master of Surveying by research may be awarded by the Council on the recommendation of the Higher Degree Committee of the Faculty of Engineering (hereinafter referred to as the Committee) to a candidate who has demonstrated ability to undertake research by the submission of a thesis embodying the results of an original investigation.

See Master of Engineering above. **Master of Science (MSc)**

See Master of Engineering without supervision above. **Master of Science (MSc) without supervision**

1. A Graduate Diploma may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study. **Graduate Diploma (GradDip)**

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). Qualifications

(2) An applicant who submits evidence of such other academic or professional attainments as may be approved by the Committee may be permitted to enrol for the 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 prescribed, before permitting enrolment.

3. (1) An application to enrol as a candidate for the diploma shall be made on the prescribed form which shall be lodged with the Registrar at least two calendar months before the commencement of the session in which enrolment is to begin. Enrolment and Progression

(2) A candidate for the diploma shall be required to undertake such formal subjects and pass such assessment as prescribed.

(3) The progress of a candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(4) No candidate shall be awarded the diploma until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or four sessions in the case of a part-time candidate. The maximum period of candidature shall be four academic sessions from the date of enrolment for a full-time candidate and six sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee.

4. A candidate shall pay such fees as may be determined from time to time by the Council. Fees

Scholarships and Prizes

The scholarships and prizes listed below are available to students whose courses are listed in this book. Each faculty handbook contains in its **Scholarships and Prizes** section the scholarships and prizes available with that faculty. The **General Information** section of the Calendar contains a comprehensive list of 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 the Student Centre located on the Lower Ground Floor of the Chancellery.

Unless otherwise indicated in footnotes, applications for the following scholarships should be made to the Registrar and Deputy Principal by 14 January each year. Please note that not all of these awards are available every year.

Donor	Value	Year/s of Tenure	Conditions
General			
Australian Development Cooperation Scholarship	Tuition fees only	1992 and 1993 only	Applicants must complete their studies by the end of the 1993 academic year. Scholarships may only be offered in 1992. Only students from specified countries and in certain fields of study can apply. Applications from the Student Centre. The closing date is well before 1 October 1991.
Equity and Merit Scholarship Scheme	Tuition fees. Some students may be eligible for air fares and a stipend.	Determined by normal course duration	Information should be obtained from Australian Diplomatic Posts. Conditions and entitlements vary depending on the home country.
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.

Undergraduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
General (continued)			
Girls Realm Guild	Up to $1500 pa	1 year with the prospect of renewal subject to satisfactory progress and continued demonstration of need	Available only to female students under 35 years of age who are permanent residents of Australia enrolling in any year of a full-time undergraduate course on the basis of academic merit and financial need.
W.S. and L.B. Robinson*	Up to $6500 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.
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.
Sporting Scholarships	$2000 pa	1 year with possibility of renewal	Available to students who are accepted into a course of at least two years duration. Prospective applicants should have an outstanding ability in a particular sport and are expected to be an active member of a UNSW Sports Club. Apply directly to Sport and Recreation Section, PO Box 1, Kensington 2033.

*Applications close 30 September each year. Apply directly to PO Box 460 Broken Hill NSW 2880

Applied Science			
Malcolm Chaikin Foundation Scholarship	Up to $8000 pa	1 year renewable for the duration of the course subject to satisfactory progress	Permanent residence in Australia and in the first year in the Faculty of Applied Science enrolled in a course leading to the award of the degree of Bachelor of Science or Engineering.
Applied Bioscience			
Food Science and Technology			
Coca-Cola South Pacific Export Corporation	Up to $1800 pa	1 year renewable for the duration of the course subject to satisfactory progress	Permanent residence in Australia. Not more than 22 years of age on 1 December preceding the year in which the award commences and eligibility for admission to Year 1 of the full-time degree course in Food Technology.
George Weston Foods Ltd	Up to $4000 over 4 years		
Chemical Engineering and Industrial Chemistry			
Bridge Oil Ltd	Up to $9300 pa	1 year renewable for the duration of the course subject to satsfactory progress	Permanent residence in Australia living in Queensland and must have completed the first two years of any accredited engineering program in that state

Undergraduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
Applied Science (continued)			
Chemical Engineering and Industrial Chemistry (continued)			
Dow Chemical Australia	Up to $1000 pa	1 year renewable for the duration of the course subject to satisfactory progress	Permanent residence in Australia and eligibility for admission to Year 2 of the full-time degree course in Chemical Engineering
Shell Refining Australia Pty Ltd	Up to $1500 pa		Eligibillity for admission to Year 2 of the full-time degree course in Chemical Engineering
Society of Petroleum Engineers Pty Ltd	Up to $2500		Permanent residence in Australia living in specified state and must have completed the first two years of any accredited engineering program in that state
Proctor & Gamble Australia Pty Ltd	Up to $2500		Permanent residence in Australia and full-time in the fourth year of the degree course
Fibre Science and Technology			
Textile Technology			
Australian Wool Corporation	Up to $2500	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 Textile Technology
Wool and Animal Science			
Merck, Sharp and Dohme	Up to $1000 pa	1 year renewable for the duration of the course subject to satisfactory progress	Eligibility for admission to the full-time degree course in Wool and Pastoral Sciences
Australian Wool Corporation	Up to $2500 pa		
Dalgety Farmers Bicentennial	Up to $2500 pa		
Materials Science and Engineering			
Materials			
Australian Ceramic Society	Up to $400 pa	1 year renewable for the duration of the course subject to satisfactory progress	Permanent residence in Australia and eligibility for admission to Year 1 or Year 2 of the full-time degree course in Ceramic Engineering
The Clay Brick Association of New South Wales	Up to $2500 pa		
Caroma Industries Ltd	Up to $1000 pa		
Fowlerware	Up to $500 pa		
Monier PGH Limited	Up to $1000 pa		
The Thomson Family	Up to $1000 pa		
Zacuba Pty Ltd	Up to $1500 pa		
Metallurgy			
Sir Rupert Myers	Up to $2000 pa	1 year renewable for the duration of the course subject to satsfactory progress	Open to students whose parents are permanent residents of Australia or who are themselves permanent residents and who are eligible for admission to Year 1 or Year 2 of the full-time degree course in Metallurgy or Metallurgical Engineering

Undergraduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
Applied Science (continued)			
Metallurgy (continued)			
Industrial Sponsors Program Comalco Research Award in Metallury	Up to $1250 pa Up to $1500	1 year renewable for the duration of the course subject to satisfactory progress	Eligibility for admission to Year 1 of the full-time degree course in Metallurgy or Metallurgical Process Engineering
Mines			
Applied Geology			
Renison Goldfields Consolidated	$5000 pa	1 year	Permanent residence in Australia and enrolled in Year 4 of the Applied Geology course, or equivalent Science and Mathematics (honours) degree course
Mining Engineering			
Stan Sawyer Memorial Scholarship to Coal Mining Students	Up to $200 pa	1 year renewable for the duration of the course, subject to satisfactory progress	Eligibility for admission to Year 3 or Year 4 of the full-time degree course in Mining Engineering
School of Mines			
The Charles Warman Scholarship	$4000 pa	1 year	Permanent residence in Australia and enrolled in any year of the full-time degree course in Mineral Engineering
Minproc	$7000 pa	1 year renewable for the duration of the course subject to satsfactory progress	Available to a student entrering the degree course Chemical Engineering (Minerals) or who plans to enrol in the combined BE BSc degree course in Chemical and Minerals Engineering

The UNSW Co-op Program

The University of New South Wales has industry-linked education scholarships to the value of $9300 per annum in the following areas: Accounting (and Economics, Finance, Information Systems or Japanese Studies); Business Information Technology, Aeronautical, Ceramic, Chemical, Civil, Computer, Electrical, Environmental, Materials, Mechanical, Metallurgical, Mineral, Mining and Petroleum Engineering; Applied Geology, Industrial Chemistry, Manufacturing Management, Textile Management, Textile Technology, and Wool and Pastoral Science.

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.

