

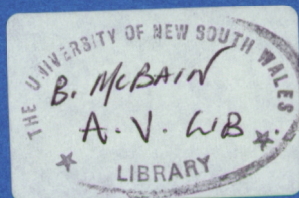
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The University of New South Wales

Applied Science



1988
Faculty Handbook

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

Information in this Handbook has been brought up to date as at 12 September 1989, but may be amended without notice by the University Council.

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Calendar of Dates

1989

1990

Session 1 (67 teaching days)

	27 February to 23 March	26 February to 12 April
<i>Recess</i>	24 March to 2 April	13 April to 22 April
	3 April to 8 June	23 April to 7 June
<i>Study Recess</i>	9 June to 14 June	8 June to 13 June
<i>Midyear Recess</i>	1 July to 23 July	30 June to 22 July
<i>Examinations</i>	15 June to 30 June	14 June to 29 June

Session 2 (67 teaching days)

	24 July to 22 September	23 July to 21 September
<i>Recess</i>	23 September to October	22 September to 1 October
	3 October to 1 November	2 October to 31 October
<i>Study Recess</i>	2 November to 7 November	1 November to 6 November
<i>Examinations</i>	8 November to 24 November	7 November to 23 November
<i>Vacation Weeks</i>	27 March to 2 April	16 April to 22 April
<i>Common to Australian Universities</i>	3 July to 9 July	2 July to 8 July
	25 September to 1 October	24 September to 30 September

Important Dates for 1989**January**

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

February

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

March

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

April

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

May

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

June

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

July

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

August

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

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

October

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

November

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

December

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

Foreword

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 multi-disciplinary course options are available to students through the various Schools within the Faculty — Biological Technologies, Chemical Engineering and Industrial Chemistry, Fibre Science and Technology, Geography, Materials Science and Engineering, and Mines.

Undergraduate courses available are:

- Applied Geology (including specialization in Mineral and Energy Resources, Engineering Geology, and Geophysics)
- Ceramic Engineering
- Chemical Engineering (including Fuel Engineering)
- Food Science and Technology
- Geography (including Applied Physical Geography, Applied Economic Geography, and Human and Physical Resources)
- Industrial chemistry (including Polymer Science)
- Mining Engineering
- Metallurgical Engineering
- Mineral Engineering
- Mining Geology
- Petroleum Engineering
- Textile Technology (including Textile Chemistry, Textile Engineering, Textile Management, 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 (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.

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.

The format of this Handbook has been changed this year to make it more useful to you; we would welcome your comments. Also 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.

Senior Project Officer

Desmond Roktalussy, BE Bud.

Professional Officers

Badan-Singh Deol, MSc Punj'i., PhD Syd.

Oto Zubzanda, Diplng, T.U. Bratislava, PhD N.S.W.

Narendra Mohan Saha-Chaudhury, BME Jadavpur, MIEInd, MIEAust

Officer-in-charge, Drawing Office

Max Renner

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 Miss L. Bruce, Administrative Assistant.
Room 915, Applied Science Building. Tel. 697 4262

Applied Bioscience Ms. L. Kulakauskas
Room 110A Biological Sciences Building.
Tel: 697 2050

Chemical Engineering and Industrial Chemistry Mr. P. Dunkley.
Room 207, Applied Science Building. Tel. 697 4319.

Food Science and Technology Mr. R. Greenwood, Administra-
tive Officer.

Room 411, Applied Science Building. Tel. 697 4364.

Geography Ms. T. Bean, Administrative Assistant.
Room G10, Geography and Surveying. Tel. 697 4386.

Materials Science and Engineering Mr. O. Andersen,
Administrative Assistant.
Room 110B, Materials Science and Engineering Building. Tel.
697 4436.

Mineral Engineering Associate Professor R. Robins.
Room 213, Materials Science and Engineering Building. Tel.
697 4429.

Mining Engineering Professor F.F. Roxborough.
Room 37, Main Building. Tel. 697 4525.

Textile Technology Mr D. Rose, Clerk.

Room 102, Sir Robert Webster Building. Tel. 697 4477.

Wool and Animal Science Assoc. Professor J. Kennedy.
Room 107, Wool and Pastoral Sciences Building. Tel. 697 4482.

Faculty of Applied Science Enrolment Procedures

All students re-enrolling in 1988 should obtain a copy of the free booklet *Enrolment Procedure 1988* available from School Offices and the Admissions Office. This booklet provides detailed information on enrolment procedures and fees, enrolment timetables by Faculty and course, enrolment in miscellaneous subjects, locations and hours of Cashiers and late enrolments.

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 Sciences, and from the Schools of Biological Technologies Health Administration and Fibre Science and Technology. 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 library and in specific subject material can be arranged.

Computerized literature searches and interlibrary loans are also available.

Acting Biomedical Librarian Betty McEwin

The Physical Sciences Library

This library, situated on Levels 6 and 7 of the Library tower, caters for the information needs of staff, graduate and undergraduate students in the pure and applied sciences, engineering and architecture. Details of the books, series and microfilms in the Physical Sciences Library are included in the microfiche monograph and serial catalogues and the items themselves are identified by the prefix 'P'. Serials with the prefix 'PJ' are not available for loan, but self-service photocopying facilities are located on Level 7. This library provides reference, reader assistance and reader education services and also, where appropriate, inter-library loan and literature-searching services. Trained staff are available on Level 7 to assist readers with their enquiries.

Physical Sciences Librarian Marian Bate

The Bachelor of Social Science Degree Course (3420)

The Bachelor of Social Science (BSocSc) is a degree course of special interest to students wishing to pursue careers in research, teaching, social planning and social administration. It enables students to gain a broad view of social issues, and introduces them to diversity of social data. The program combines depth and breadth by requiring students to undertake a range of studies and to complete compulsory courses in the theories and methods of the various social sciences.

Although administered by the Faculty of Arts, the BSocSc degree course allows for in-depth study in two major disciplines drawn from various faculties. These disciplines are economic History, Economics, Industrial Relations, Geography, History, History and Philosophy of Science, Mathematics, Philosophy, Political Science, Psychology, Sociology and Statistics.

It may be possible for a limited number of students who have completed a year of study in a faculty other than Arts to transfer into the second year state of the course if their performance in at least two of the above disciplines is of a sufficiently high standard (Credit grade or better).

For further enquiries, contact the Arts Faculty Office, Room G1, Morven Brown Building. Tel. 697 2288.

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 appropriate school 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.

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

The program requires students to undertake studies in three areas:

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

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

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

Subjects in categories (A) and (B) are in preparation. The exact form of category (C) is still being decided and should be clearly defined in 1989. This could involve, however, a slight subsequent change to the structure of the later years of degree programs.

There are differing requirements for students commencing **before and from 1988:**

Students who commenced their undergraduate program before 1988.

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

Students commencing their undergraduate program in 1988 and following.

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

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

General Education Program

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

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 Technology, Industrial Chemistry, Mining Geology, Textile Technology 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, Mineral 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.

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 School of Food Science and Technology; 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 booklet *Enrolment Procedures 1988* available from School Offices and the Admissions Office. This booklet provides detailed information on enrolment procedures and fees, enrolment timetables by faculty and course, enrolment in miscellaneous subjects, locations and hours of Cashiers and late enrolments.

Graduate 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, 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.

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, Food Technology, Mining and Mineral Engineering, Remote Sensing, Textile Technology and Wool and Pastoral Sciences.

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 by Number

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

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

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

1. The authority offering the subject, normally a School of the University, is indicated by the number before the decimal point.
2. Each subject number is unique and is not used for more than one subject title.
3. Subject numbers which have previously been used are not used for new subject titles.
4. Graduate subjects are indicated by a suffix 'G' to a number with three digits after the decimal point. In other subjects three or four digits are used after the decimal point.