Graduate Scholarships (continued)

General

Donor	Value	Year/s of Tenure	Conditions
University Postgraduate Research Scholarships	Living allowance of $13,504 pa. Other allowances may also be paid. Tax free.		Applicants must be honours graduates or equivalent. A limited number of scholarships are offered subject to the availbility of funds. Information should be obtained from the Faculty office.
Australian Postgraduate Research Awards	$13,504 to $17,427		Applicants must be honours graduates or equivalent or scholars who will graduate with honours in current academic year, and who are domiciled in Australia. Applications to Registrar by 31 October.
Australian Postgraduate Course Awards	Living allowance of $10,903 pa. Other allowances may also be paid. Tax free.	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 Postgraduate Award. Applicants must be domiciled in Australia. Preference is given to applicants with employment experience. Applications to the Registrar by 28 September.
Australian Development Cooperation Scholarship	Tuition fees only	1992 and 1993 only	Applicants must complete their studies by the end of the 1993 academic year. Scholarships may only be offered in 1992. Only students from specified countries and in certain fields of study can apply. Applications from the Student Centre. The closing date is well before 1 October 1991.
Equity and Merit Scholarship Scheme	Tuition fees. Some students may be eligible for air fares and a stipend.	Determined by normal course duration	Information should be obtained from Australian Diplomatic Posts. Conditions and entitlements vary depending on the home country.
Overseas Postgraduate Research Scholarships	Tuition fees only	2 years for a Masters and 3 years for a PhD degree	Eligibility is confined to postgraduate research students who are citizens of overseas countries excluding citizens of countries which are covered by the Equity and Merit Scholarship Scheme (EMSS). Applications to the Registrar by 28 September.
Special Oversas Postgraduate Fund	Tuition fees only	1 year for a Post-graduate Diploma, 2 years for Masters degree and 3 years for Doctorate	Eligibility is confined to postgraduate students who are citizens of overseas countries excluding citizens of countries which are covered by the Equity and Merit Scholarhsip Scheme (EMSS). Applications to the Registrar by 28 September.
Australian American Educational Foundation Fulbright Award	Travel expenses and $A2000 as establishment allowance	1 year, renewable	Applicants must be graduates who are domiciled in Australia and wish to undertake research or study for a higher degree in America. Applications close 30 September with The Secretary, DEET, AAEF Travel Grants, PO Box 826, Woden, ACT 2606.
Australian Federation of University Women	Amount varies, depending on award	Up to 1 year	Applicants must be female graduates who are members of the Australian Federation of University Women

Graduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
General (continued)			
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 the Registrar in September or October each year.
The English-Speaking Union (NSW Branch)	$7000	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	$6000 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.
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.

Graduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
General (continued)			
The Rhodes Scholarship to Oxford University	Approximately £4862 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.
Applied Science			
Pig Research Council Study/Training Awards			Applications close 19 September with the Department of Primary Industry, Canberra, ACT 2600
Australian Wool Corporation Postgraduate Scholarships	$21,362 pa (taxable)	1 year subject to satisfactory progress. Renewable annually; maximum tenure of 2 years for a Masters candidate or 3 to 4 years for a PhD degree.	Tenable in Australian tertiary institutions or overseas in exceptional circumstances. Enquiries to the School of Fibre Science and Technology.
Australian Meat and Live-stock Research and Development Corporation	$8882 pa	1-3 years varies with course	Awarded for graduate study of the industry leading to the award of a diploma, or Masters or PhD degree. Tenable in Australia or overseas. Applications close 31 July with the AMLRD Corporation, PO Box A498, Sydney South, NSW 2000.
Water Industry Research Award	$21,000 pa	2-4 years	Applications close with the Registrar 20 June
Lionel Murphy Australian	See above under **Law**		

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 Statuette	Leadership in student affairs combined with marked academic proficiency by a graduand
The University of New South Wales Alumni Association Prize		
School of Applied Bioscience		
Department of Food Science and Technology		
The Cottee's Foods Prize	$500.00	The best performance in FOOD1420 Food Leglislation in the Bachelor of Science in Food Technology degree course
The Nestlé Australia Pty Limited Prize	$200.00	The best performance in ABIO1400 Project in the Bachelor of Science in Food Technology degree course
The Wilfred B.S. Bishop Prize	$75.00	The best overall performance in the Bachelor of Science Degree in Food Technology degree course by a student who has made a significant contribution to staff and student activities
Department of Biotechnology		
The Burns Philp Food Prize	$175.00	The best performance in BIOT3100 Fermentation Processes in the Bachelor of Science degree course
The Burns Philp Food Prize	$175.00	The best performance in one of the Level 3 Biotechnology subjects • BIOT3011 Biotechnology A • BIOT3021 Biotechnology B • BIOT3031 Microbial Genetics by a student in the Bachelor of Science degree course
The Burns Philp Food Prize	$175.00	The best overall performance in the Bachelor of Science degree course in Biotechnology at honours level
School of Chemical Engineering and Industrial Chemistry		
The Abbott Laboratories Pty Ltd Prize	$200.00	The best performance in Year 4 of the Bachelor of Engineering degree course in Chemical Engineering.
The AGL Sydney Limited Prize	$250.00	The best performance in a subject selected by the Head of School
The AKZO Chemicals Prize	$500.00	The best performance in INDC3090 Chemistry of Industrial Processes
The Australasian Corrosion Association (NSW Branch) Award	$150.00 and one years membership of the Association	The best performance in INDC3042 Corrosion in the Chemical Industry
The Australian Institute of Energy Prize	$50.00	The best performance in a subject selected by the Head of School
The Australian Paper Manufacturers Ltd Prize	$200.00	The best performance in INDC3070 Instrumentation and Process Control 1 in the Chemical Engineering course