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

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

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

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

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

HSC Exam Prerequisites

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

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

Information Key

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

S1 Session 1, **S2** Session 2

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

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

CCH class contact hours

L Lecture, followed by hours per week

T Laboratory/Tutorial, followed by hours per week

hpw hours per week

C Credit *or* Credit units

CR Credit Level

DN Distinction

School, Department etc	Faculty	Page	School, Department etc	Faculty	Page
*Subjects also offered for courses in this handbook			*Subject also offered for courses in this handbook		
1 School of Physics*	Science		41 School of Biochemistry*	Biological Sciences	
2 School of Chemistry*	Science		42 School of Applied Bioscience (Biotechnology)	Applied Science	13
3 School of Chemical Engineering and Industrial Chemistry (New Course)	Applied Science	33	44 School of Microbiology*	Biological and Behavioural Sciences	
4 School of Materials Science and Engineering	Applied Science	91	45 School of Biological Science	Biological and Behavioural Sciences	
5 School of Mechanical and Industrial Engineering*	Engineering		46 Faculty of Applied Science	Applied Science	
6 School of Electrical Engineering and Computer Science*	Engineering		47 Centre for Safety Science	Engineering	
7 School of Mines (Mineral Processing and Extractive Metallurgy and Mining Engineering)	Applied Science	103	48 School of Chemical Engineering and Industrial Chemistry (Old Course)	Applied Science	3
8 School of Civil Engineering*	Engineering		49 School of Applied Bioscience (Food Science and Technology)	Applied Science	13
9 School of Fibre Science and Technology (Wool and Animal Science)	Applied Science	57	50 School of English	Arts	
10 School of Mathematics*	Science		51 School of History	Arts	
11 School of Architecture	Architecture		52 School of Philosophy	Arts	
12 School of Psychology	Biological Sciences		53 School of Sociology	Arts	
13 School of Fibre Science and Technology (Textile Technology)	Applied Science	57	54 School of Political Science*	Arts	
14 School of Accounting*	Commerce and Economics		55 School of Librarianship	Professional Studies	
15 School of Economics*	Commerce and Economics		56 School of French	Arts	
16 School of Health Administration	Professional Studies		57 School of Theatre Studies	Arts	
17 Faculty of Biological and Behavioural Sciences*	Biological and Behavioural Sciences		58 School of Education	Professional Studies	
18 School of Mechanical and Industrial Engineering (Industrial Engineering)	Engineering		59 Department of Russian Studies	Arts	
19 School of Information Systems	Commerce and Economics		60 Faculty of Arts	Arts	
20 Centre for Petroleum Engineering Studies	Applied Science	38	61 Department of Music	Arts	
21 Department of Industrial Arts	Architecture		62 School of Science and Technology Studies	Arts	
25 School of Mines (Applied Geology)	Applied Science	103	63 School of Social Work	Professional Studies	
26 Centre for Liberal and General Studies	Liberal and General Studies		64 School of German Studies	Arts	
27 School Geography	Applied Science	73	65 School of Spanish and Latin American Studies	Arts	
28 School of Marketing*	Commerce and Economics		66 Subjects Available from Other Universities		
29 School of Surveying*	Engineering		67 Faculty of Science	Science	
30 School of Industrial Relations and Organizational Behaviour	Commerce and Economics		68 Board of Studies in Science and Mathematics	Board of Studies in Science and Mathematics	
31 School of Optometry	Science		70 School of Anatomy	Medicine	
32 Centre for Biomedical Engineering	Engineering		71 School of Medicine	Medicine	
35 School of Building	Architecture		72 School of Pathology	Medicine	
36 School of Town Planning*	Architecture		73 School of Physiology and Pharmacology	Medicine	
37 School of Landscape Architecture*	Architecture		74 School of Surgery	Medicine	
38 School of Applied Bioscience (Food Science and Technology)	Applied Science	13	75 School of Obstetrics and Gynaecology	Medicine	
39 Graduate School of the Built Environment	Architecture		76 School of Paediatrics	Medicine	
40 Academic Board			77 School of Psychiatry	Medicine	
			78 School of Medical Education	Medicine	
			79 School of Community Medicine	Medicine	
			80 Faculty of Medicine	Medicine	
			81 Medicine/Science/Biological Sciences	Medicine	
			85 Australian Graduate School of Management	AGSM	
			90 Faculty of Law	Law	
			97 Faculty of Engineering	Engineering	
			98 School of Banking and Finance	Commerce and Economics	
			99 Department of Legal Studies and Taxation	Commerce and Economics	

School of Applied Bioscience

School of Applied Bioscience

Head of School

Professor P. P. Gray

Administrative Assistant

Ms L. Kulakauskas

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.

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.

A Graduate Diploma course in Food Technology of one year full-time or two years part-time is designed for graduates in science or agriculture wishing to familiarize themselves with the principles of food technology.

General Education Electives

For details of changes in the General Education requirements refer to the table earlier in this chapter.

Staff

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, MAmerlChE, MABA

Professor of Food Technology, and Head of Department of Food Science and Technology
Ronald Alexander Edwards, BSc PhD N.S.W., ASTC, FAIFST, FTS

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

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Professor and Head of Department of Biotechnology
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Associate Professors

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John Colin Madgwick, MSc PhD *N.S.W.*

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Professional Officers

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Mark Ronald Quinlan, BAppSc *N.S.W.I.T.*
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Administrative Assistant

Lenore Kulakauskas

Department of Food Science and Technology

Professor, and Head of

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Ronald Alexander Edwards, BSc PhD *N.S.W.*, ASTC, FAIFST, FTS

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Ronald Baden Howe Wills, BSc *N.S.W.*, PhD *Macq.*, ASTC, FAIFST
Michael Wootton, BSc PhD *N.S.W.*, FAIFST, ARACI, MAGI

Senior Lecturers

Graham Harold Fleet, MSc *Qld.*, PhD *Calif.*, AAIFST
Heather Greenfield, BSc PhD *Lond.*, AAIFST

Lecturers

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Jeanette Ramos, MS *Philippines*, GradDip *N.S.W.*
Frances Maud Scriven, BSc PhD *N.S.W.*, AAIFST

Tutors

Tass Karalis, BSc *N.S.W.*
Catherine Elizabeth Meyer, BSc *N.S.W.*
Jane Elizabeth Paton, BSc *N.S.W.*, AAIFST

Administrative Officer

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

Professional Officers

Maxwell Robert Bell, BSc MAppSc *N.S.W.*, ASTC
Raymond Allan Francke, BA *Macq.*
Annesley Jean Watson, BSc *N.S.W.*, AAIFST

Honorary Associates

Gary William Pace, BSc *N.S.W.*, PhD *M.I.T.*
Diana Joy Freeman, BSc MSc *Syd.*

*Conjoint appointment with The Garvan Institute of Medical Research.

Course Outlines

Undergraduate Study

3060

Food 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 technology is based. Students completing the Year 1 requirements are eligible for selection for admission to Year 2 of the course.