Undergraduate Prizes (continued)

Donor/Name of Prize	Value $	Awarded for
School of Chemical Engineering and Industrial Chemistry (continued)		
The Australian Paper Manufacturers Ltd Prize	$200.00	The best performance in INDC3070 Instrumentation and Process Control 1 in the Industrial Chemistry course
The CSR Limited Prize	$100.00	The best performance in a subject selected by the Head of School
The Chemical Technology Society Annual Award	$50.00	The best performance by an undergraduate in Years 1 and 2 or Stages 1 to 4 of the Bachelor of Science degree course in Industrial Chemistry
The Esso Australia Ltd Prize	$200.00	The best performance in Year 2 of Chemical Engineering
The Fuel Technology Staff Prize	$200.00	The best performance in a subject selected by the Head of School
The Institution of Chemical Engineers Prize	$100.00 and Medal	The best thesis by a student in the final year of the Bachelor of Engineering degree course in Chemical Engineering
The Johnson Matthey Prize	$200.00	The best performance in the Industrial Chemistry degree course
The National Starch & Chemical Prize	$500.00	The best performance in POLY3010 Polymer Science
The Shell Prize	$100.00	The best performance by a student in Year 2 or equivalent part-time stage of the Chemical Engineering or Industrial Chemistry courses including sporting and student activities
The Shell Prize	$100.00	The best performance by a student in Year 3 or equivalent part-time stage of the Chemical Engineering or Industrial Chemistry courses including sporting and student activities
The Shell Prize	$100.00	The best performance by a student in Year 4 or equivalent part-time stage of the Chemical Engineering or Industrial Chemistry courses including sporting and student activities
The Shell Prize	$100.00	For a student who has, in the opinion of the Head of School, performed some meritorious activity of note either inside or outside the University
The Shell Prize	$200.00	The best performance in a subject selected by the Head of School
The Simon-Carves Australia Prize	$100.00	The best performance in INDC3010 Thermodynamics
The Western Mining Corporation Ltd Prize	$150.00	The best performance in CEIC0367 Chemical Engineering Laboratory 1
The Western Mining Corporation Ltd Prize	$150.00	The best performance in CEIC0447 Chemical Engineering Laboratory 2
School of Fibre Science and Technology		
Department of Textile Technology		
The J.B. Speakman Prize	$50.00	The best undergraduate thesis in the final year of the Bachelor of Science degree course in Textile Technology or Textile Management
The R.J. Webster Prize	$250.00	The best performance throughout the Bachelor of Science degree course in Textile Technology or Textile Management
The Textile Institute Prize	Two years free membership of the Textile Institute	The best performance in textile technology subjects by a student in the Bachelor of Science degree course in Textile Technology or Textile Management

Undergraduate Prizes (continued)

Donor/Name of Prize	Value $	Awarded for
School of Fibre Science and Technology (continued)		
Department of Wool and Animal Science		
The Bayer Animal Health Prize	$120.00	The best performance in Years 2 and Year 3 of a degree course in Wool Science
The C.R. Luckock Prize	Book or $60.00 voucher drawn on University Co-op Bookshop	The best performance in Meat Science in the Department of Wool and Pastoral Sciences
The National Farmers' Federation Prize	$150.00	Excellent academic attainment by a graduating student in the Bachelor of Science degree course in Wool and Pastoral Sciences
The Parkes Wool Promotion Committee Prize	A shield held in the Department of Wool and Aminal Science on which the name of the successful student is engraved each year	The best performance in Practical Wool Studies in the Department of Wool and Pastoral Sciences
The P.R. McMahon Memorial Prize	$100.00	Excellence in Wool Science in the Bachelor of Science degree course in Wool and Pastoral Sciences
School of Geography		
The Jack Mabbutt Medal	Medal	The best performance in the Year 4 Project in Applied Geography by a student in the Bachelor of Science degree course in Applied Science
The Jack Mabbutt Prize	$150.00	Best performance by a Year 3 student proceeding to the award of honours in Geography
School of Mines		
The Joint Coal Board Prize	$200.00	The best performance in Year 2 of the Bachelor of Engineering degree course in Mining Engineering
The Joint Coal Board Prize	$200.00	The best performance in Year 3 of the Bachelor of Engineering degree course in Mining Engineering
The Joint Coal Board Prize	$300.00	The best overall performance in the Bachelor of Engineering degree course in Mining Engineering
The Western Mining Corporation Ltd Melbourne Prize	$200.00	The best overall performance by a student in the Bachelor of Engineering degree course in Mining Engineering
The Western Mining Corporation Ltd Perth Prize	$150.00	The best overall performance by a student in the final year of the Bachelor of Engineering degree course in Mining Engineering
The Western Mining Corporation Ltd Perth Prize	$150.00	The best overall performance by a student in Year 3 of the Bachelor of Engineering degree course in Mining Engineering
Department of Applied Geology		
The Crae Mapping Prize in Applied Geology	$250.00	The best performance in GEOL3121 Earth Environments 2 - Geological Field Mapping Tutorial by a student in the Bachelor of Science degree course
The F.C. Loughnan Prize For First Year Geology	$100.00	The best performance in year 1 of the Geology component of the Bachelor of Science degree course
The F.C. Loughnan Prize in Applied Geology	$340.00	The best performance in Year 3 of the Geology component of the Bachelor of Science degree course

Undergraduate Prizes (continued)

Donor/Name of Prize	Value $	Awarded for
School of Mines (continued)		
The Prospectors Supplies Prize	Brunton Compass	Meritorious performance in GEOL4203 Field Project by a student in Year 4 of the Applied Geology degree course, or equivalent Science and Mathematics degree course at honours level, proceeding to the award of the degree of Bachelor of Science

Graduate University Prizes

The following table summarizes the graduate prizes awarded by the University.

Donor/name of Prize	Value $	Awarded for
Faculty of Commerce and Economics		
The Universities Credit Union Prize	$200.00	The best performance by a full-time student in Year 1 of the Master of Commerce degree course
The Universities Credit Union Prize	$200.00	The best performance by a part-time student in Year 1 of the Master of Commerce degree course
Faculty of Applied Science		
Department of Safety Science		
The Ergonomics Society of Australia (NSW) Prize	$100 and membership of the Society	The best performance in the core subjects of the Graduate Diploma course in Ergonomics
The Manufacturers Mutual Insurance Prize for Ergonomic Principles	$200.00	The best performance in SAFE9224 Principles o Ergonomics by a student proceeding either to the award of the degree of Master of Safety Science or to the Graduate Diploma in Safety Science or to the Graduate Diploma in Ergonomics
Department of Safety Science		
The Manufacturers Mutual Insurance Prize for Occupational Disease	$150.00	The best performance in CMED9701 Occupational Disease by a student proceeding either to the award of the degree o Master of Safety Science or to the Graduate Diploma i Safety Science or to the Graduate Diploma in Ergonomics
The Manufacturers Mutual Insurance Prize for Occupational Health and Hygiene	$150.00	The best performance in SAFE9261 Occupational Health and Hygiene by a student enrolled in the Masters degree or Graduate Diploma courses in Safety Science
The National Safety Council of Australia (NSW Division) Prize	$100.00	The best performance in SAFE9211 Introduction t Safety Engineering in the Masters degree or Graduate Diploma courses in Safety Science
The Neil Adams Ergonomics Prize	$250.00	Awarded annually to the student enrolled in the Graduate Diploma course in Ergonomics who achieved the best performance in the preceding calendar year considering the students best three subjects during that year providing at least one of the three subjects was an Ergonomics subject
The Safety Institute of Australia (NSW Division) Bill Lessels' Memorial Prize for Master of Safety Science	Books to the value of $200.00	The best overall performance by a student in the Master of Safety Science degree course