Year 1 (New Course)	Hours per week	
	S1	S2
1.001 Physics 1 or		
1.021 Introductory Physics 1	6	6
2.121 Chemistry 1A	6	0
2.131 Chemistry 1B	0	6
10.001 Mathematics 1 or		
10.011 Higher Mathematics 1 or		
10.021B General Mathematics 1B and	6	6
10.021C General Mathematics 1C		
17.031 Biology A	6	0
17.041 Biology B	0	6
	24	24

Year 2 (New Course)

2.102A Physical Chemistry	0	6
2.102B Organic Chemistry	5	1
2.102D Chemical and Spectroscopic Analysis	0	6
10.301 Statistics SA	2	2
41.101 Introductory Biochemistry	6	6
44.141 Microbiology	8	0
49.321 Introductory Nutrition	3	0
49.421 Introductory Food Engineering	0	3
	24	24

Year 3 (New Course)

	Hours per week	
	S1	S2
2.043B Food Chemistry	6	0
49.131 Food Preservation	6	0
49.132 Plant Food Science	2	0
49.133 Animal Food Science	3	0
49.134 Quality Evaluation and Control	0	2
49.135 Food Technology Laboratory	0	6
49.231 Food Microbiology	4	0
49.331 Nutrition	0	3
49.431 Food Process Engineering	0	4
49.432 Computer Applications	0	2
42.102D Principles of Biotechnology	3	0
2.0433 Analytical Instrumentation	0	3
General Education Subject	0	4
	24	24

Year 4 (Old Course)*

	Hours per week	
	S1	S2
38.140 Food Technology Project	8	8
38.141 Food Regulation and Control	3	0
38.146 Inspections	0	3
38.444 Computer Applications in Food Technology	2	0
General Education Subject	2	2
	15	13

Plus three or more of the following electives to a total of not less than 9 hours per week.

2.003B Organic Chemistry	0	6
18.121 Production Management	3	3
18.551 Operations Research	3	3
28.012 Marketing Systems	4	0
28.052 Marketing Research	0	4
38.142 Oenology	6	0
38.143 Cereal Technology	6	0
38.144 Treatment and Utilization of Food Processing Wastes	0	3
38.145 Marine Products Technology	2	0
38.149 Postharvest Technology of Fruit and Vegetables	6	0
38.171 Special Topics in Meat Science	2	0
38.341 Food Microbiology 2	0	6
38.344 Yeast Technology	3	0
38.443 Food Engineering 3	6	0
38.541 Advanced Nutrition	0	3
38.544 Nutritional Evaluation of Foods	0	6
42.102A Biotechnology A	6	0
42.102B Biotechnology B	0	6

or such other electives, to a total of not less than 9 hours per week, as approved by the Head of School.

During Years 2, 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.

*The course is being revised. Contact the Department for further details.

3070

Food Technology — Part-time Course*

Bachelor of Science (Technology) BSc(Tech)

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 School 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 School not later than 31 December of the year in which the sixth stage is completed.

Stages 1 and 2*

		Hours per week	
		S1	S2
1.001	Physics 1 <i>or</i>		
1.021	Introductory Physics 1	6	6
2.121	Chemistry 1A	6	0
2.131	Chemistry 1B	0	6
10.001	Mathematics I <i>or</i>		
10.011	Higher Mathematics 1† <i>or</i>	6	6
10.021B	General Mathematics 1B <i>and</i>		
10.021C	General Mathematics 1C		
17.031	Biology A	6	0
17.041	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

2.102B	Organic Chemistry	5	1
2.102D	Chemical and Spectroscopic Analysis	0	6
41.101	Introductory Biochemistry	6	6
		11	13

Stage 4

2.102A	Physical Chemistry	0	6
10.301	Statistics SA	2	2
44.141	Microbiology	8	0
49.321	Introductory Nutrition	3	0
49.421	Introductory Food Engineering	0	3
		13	11

Stage 5

2.043B	Food Chemistry	6	0
49.231	Food Microbiology	4	0
42.102D	Principles of Biotechnology	3	0
49.331	Nutrition	0	3
49.431	Food Process Engineering	0	4
49.432	Computer Applications	0	2
	General Education Subject	0	4
		13	13

Stage 6

49.131	Food Preservation	6	0
49.132	Plant Food Science	2	0
49.133	Animal Food Science	3	0
49.134	Quality Evaluation and Control	0	2
49.135	Food Technology Laboratory	0	6
2.0433	Analytical Instrumentation	0	3
	General Education Subject	2	2
		13	13

Graduate Study

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

5320 Biochemical Engineering Graduate Diploma Course*

Graduate Diploma GradDip

The Department offers a course in biochemical engineering which leads to the award of a graduate diploma (GradDip). The course is open to graduates in the biological sciences, chemistry, chemical engineering or agriculture, and can be completed in one year of full-time or over a longer period by part-time study. It contains a component of graduate level 'bridging' subjects, designed to facilitate the introduction of graduates with a variety of backgrounds to the current practice of biochemical engineering.

The normal entrance requirement is an appropriate degree or equivalent qualification in biological sciences, chemistry, chemical engineering or agriculture. Intending students are referred to the conditions for the award of Graduate Diplomas set out later in this handbook.

*This course is being revised. Contact the Department for further details.

	Hours per week	
	S1	S2
<i>Session 1</i>		
42.211G Principles of Biology	3	0
42.212G Principles of Biochemistry	3	0
42.282G Thermodynamics	4	0
42.284G Mass Heat and Momentum Transfer	4	0
44.101 Introductory Microbiology	6	0

Session 2

42.213G	Biochemical Methods	0	3
42.214G	Biotechnology	0	3
42.283G	Process Dynamics and Biochemical Engineering Design	0	8

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 20 hours per week, or two years part-time study, consisting of an average of 10 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.

*This course is being revised. Contact the Department for further details.

		Hours per week	
		S1	S2
Obligatory Subjects			
42.102A	Biotechnology A	6	0
42.102B	Biotechnology B	0	6
42.215G	Practical Biotechnology	8	8

Elective Subjects

42.102C	Microbial Genetics	6	0
42.104G	Graduate Seminars	2	2
42.407G	Biological Principles	3	0
42.408G	Bioengineering Principles	3	0
44.101	Introductory Microbiology	6	0
44.121	Microbiology 1	0	6

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

8041**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
42.401G	Applied Genetics	0	5
42.402G	Peptide and Protein Technology	0	5
42.403G	Biochemical Engineering	0	5
42.404G	Microbial Mineral Processing	3	0
42.405G	Biodeterioration	2	0
42.406G	Applied Cellular Physiology	5	0
42.407G	Biological Principles	3	0
42.408G	Bioengineering Principles	3	0
42.306G	Biotechnology Project (Major)	7	7
42.502G	Biotechnology Project (Minor)	3	3

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 material (generally designated as subjects without a suffixed G or X number) 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 School has developed special expertise.

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

Food Technology Course 8030

Food Engineering Course 8035

Intending candidates are invited to contact the Head of the School for advice and recommendation. The basis of an acceptable program would be formal study aggregating at least 18 hours weekly for 2 sessions full-time or 9 hours weekly for 4 sessions or 6 hours weekly 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% no 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 (generally designated as subjects without a suffixed G or X number) 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 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.

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 component (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	Hours per week*
49.152G Principles of Food Preservation	3
49.155G Food Technology Laboratory	3
49.170G Seminar	1
49.171G Major Research Project	9
OR	
49.172G Research Project	6
OR	
49.173G Minor Project	3

*Weekly equivalent of total hours for subject. These hours may be concentrated in one session.

Elective components

Elective subjects making up the remainder of the hours, 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 School.

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.

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 emphasises 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	Hours per week*
49.170G Seminar	1
49.452G Advanced Food Engineering	2
49.455G Food Engineering Laboratory	1½
49.171G Major Research Project	9
OR	
49.172G Research Project	6
OR	
49.173G Minor Project	3

*Weekly equivalent of total hours for subject. These hours may be concentrated in one session.

Elective components

The elective subjects making up the remainder of the hours, 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 School.

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 the School.

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 (17 hours/week), or two years of part-time study (8½ hours/week). It involves the following program:

Core components	Hours per week*
49.152G Principles of Food Preservation	3
49.153G Plant Food Products	1
49.154G Animal Food Products	1½
49.155G Food Technology Laboratory	3
49.251G Food Microbiology	2

*Weekly equivalent of total hours for subject. These hours may be concentrated in one session.