Graduate Prizes (continued)

Donor/Name of Prize	Value $	Awarded for
Faculty of Applied Science (continued)		
The Safety Institute of Australia (NSW Division) Bill Lessels' Memorial Prize for Graduate Diploma in Safety Science	Books to the value of $200.00	The best overall performance by a student in the Graduate Diploma course in Safety Science
School of Applied Bioscience		
Department of Biotechnology		
The Burns Philp Foods Prize	$175.00	The best overall performance in the Master of Applied Science degree course in Biotechnology
School of Chemical Engineering and Industrial Chemistry		
The Clean Air Society of Australia and New Zealand Prize in Atmospheric Pollution Control	$100.00	The highest aggregate in FUEL5910 Atmospheric Pollution and Control and FUEL5920 Practical Aspects of Air Pollution Measurement and Control in a graduate course in the School of Chemical Engineering and Industrial Chemistry
School of Fibre Science and Technology		
Department of Textile Technology		
The Malcolm Chaikin Prize	$200.00 and Bronze Medal	The most outstanding PhD thesis in the Department of Textile Technology
School of Mines		
Department Of Applied Geology		
The Laric V. Hawkins Prize	$500.00	The best written account of research work in the area of Geophysics in a graduate degree or diploma course

NOTES

The University of New South Wales Kensington Campus

Theatres

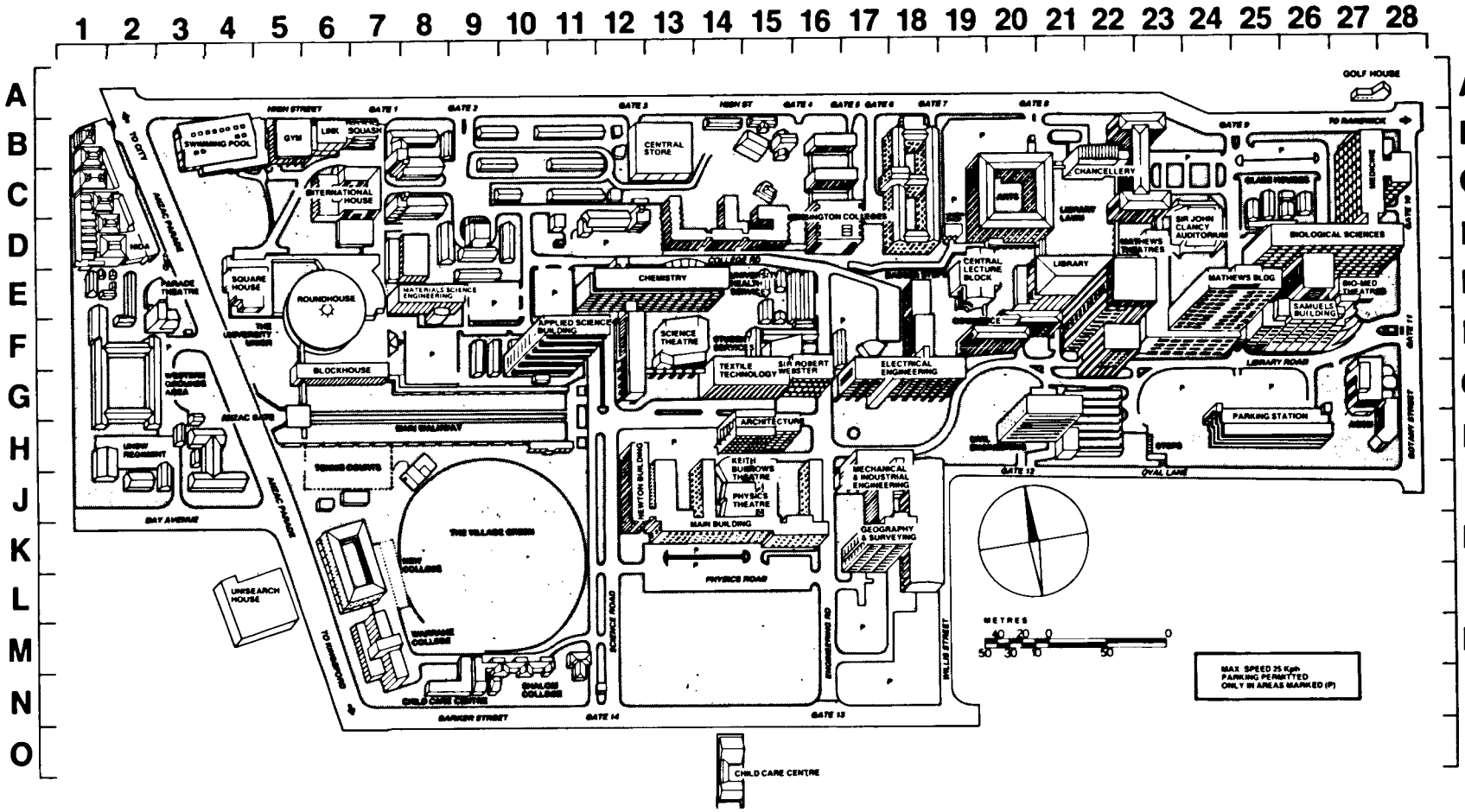
Biomedical Theatres **E27**
Central Lecture Block **E19**
Chemistry Theatres *(Dwyer, Mellor, Murphy, Nyholm, Smith)* **E12**
Classroom Block *(Western Grounds)* **H3**
Fig Tree Theatre **B14**
Io Myers Studio **D9**
Keith Burrows Theatre **J14**
Mathews Theatres **D23**
Parade Theatre **E3**
Physics Theatre *(Main Building)* **K14**
Rex Vowels Theatre **F17**
Science Theatre **F13**
Sir John Clancy Auditorium **C24**

Buildings

Barker Street Gatehouse **N11**
Basser College *(Kensington)* **C18**
Central Store **B13**
Chancellery **C22**
Dalton *(Chemistry)* **F12**
Goldstein College *(Kensington)* **D16**
Golf House **A27**
Gymnasium **B5**
International House **C6**
John Goodsell *(Commerce and Economics)* **F20**
Kensington Colleges *(Office)* **C17**
Library *(University)* **E21**
Link **B6**
Maintenance Workshop **B13**
Mathews **F23**
Menzies Library **E21**
Morven Brown *(Arts)* **C20**
New College **L6**
Newton **J12**
NIDA **D2**
Parking Station **H25**
Philip Baxter College *(Kensington)* **D14**
Robert Heffron *(Chemistry)* **E12**
Sam Cracknell Pavilion **H8**
Samuels Building **F26**
Shalom College **N9**
Sir Robert Webster **G14**
Unisearch House **L5**
University Regiment **J2**
University Union *(Roundhouse)* **E6**
University Union *(Blockhouse)* **G6**
University Union *(Squarehouse)* **E4**
Wallace Wurth School of Medicine **C27**
Warrane College **M7**

General

Aboriginal Student Centre
47 Botany St, Randwick
Accommodation *(off-campus)* **F15**
Accounting **F20**
Admissions **C22**
Adviser for Prospective Students **C22**
Anatomy **C27**
Applied Bioscience **D26**
Applied Economic Research **G14**
Applied Geology **F10**
Applied Science *(Faculty Office)* **F10**
Architecture *(Faculty Office)* **H14**
Archives, University **E21**
Arts and Social Sciences *(Faculty Office)* **C20**
Asia-Australia Institute
34 Botany St, Randwick
Audio Visual Unit **F20**
Australian Graduate School of Management **G27**
Banking and Finance **F20**
Biochemistry and Molecular Genetics **D26**
Biological and Behavioural Sciences *(Faculty Office)* **D26**
Biomedical Engineering **F26**
Biomedical Library **F23**
Biotechnology **F26**
Cashier's Office **C22**
Chaplains **E15**
Chemical Engineering and Industrial Chemistry **F10**
Chemistry **E12**
Civil Engineering **H20**
Co-op Bookshop **G17**
Commerce and Economics *(Faculty Office)* **F20**
Communications Law Centre **C15**
Community Medicine **D26**
Computer Science and Engineering **G17**
Computing Services Department **F26**
Cornea and Contact Lens Research Unit
22-32 King St, Randwick
Counselling and Careers/Loans **F15**
Economics **F20**
Education Studies **G2**
Educational Testing Centre **E15D**
Electrical Engineering **G17**
Energy Research, Development & Information Centre **F10**
Engineering *(Faculty Office)* **K17**
English **C20**
Examinations **C22**
Fees Office **C22**
Fibre Science and Technology **G14**
Food Science and Technology **B8**
French **C20**
Geography **K17**
German and Russian Studies **C20**
Graduate Office and Alumni Centre **E4**
Graduate School of the Built Environment **H14**
Groundwater Management and Hydrogeology **F10**
Health Service, University **E15**
Health Services Management **C22**
History **C20**
House at Pooh Corner *(Child Care)* **N8**
Industrial Design **G14**
Industrial Relations and Organizational Behaviour **F20**