Elective components

The elective subjects making up the remainder of the hours, 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 School. In all cases the hours devoted to graduate subjects constitute at least 50 per cent of the total course hours.

Subject Descriptions

Undergraduate Study

Department of Food Science and Technology

38.140 Food Technology Project F T8 (Year 4, Old Course)

Pre- or co-requisites: 38.131, 38.132, 38.133, 38.134.

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

38.141 Food Regulation and Control S1 L3 (Year 4, Old Course)

Pre-requisites: 38.131, 38.132, 38.133, 38.134, 38.135.

Food legislation: State and NHMRC food standards and mechanisms; Codex standards; case studies in food standards development; food and nutrition policy. *Food additives:* functions and modes of action of various classes of food additives; consequences of their use; National, State and International attitudes and standards; principles of toxicological testing and evaluation of results. *Product development:* needs for new food products; role of market research, advertising and food technology in the generation of new product ideas; steps in the development of a new product; new product failure and success; practical exercises in new product development. *Microbiological quality control:* good manufacturing practice; in-plant testing; microbiological sampling; sampling plans; decision criteria; microbiological criteria for foods, hazard analysis and critical control point (HACCP) concepts, case studies.

38.142 Oenology (Year 4, Old Course) S1 L2T4

Prerequisite: 38.132.

History and nature of grape wines; grape and wine statistics; concept of cultivars within *Vitis vinifera*; other *Vitis* species; vine and grape physiology and biochemistry; maturity assessment and significance; influence of climate, soil, and other factors on wine quality; harvesting procedures; oenological procedures including crushing, sulphiting, pressing and draining, fermentation, maturation and storage, stabilization and clarification, bottling, packaging, and distribution; wine types and composition; quality assessment; quality control and analytical procedures; distillation and production of fortifying spirit and brandy; world wine industry, wine organizations, wine literature; social uses of alcohol.

38.143 Cereal Technology (Year 4, Old Course)

S1 L2T4

Prerequisite: 38.132.

A treatment in greater depth of the following topics dealt with in graduate and undergraduate courses: 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. Additional topics include 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.

38.144 Treatment and Utilization of Food Processing Wastes (Year 4, Old Course)

S2 L2T1

Ecological effects of waste discharges into the marine environment. Purification of water for domestic and industrial applications; water reuse; process modifications for effluent reduction. Origin, composition, treatment, disposal and utilization of wastes from food processing operations. Legal and economic aspects of waste disposal. Inspections of water and waste treatment plants. Seminars, assignments.

38.145 Marine Products Technology (Year 4, Old Course)

S1 L2

Prerequisite: 38.133.

Fish species, quality control and operations used in fish canning, problems encountered with canned marine products. Fish farming, processing of carp and fish roe. Preparation of individual fish portions and utilization of commercially unattractive species. Harvesting, handling, processing and spoilage of molluscs and crustaceans. Utilization of unusual marine organisms. Industrial fishery products.

38.146 Inspections (Year 4, Old Course)

S2 T3

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

38.149 Postharvest Technology of Fruit and Vegetables (Year 4, Old Course)

S1 L1T5

Prerequisite: 38.132.

The systems available for the storage and handling of fruit and vegetables after harvest and the causes of wastage and deterioration in these systems. The effects of temperature, humidity, atmosphere control of the physiology and biochemistry of the product. The application of basic knowledge to develop improved commercial storage and marketing systems.

**38.171 Special Topics in Meat Science
(Year 4, Old Course)****S1 T2***Prerequisite:* 38.133 or equivalent.

Students will be allocated a specific area of study on an aspect of meat science involving a literature survey, industrial visits and the presentation of a seminar and a written report on the specific area of study.

**38.341 Food Microbiology 2
(Year 4, Old Course)****S2 L2T4***Prerequisite:* 38.331.

A detailed theoretical and practical treatment of the ecology, taxonomy and biochemistry of bacteria, yeasts, fungi and viruses involved in food spoilage, food-borne disease and food fermentations. Emphasis on specific methodologies for the detection, enumeration and identification of food associated bacteria, yeasts and fungi. Problems of enumerating microorganisms in foods: techniques of food and surface sampling, formulation, performance and evaluation of selective-differential media, sub-lethal injury; the value of indicator organisms. Rapid methods for microbial enumeration and identification. Control of microorganisms in foods; microbiological quality control in food production; sanitation and disinfection; food legislation and microbiological standards.

38.344 Yeast Technology (Year 4, Old Course)**S1 L2T1***Prerequisite:* 38.331.

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.

38.443 Food Engineering 3 (Year 4, Old Course)**S1 L4T2***Prerequisites:* 38.421, 38.432.

Multiple effect and vapour recompression evaporation, vapour compression and absorption refrigeration; distillation, gas absorption, liquid-liquid and liquid-solid extraction; use of computing equipment; transient heat transfer; economic decision making, specification of equipment for filtration, mixing, concentration, refrigeration and handling of foods; laboratory work involving automatic flow control, evaporation, computer control.

**38.444 Computer Applications in
Food Technology (Year 4, Old Course)****S1 L1T1**

Introduction to VAX/VMS, KRONOS and other control languages; the use of SPSS, MPOS and other program packages to solve problems in food technology.

38.541 Advanced Nutrition (Year 4, Old Course)**S2 L2T1***Prerequisite:* 38.521.

Detailed study of the role of nutrients in human structure, function and disease, including study of micronutrients and trace minerals. Regulatory mechanisms such as appetite, control of

nutrient metabolism and growth. Nutrition and infection. Alcoholism. Therapeutic nutrition and formulation of special dietary foods.

**38.544 Nutritional Evaluation of Foods
(Year 4, Old Course)****S2 L1T5***Prerequisites:* 2.043L, 38.134.

Analytical methods for nutrients in foods, including advanced analytical techniques. Evaluation of nutrients in specific food groups, and the effect of processing and preparation on nutrient value of foods.

49.131 Food Preservation**S1 L3 T3***Prerequisites:* 2.102A, 2.102B, 2.102D, 38.421, 38.521, 41.101, 44.101

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.

49.132 Plant Food Science**S1 L2***Prerequisites:* 2.102A, 2.102B, 2.102D, 38.421, 38.521, 41.101, 44.101

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.

49.133 Animal Food Science**S1 L3***Prerequisites:* 2.102A, 2.102B, 2.102D, 38.521, 41.101, 44.101

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, marinating 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; preserva-

tion of the intact egg; pulping, freezing and drying of whole egg pulp, yolk and albumen.

49.134 Quality Evaluation and Control S2 L1 T1

Prerequisites: 10.301, 38.131, 38.132, 38.133, 38.331

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.

49.135 Food Technology Laboratory S2 T6

Prerequisites: 38.131, 38.132, 38.133, 38.331

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.

49.140 Project F T8

Prerequisites: 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.

49.141 Field excursions S1 T3

Prerequisites: 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.

49.142 Food Legislation S1 L2

Prerequisites: 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.

49.143 Food Industry Management S1 L2

Prerequisites: Completion of Year 3 subjects

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

49.144 Food 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.

49.145 Food Processing Wastes S2 L2 T1

Prerequisite: 38.134

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.

49.146 Cereal Technology S1 L2 T4

Prerequisite: 38.134

A treatment in greater depth of the following topics dealt with in 49.132: 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; preparatoin and uses of cereal protein, starches and lipids.

49.231 Food Microbiology S1 L2 T2

Prerequisites: 44.101 and 44.121

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.

49.241 Advanced Food Microbiology S2 L2 T4

Prerequisite: 49.231

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.

49.321 Introductory Nutrition S1 L2 T1*Co-or prerequisite: 41.101*

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.

49.331 Nutrition S2 L2 T1*Prerequisite: 38.521*

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.

49.341 Advanced Nutrition S2 L3 T3*Prerequisite: 49.331*

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.

49.421 Introductory Food Engineering S2 L2 T1*Prerequisites: 1.001 or 1.021 and 10.001 or 10.011 or 10.021B and 10.021C*

Units and dimensions, dimensionless groups, dimensional analysis; material and energy balances; steady state and unsteady state heat transfer; selection of insulation, heat exchangers and heat transfer equipment; refrigeration, freezing, filtration.

49.431 Food Process Engineering S2 L2 T2*Prerequisite: 38.421*

Food rheology, fluid flow, thermal properties of foods, evaporation, psychrometry, dehydration, extraction, size reduction, extrusion, measurement and control of process variables. Laboratory exercises in food rheology, fluid flow, heat transfer, evaporation, psychrometry, drying, instrumentation and process control.

49.432 Computer Applications SS L1 T1*Prerequisite: 10.301*

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.

49.441 Advanced Food Engineering S1 L2 T1*Prerequisites: 38.432, 38.444*

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.

49.442 Food Packaging S1 L2 T1*Co-requisite: 49.131*

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; laboratory work on physical properties of package materials and evaluation of packaging materials and systems.

Department of Biotechnology

Biotechnology is a Department within the School of Applied Bioscience.

42.102A Biotechnology A S1 L3T3*Prerequisites: 41.101 and 44.101 (Pass Conceded (PC) or Terminating Pass (PT) awarded prior to Session 2, 1983, is not acceptable).*

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.

42.102B Biotechnology B S2 L2T4*Prerequisite: 42.102A (Pass Conceded (PC) or Terminating Pass (PT) awarded prior to Session 2, 1983, is not acceptable).*

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 agro-industry 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.

42.102C Microbial Genetics

S1 L2T4

Prerequisites: 41.101 or 44.101. *Excluded:* 43.102.

A detailed study of the mutational basis of microbial variation. Mutagens; mechanisms of mutagenesis; induction, enrichment, isolation and characterization of mutants; mechanisms of repair of mutational damage. Systems of gene transfer and recombination in fungi, bacteria and bacterial viruses; the use of these systems in constructing genetic maps, and as tools for probing aspects of microbial physiology and biochemistry. Genetic control of gene expression; the operon concept and its application to specific regulatory systems. Genetic code, collinearity between a gene and its product, genes within genes, suppression of mutations. Restriction and modification of DNA; genetic engineering — its implications and prospects. Genetics of nitrogen fixation.

42.114 Fermentation Processes

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.

42.102D Principles of Biotechnology

S1 L3

Prerequisite: 44.101

Lecture component of 42.102A Biotechnology A.

42.102E Biotechnology Laboratory

S1 T3

Prerequisite: 42.102D

Laboratory component of 42.102A Biotechnology A.

42.103 Biotechnology (Honours)

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

42.105 Biological Process Engineering

F L2T4

Prerequisite: 44.101.

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.

38.151G 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.

38.152G Food Process Laboratory S2 T6

Co- or prerequisites: 38.164G, 38.165G, 38.166G, 38.350G or their equivalent.

An integrated series of laboratory and pilot plant exercises illustrating the principles and procedures involved in processing and examination of foods.

38.153G Food Technology 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.

38.157G Technology of Cereal Products S1 L2

Prerequisite: 38.132 or 38.165G 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.

38.158G Marine Products S1 L2

Prerequisite: 38.133 or 38.166G or equivalent.

World fisheries, oceanographic factors and fish populations. Biochemistry and microbiology of growth, culture, harvesting and post-harvest 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.

38.161G Food Additives and Toxicology S2 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.

38.162G Postharvest Physiology and Handling of Fruit and Vegetables S1 L1T5

Biochemistry and physiology of metabolism in fresh fruit and vegetables; respiration measurements as an index of metabolism, maturation and senescence; concept of climacteric and non-climacteric 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 disinfection and quarantine measures. Examination of current commercial storage and marketing operations.

38.351G The Microbial Ecology of Foods S2 L2T4

Prerequisites: an introductory subject in microbiology, 38.350G, 38.331 or equivalent.

An integrated lecture and laboratory course covering the ecology, taxonomy and biochemistry of bacteria, yeasts, fungi and viruses involved in food spoilage, food-borne disease and food fermentations. Emphasis on specific methodologies for the detection, enumeration and identification of food associated bacteria, yeasts and fungi. Problems of enumerating microorganisms in foods: techniques of food sampling; formulation, performance and evaluation of selective-differential media; sublethal injury; indicator organisms. Rapid methods for microbial enumeration and identification. Control of microorganisms in foods; microbiological quality control, food legislation, microbiological criteria.

38.451G Advanced Food Engineering S1 L2T1

Prerequisites: 38.421 and 38.432 or an introductory subject in material and energy balances, heat transfer and fluid mechanics or equivalent.

Mathematical representation using vector calculus of heat and mass transfer and fluid mechanics in foods; numerical methods of solution; thermodynamic analysis of processes; laboratory work on the thermophysical properties of foods.

38.452G Drying of Foods S2 L2T1

Prerequisite: 38.451G or equivalent.

Psychrometry; water activity of foods; transport in porous media; spray drying, fluidized bed drying, freeze drying, batch and continuous drying; drying of grain in bulk silos; solar drying of fruit and vegetables.

38.551G Advanced Nutrition

S2 L2T1

Prerequisite: 38.553G or equivalent.

Detailed treatment of the role of nutrients in health and disease at different stages of the human life cycle. Nutritional topics of particular relevance to developing countries including population, infection, rehabilitation, productivity, education.

38.552G Methods of Nutritional Assessment and Analysis

S2 L1T5

Co- or prerequisite: 2.271G or equivalent.

Nutrient assay of foods including bench and instrumental techniques. Human nutritional assessment by anthropometric, dietary and biochemical methods.

49.150G 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.

49.151G Food Chemistry and Enzymology

S1 L2 T1

Chemistry and function of carbohydrates, proteins, lipids, vitamins, minerals and pigments; non-enzymic browning reactions and autoxidation; effects of food processing on the functional properties of food components. *Characteristics of enzymes:* factors affecting enzyme action; the hydrolases and oxidoreductases; respiration, glycolysis, autolysis, enzymic browning and fat decomposition.

Basic laboratory techniques for the analysis of food components.

49.152G 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.

49.153G 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.

49.154G 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 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, marinating 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.

49.155G Food Technology Laboratory

S2 T6

Prerequisites: 49.152G, 49.153G, 49.154G 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.

49.160G Dairy Technology

S2 L1 T1

Prerequisite: 49.154G 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.

49.161G 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.

49.162G Technology of Cereal Products

S2 L2

Prerequisite: 49.153G 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.

49.163G Marine Products S2 L2

Prerequisite: 49.154G or equivalent.

World fisheries, oceanographic factors and fish populations. Biochemistry and microbiology of growth, culture, harvesting and post-harvest 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.

49.164G 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.

49.165G Postharvest Physiology and Handling of Fruit and Vegetables S1 L1 T5

Pre- or Co-requisite: 49.153G 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 non-climacteric 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 disinfection and quarantine measures. Examination of current commercial storage and marketing operations.

49.166G Postharvest Storage of Foods S1 L2 T4

Prerequisite: 49.155G or equivalent

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

49.170G 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.

49.171G Major Research Project F T9

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

49.172G Research Project F T6

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

49.173G Minor Project F T3

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

49.174G Special Topics in Food Science and Technology S1 or 2 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.

49.175G Special Topics in Food Science and Technology S1 or 2 T3

A similar but shorter investigation to that outlined in 49.174G.