Information Systems **F20**
Institute of Languages
14 Francis St, Randwick
International Student Centre **F16**
IPACE **F23**
Japanese Economic and Management Studies **F20**
Kanga's House *(Child Care)* **O14**
Landscape Architecture **K15**
Law *(Faculty Office)* **F21**
Law Library **F21**
Legal Studies & Taxation **F20**
Liberal and General Studies **C20**
Librarianship **F23**
Lost Property **C22**
Marine Science **D26**
Marketing **F20**
Materials Science and Engineering **E8**
Mathematics **F23**
Mechanical and Manufacturing Engineering **J17**
Medical Education **C27**
Medicine *(Faculty Office)* **B27**
Membrane and Separation Technology **F10**
Microbiology and Immunology **D26**
Mines **K15**
Minor Works and Maintenance **B14A**
Music **B11**
News Service **C22**
New South Wales University Press
22-32 King St, Randwick
Optometry **J12**
Pathology **C27**
Patrol and Cleaning Services **C22**
Performing Arts **B10**
Petroleum Engineering **D12**
Philosophy **C20**
Physics **K15**
Physiology and Pharmacology **C27**
Political Science **C20**
Printing Section **C22**
Professional Development Centre **E15**
Professional Studies *(Faculty Office)* **G2**
Property and Works **C22**
Psychology **F23**
Publications Section **C22**
Remote Sensing **K17**
Safety Science
32 Botany Street, Randwick
Science *(Faculty Office)* **F23**
Science and Technology Studies **C20**
Social Science and Policy **C20**
Social Policy Research Centre **F26**
Social Work **G2**
Sociology **C20**
Spanish and Latin American Studies **C20**
Sport and Recreation Centre **B6**
Squash Courts **B7**
Staff Office **C22**
Student Centre *(off Library Lawn)* **C22**
Swimming Pool **B4**
Students' Union **E4, C21**
Surveying **K17**
Textile Technology **G14**
Theatre and Film Studies **B10**
Town Planning **K15**
WHO Regional Training Centre **C27**
Wool and Animal Sciences **G14**


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
GOLF HOUSE
HIGH STREET
GATE 1
GATE 2
GATE 3
GATE 4
GATE 5
GATE 6
GATE 7
GATE 8
GATE 9
TO RANDWICK
TO CITY
ANZAC PARADE
SWIMMING POOL
GYM
LINK
SQUASH HOUSE
INTERNATIONAL HOUSE
CENTRAL STORE
CHANCELLERY
MAIN
LIBRARY LANE
GLASS HOUSES
MEDICINE
SIR JOHN CLANCY AUDITORIUM
BIOLOGICAL SCIENCES
MATHEWS THEATRES
MATHEWS BLDG
BIO-MED THEATRE
SAMUELS BUILDING
LIBRARY
CENTRAL LECTURE BLOCK
COLLEGE RD
CHEMISTRY
MATERIALS SCIENCE ENGINEERING
SQUARE HOUSE
ROUNDHOUSE
PARADE THEATRE
NIDA
APPLIED SCIENCE BUILDING
SCIENCE THEATRE
TEXTILE TECHNOLOGY
SIR ROBERT WEBSTER
ELECTRICAL ENGINEERING
BLOCKHOUSE
MAIN GALLERY
ANZAC GATE
ARCHITECTURE
LIBRARY ROAD
PARKING STATION
GATE 11
GATE 12
OVAL LANE
BOTANY STREET
KEITH BURROWS THEATRE
PHYSICS THEATRE
NEWTON BUILDING
MECHANICAL & INDUSTRIAL ENGINEERING
GEOGRAPHY & SURVEYING
MAIN BUILDING
PHYSICS ROAD
THE VILLAGE GREEN
NEW COLLEGE
UNIBEARCH HOUSE
BARKER STREET
GATE 14
GATE 13
SCIENCE ROAD
ENGINEERING RD
WILLIS STREET
METRES
40 20 0 0
50 30 10 50
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.