49.176G Reading Assignment S5 T1

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

49.250G Introductory Food Microbiology S1 L1 T1

An integrated lecture and laboratory program providing an introduction to food microbiology; microorganisms associated with food; factors affecting microbial growth and survival; enumeration of microorganisms in foods; microbial food spoilage; food-borne microbial disease and food hygiene; food fermentations.

49.251G Food Microbiology S1 L2 T2

Prerequisite: 49.250G 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. *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.

49.252G Advanced Food Microbiology S2 L2 T4

Prerequisite: 49.251G or equivalent.

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.

49.350G 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.

49.351G Nutrition S2 L2 T1

Prerequisite: 49.350G 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.

49.352G Advanced Nutrition S2 L3 T3

Prerequisite: 49.351G 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.

49.450G Food Engineering Principles S2 L2 T1

Prerequisites: First year mathematics and physics or equivalents

Units and dimensions, dimensionless groups, dimensional analysis; material and energy balances; steady state and unsteady state heat transfer; selection of insulation, heat exchangers and heat transfer equipment; refrigeration, freezing, filtration.

49.451G Unit Operations In Food Engineering S2 L2 T2

Prerequisite: 49.450G or equivalent.

Food rheology, fluid flow, thermal properties of foods, evaporation, psychrometry, dehydration, extraction, size reduction, extru-

sion, measurement and control of process variables. Laboratory exercises in food rheology, fluid flow, heat transfer, evaporation, psychrometry, drying, instrumentation and process control.

49.452G Advanced Food Engineering S2 L2 T2

Prerequisites: 49.451G, 49.453G 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.

49.453G 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.

49.454G 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. Diffusion of gases. Assessment of package performance. Prediction of shelf life.

49.455G Food Engineering Laboratory S2 T3

Co-requisite: 49.452G

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

49.456G Food Engineering Field Work S1 T3

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

49.457G Principles of Food Packaging S1 or S2 L2 T1

Co-requisite: 49.152G

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; laboratory work on physical properties of package materials and on evaluation of packaging materials and systems.

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.

42.104G Graduate Seminars

42.111G Reading List in Biotechnology (Microbiology)

42.112G Reading List in Biotechnology (Biochemistry)

42.211G Principles of Biology

SS L3

A study of the characteristics of living systems, including a functional treatment of cytology, metabolism, bioenergetics; structure, function and characteristics of single and multicellular systems; growth; cell division; reproduction; heredity and evolution.

42.212G Principles of Biochemistry

SS L3

A condensed treatment of biochemistry comprising the following aspects: the elemental and molecular composition of living organisms; the chemistry and roles of the biological elements and molecules; the thermodynamics and enzymatic catalysis of metabolism; catabolic, anabolic, amphibolic and anaplerotic processes, with emphasis on hydrolysis and synthesis of polymers, glycolysis and gluconeogenesis of glucose, β -oxidation and synthesis of fatty acids, deamination and decarboxylation of amino acids, the tricarboxylic acid cycle, electron transport and oxidative phosphorylation; metabolic regulation and integration.

42.213G Biochemical Methods

SS T3

A laboratory program in practical biochemistry. The basic instrumentation and methodology of the biochemist will be introduced by practical exercises and demonstrations. A comprehensive treatment of the relevance and applicability of biochemical techniques is covered in tutorials.

42.214G Biotechnology

SS L2T1

The selection, maintenance and genetics of industrial organisms; metabolic control of microbial synthesis; fermentation kinetics and models of growth; batch and continuous culture; problems of scale-up and fermenter design; control of the

microbial environment; computer/fermentor interactions. Industrial examples will be selected from: antibiotic and enzyme production, alcoholic beverages, single cell protein (SCP), microbial waste disposal and bacterial leaching. *Tutorial/practical sessions* include: problem solving, instrumentation, continuous culture techniques, and mathematical modelling and simulation of industrial processes.

42.215G Practical Biotechnology

F T7

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

42.281G Design of Microbial Reactors

Unit 1 Rate Processes

Bridging unit designed to provide the background in rate processes in heterogenous systems required for Unit 3. This unit would not be offered to a graduate with background in advanced rates processes, the equivalent of 48.0454 Reactor Engineering.

Process rates and rates of change; generalized definition of a process rate. Material balances with reaction — integral balances and balanced differential with respect to time, space, and both time and space. Measurement, interpretation and correlation of process rates. Heterogeneous systems, the influence of diffusional processes, linear and non-linear systems, lumped and distributed systems.

Unit 2 Fundamentals of Microbial Stoichiometry

This is a bridging unit offered to students with little or no background in the life sciences. A prerequisite or co-requisite would be 44.101 Introductory Microbiology or its equivalent. The unit is designed to provide an understanding of the structure of metabolism to allow the student to carry out the overall metabolic balances necessary for qualification of living systems.

Growth of an undifferentiated organism as a physico-chemical process leading to quantification of the growth processes. Overall structure of metabolic processes. Material, energy and redox balances under anaerobic and aerobic conditions. Specific metabolic rates and their quantification.

Unit 3 Design of Microbial Reactors

This unit would normally follow rate processes or fundamentals of microbial stoichiometry and is divided into two strands.

Reactor Design Fundamentals: Ideal and non-ideal reactors, residence time distribution and non-ideal reactor models. The significance of mixing and diffusion in microbial reactors for freely suspended microorganisms. The concept of a microfluid and a macrofluid and its application to the description of two-phase reacting systems — gas-liquid, oil-aqueous and solid-fluid systems will be examined with examples relevant to the biological process industries. *Microbial Reactor Calculations:* The collection, quantification and interpretation of rate data, and the design of reactors for freely suspended microorganisms; batch, semi-batch and continuous reactors; gas exchange balances. Rate processes in microbial flocs and microbial films. Design for microbial floc and film reactors.

42.282G Microbial Kinetics and Energetics

Unit 1 Microbial Kinetics

Prerequisite or co-requisite: 42.281G Unit 2 or equivalent.

Principles used in the quantification of complex systems. The quantification of biomass and the growth processes. A mechanistic approach to the quantification of microbial processes. The Monod model. Extension of the Monod model. Metabolic uncoupling. Inhibition kinetics and reactor stability. Factors affecting the substrate unlimited growth rate. The integration of metabolic control into an overall response.

Unit 2 Microbial Energetics

Prerequisite or co-requisite: 48.221G Unit 2 or equivalent.

Significance of entropy and free energy changes in microbial growth. Driven reactions, group transfer potentials, driven reaction sequences and the significance of actual and standard free energy changes in open systems. Application to metabolism, energy requiring pathways, energy producing pathways. Thermodynamic efficiency of growth. Mass, heat and entropy balances in growing cultures, prediction of yield.

42.283G Bioprocess Unit Operations and Equipment Design

Prerequisite or co-requisite: 48.284G or equivalent.

Engineering design and operating characteristics of plant and processes normally used, eg sterilization and air purification, dehydration, drying at reduced pressure, reduced temperature preservation, radiation, product isolation, sedimentation, filtration, centrifugation, extraction, absorption, chromatography and ion exchange, absorption with reaction, electrophoresis and dialysis, aseptic design, materials of construction, effluent disposal.

42.284G Heat, Mass and Momentum Transport

A bridging subject designed to provide an introductory understanding of the mechanisms of transport processes. This subject would not be offered to a graduate with a background in chemical engineering principles. Mechanisms of molecular and turbulent transport. Heat, mass and momentum transport as rate processes. Boundary layer theory. Lift and drag coefficients. Introduction to non-Newtonian flow.

48.285G Bioprocess Laboratory

Practical experience in the industrial processing of biological and microbial systems. Small projects in areas of interest to the student.

42.401G Applied Genetics

SS L2T3

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.

42.402G Peptide and Protein Technology

SS L2T3

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.

42.403G Biochemical Engineering

SS L2T3

Design of bioreactors; range of biocatalysts from free enzymes to immobilised 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.

42.404G Microbial Mineral Processing

SS L1T2

Role of autotrophic and heterotrophic microbes in low-grade ore decomposition and pollution control. Microbial weathering of copper and iron sulphides, manganese oxides and silicates. Formation of manganese oxides.

The laboratory component includes column and shakeflask leaching studies on mined copper and manganese ores. Microbial physiology, enumeration and quantification of biological contributions in biohydrometallurgical processes.

42.405G Biodeterioration

SS L2T1

Material and microbe interactions and ecology. Rates of decomposition, distribution of microorganisms and the effects of temperature, pH, Eh and water activity. Microbial breakdown of hydrocarbons, oils and surfactants. Corrosion of metals. Cellulose and aromatic compound catabolism. Waste-water treatment.

42.406G Applied Cellular Physiology**SS L2T3**

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.

42.407G Biological Principles**SS L3**

A study of the characteristics of living systems. Biological molecules: carbohydrates, lipids, proteins and nucleic acids. Cell structure and function: prokaryotic and eukaryotic cells. Basic biochemistry: thermodynamics and catalysis of metabolism; catabolic and anabolic processes; properties of enzymes; DNA replication; protein synthesis. Comparative metabolism of viruses, bacteria, fungi, plants and animals. Metabolic regulation. Modes of nutrition and nutrient cycles. Reproduction and genetics: eukaryotic and prokaryotic systems; sexual and asexual reproduction; bacterial genetics; recombinant DNA technology. Microorganisms of commercial significance. Biodeterioration and biodegradation. Pathogenic microorganisms: aetiology and epidemiology of infection; host defence mechanisms; chemotherapy; mechanisms of drug action; drug resistance.

42.408G Bioengineering Principles**SS 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 (descriptive only).

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

42.501G Biotechnology Project (Major)**F T11**

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

42.502G Biotechnology Project (Minor)**F T3**

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**

School of Chemical Engineering and Industrial Chemistry

Head of School

Professor D.L. Trimm

Administrative Officer

Mr P.B. Dunkley

The School contains the Departments of Chemical Engineering and Industrial Chemistry which service two 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.

For the award of Honours in both the Chemical Engineering and Industrial Chemistry 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 must obtain a minimum of twelve weeks' professionally oriented or industrial experience.

It is recommended that before graduation students in the full-time courses in Industrial Chemistry obtain a minimum of eight 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.*, CEng, FRACI, FIChemE

Professor of Chemical Engineering (and Dean, Faculty of Engineering from 1/1/89)

Christopher Joseph Dalzell Fell, BSc N.S.W., PhD *Camb.*, CEng, FIChemE, FIEAust, MAMerlChE

Professor of Petroleum Engineering

Val Wolf Pinczewski, BE *Ncle.(N.S.W.)*, PhD N.S.W., CEng, MIChemE

Associate Professors

Anthony Gordon Fane, BSc PhD DIC *Lond.*, CEng, MIChemE

John Kingsford Haken, MSc PhD N.S.W., ASTC, FRACI

Maria Skyllas Kazacos, BSc PhD N.S.W., ARACI, MES

Geoffrey David Sergeant, BSc PhD *Wales*, CEng, FlntE, FAIE

Mark Sebastian Wainwright, MAppSc *Adel.*, PhD *McM.*, MAMerlChE, FRACI, MIE

Senior Lecturers

Michael Paul Brungs, BSc PhD N.S.W.

John Buchanan, ME *Syd.*, PhD N.S.W.

Robert Paul Burford, BSc PhD *Adel.*, FPRI, MAMerlChE, ARACI

Rodney Phillip Chaplin, BSc PhD *Adel.*, ARACI

Douglas Christopher Dixon, BE MEngSc *Syd.*, PhD N.S.W., MIEAust

Neil Russell Foster, BSc PhD N.S.W., MAMerlChE, ARACI

Brian David Henry, MSc N.S.W., PhD *Lough.*, CEng, FIChemE, MIEAust MAMerlChE

James Dale Navratil, BA MS PhD *Colorado*, ACS, AICHe, AAAS, RACI

Judy Agnes Raper, BE PhD N.S.W., CEng, MIChemE

John Frank Stubington, BE *Qld.*, PhD *Camb.*, CEng, MIChemE, MAIE

Robert Marsden Wood, BSc *Leeds*, PhD *Camb.*, CEng, FIChemE

Lecturers

John Clifford Jones, BSc PhD *Leeds*, ARACI, CChem

William Patrick Walsh, BSc PhD *Syd.*

Administrative Officer

Philip Brian Dunkley, BA DipEd N.S.W.

Professional Officers

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Stephen Joseph Clough, BSc *Syd.*, MAppSc N.S.W., CChem, ARACI, MAIE

Barry William Edenborough, BE PhD N.S.W.

Ashley John Deacon, BAppSci N.S.W./I.T.

Orest Dworjanyan, MSc N.S.W., ASTC, ARACI

David John Kelly, BSc BE *Syd.*, MEngSc N.S.W.

Katia Simeonova Nasev, BE *Higher Inst. Chem. Tech. Sofia*, Grad IEAust

Cyril Leslie Samways, BSc *Syd.*, MSc N.S.W.

Department of Chemical Engineering

Head

Associate Professor M.S. Wainwright

Department of Fuel Technology

Head

Associate Professor G. D. Sergeant

Department of Industrial Chemistry

Head

Professor D. L. Trimm

Department of Polymer Science

Head

Associate Professor J. K. Haken

Centre for Petroleum Engineering Studies

(Director to 31/12/88)

Professor V. W. Pinczewski

Senior Lecturer

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

Lecturer

Juan Carlos Mantecon, ME PhD *Buenos Aires*

Visiting Professors

M Rasin Tek, PhD *Mich.*

Charles S Aldrich, BSE *Texas*, MSE *Colorado Sch. of Mines*

Centre for Membrane and Separation Technology

(Director to 31/12/88)

Professor C.J.D. Fell

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.

The revised new course commences in 1988 with prefix 3, and the old course with prefix 48, for Chemical Engineering subjects will be phased out over the next two to three years.

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 (New Course)		Hours per week	
		S1	S2
1.001	Physics 1	6	6
2.121	Chemistry 1A and	6	0
2.131	Chemistry 1B or	0	6
2.141	Chemistry 1M	6	6
3.110	Introduction to Chemical Engineering	2	2
5.0011	Engineering Mechanics 1	0	4
5.0302	Engineering Drawing and Descriptive Geometry	4	0
10.001	Mathematics 1	6	6
	General Education Subject	2	2
		26	26

Year 2 (New Course)

2.102A	Physical Chemistry	6	0
2.102E	Organic and Inorganic Chemistry (for Chemical Engineers)	4	0
3.021	Instrumental Analysis	3	3
3.022	Computing	1.5	1.5
3.121	Material and Energy Balances	2	2
3.122	Flow of Fluids	2	2
3.123	Heat Transfer	0	3
3.124	Chemical Engineering Laboratory 1	1	1
3.125	Materials and Corrosion	0	2
6.854	Electrical Power Engineering	0	3
10.031	Mathematics	2	2
10.301	Statistics SA	2	2
	General Education Subject	2	2
		23½	25½

Year 3 (New Course)

		Hours per week	
		S1	S2
3.031	Engineering Thermodynamics	3	1
3.032	Reaction Engineering	1	2
3.033	Numerical Methods	1	2
3.034	Process Control	1	1
3.131	Fluids II	1	1
3.132	Mass Transfer and Separation	3	3
3.133	Particle Mechanics	0	3
3.134	Process Plant Engineering I	3	3
3.135	Chemical Engineering Laboratory II	1.5	1.5
3.136	Chemical Engineering Applications(*)	4	4
8.6110	Structures	3	0
10.032	Mathematics	2	2
	General Education subject	2	2
		25½	25½

[*Students electing to take a coherent Fuel Engineering Elective over years 3 and 4 take 3.331 Fuel Engineering 1 in lieu of 3.136]

Year 4 (New Course)

3.140	Research Project	6	6
3.141	Process Dynamics and Control	3	2
3.142	Advanced Reaction Engineering (*)	2	0
3.143	Multicomponent Separation Processes	0	2
3.144	Process Plant Engineering II	4	0
3.145	Safety and Environmental	2	0
3.146	Process Plant Operation [*]	3	0
3.147	Management	0	2
3.148	Design Project	1	4
3.149	Professional Electives	4	4
		25	20

[*Students taking the Fuel Engineering Elective take 3.341 Fuel Engineering 2 and 3.340 Fuel Research Project in lieu of 3.142, 3.146, 3.149 and 3.140]

Year 3 (Old Course)

6.854	Electrical Power Engineering	0	3
8.6110	Structures	3	0
10.032	Mathematics	2	2
48.031	Chemical Engineering 2A	7	0
48.032	Chemical Engineering 2B	0	6
48.033	Chemical Engineering 2C	0	6
48.036	Chemical Engineering Laboratory 1	2	2
48.135	Thermodynamics	3	0
48.136	Reactor Design 1	1	2
46.163	Instrumentation and Process Control 1	0	3
	General Education Subject	2	2
		20	26

Plus one or more of the following electives to total 84 hours for the year.

7.734	Mineral Process Engineering	3	0
48.0391	Electrochemical Engineering	3	0

48.0393	Computer Simulation	0	3
44.101	Introductory Microbiology	6	0
48.321	Fuel Engineering	3	3
Any other elective approved by Head of School			

*Students should note the special proviso for enrolment in this subject as indicated in the Subject Descriptions later in this handbook.

Year 4 (Old Course)

48.041	Chemical Engineering 3A	4	0
48.042	Chemical Engineering 3B	4	0
48.043	Chemical Engineering 3C	3	2
48.044	Chemical Engineering Laboratory 2	3	0
48.047	Chemical Engineering 3D Project*	2	4
		1	11
		17	17

*The project is selected from

48.040	Chemical Engineering Project
48.240	Biological Process Engineering Project
48.340	Fuel Engineering Project

Plus one or more of the following to total 168 hours for the year

4.934	Designing with Advanced Materials	3	3
7.746	Mineral Process Chemistry	6	6
48.113	Chemistry of Industrial Processes	3	3
42.105	Biological Processes Engineering	6	6
48.331	Fuel Engineering 3	6	6
48.403	Polymer Science	3	3
48.046	Chemical Engineering Projects (additional)	6	6

Any other elective approved by Head of School

Professional Electives in Course 3040 Chemical Engineering

Biological Process Engineering

The Department of Biotechnology offers a coherent professional elective in Biological Process Engineering designed for students wishing to pursue a career in the biologically based processing industries. Students electing for this professional elective should take 44.101 Introductory Microbiology in Year 3, and 48.311 Biological Process Engineering and 48.240 Biological Process Engineering Project in Year 4.

Chemical Engineering

Students wishing to pursue a career in the chemicals, petroleum, petrochemical, minerals utilization or metallurgical industries are advised to take 48.039 Chemical Engineering 2J in Year 3 and two of 7.745 Mineral Chemistry, 48.113 Chemistry of Industrial Processes, 48.403 Polymer Science together with the 48.040 Chemical Engineering Project in Year 4. Part-time students should take these subjects at equivalent stages of the part-time degree.

Fuel Engineering

The Department of Fuel Technology offers a coherent professional elective in Fuel Engineering designed for those students wishing to pursue a career concerned with fuel and energy conversion and the application of fossil fuels to the process industries. The Department is the only one of its kind in Australia and has a long history of teaching and research in the fossil fuels area. The elective covers the broad areas of properties constitution, processing and conversion, and utilization of fossil 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 conservation; and progress in fuel science and fuel processing. Students choosing this professional elective should take 3.331 Fuel Engineering 1 in Year 3 and 3.341 Fuel Engineering 2 and 3.340 Fuel Engineering Project in Year 4. Part-time students should take these subjects at equivalent stages of the part-time degree.

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

3129

Combined Degree in Chemical and Mineral Engineering — Full-time Course

Bachelor of Engineering/Bachelor of Science. BE BSc

This combined degree course of five years full-time study enables a student from the School of Chemical Engineering to qualify for the award of the two degrees of Bachelor of Engineering and Bachelor of Science (BE BSc). The course enables such combined degree students to major in the areas of mineral processing and extractive metallurgy. It is jointly offered by the School of Chemical Engineering and Industrial Chemistry and the Department of Mineral Processing and Extractive Metallurgy, and is administered by the Faculty of Applied Science.

A part of the requirement for this double degree will be an 8 week Vacation Work Experience in the mineral industry during the summer vacation, at the end of the fourth year in Chemical Engineering.

Students enrolled in this BE BSc degree course will be awarded their degrees at the conclusion of five years study. Distinguished performance over five years may lead to the award of Honours. Years 1 to 4 of the course are equivalent to the first four years of the Chemical Engineering Course 3040.

Students must have completed the BE course in Chemical Engineering with the Mineral Subjects in Years 3 and 4 (i.e. including a Year 4 project which is minerals oriented) to have the opportunity to enrol in Year 5 which is set out below.

Year 5

		Hours per week	
		S1	S2
7.622/2	Mineral Engineering I Unit 2	3	0
7.632	Mineral Engineering II	3	3
7.642	Mineral Engineering III	6	6
7.643	Mineral Engineering Projects and Laboratory	6	9
25.520	Geology for Mining Engineers	2	2
25.523	Mineralogy	2	2
7.142	Mine Development	1	1
7.113	Mining Methods	2	2
		<u>25</u>	<u>25</u>

Year 3

2.030	Organic Chemistry	6	0
48.113	Chemistry of Industrial Processes	3	3
48.121	Corrosion in the Chemical Industry	0	2
48.135	Thermodynamics	3	0
48.136	Reactor Design 1	1	2
48.137	Industrial Chemistry 2A	2	0
48.138	Industrial Chemistry 2B	0	3
48.139	Experimental Design	0	2
48.163	Instrumentation and Process Control 1	0	3
48.171	Chemistry of High Temperature Materials	0	2
48.172	Instrumental Analysis 2	4	0
48.403	Polymer Science	3	3
	General Education Subject	<u>2</u>	<u>2</u>
		<u>24</u>	<u>22</u>

3100**Industrial Chemistry — Full-time Course****Bachelor of Science
BSc**

To accommodate changes in the Chemical Engineering course minor changes will take place in the Industrial Chemistry course from 1988 onwards.

Year 1

		Hours per week	
		S1	S2
1.001	Physics 1	6	6
2.121	Chemistry 1A and	6	0
2.131	Chemistry 1B	0	6
or			
2.141	Chemistry 1M	6	6
10.001	Mathematics 1	6	6
3.210	Industrial Chemistry 1	2	2
5.0011	Engineering Mechanics 1	0	4
or			
17.031	Biology A or	6	0
25.110	Earth Materials and Processes	6	0
and			
5.0302	Engineering Drawing and Descriptive Geometry	<u>4</u>	<u>0</u>
		<u>24</u>	<u>24</u>

Year 4

18.1211	Production Management A	3	0
42.114	Fermentation Processes	0	2
48.0471	Management	0	2
48.124	Applied Kinetics	2	0
48.134	Applied Thermodynamics	2	0
48.165	Laboratory Automation Science	4	0
48.174	Seminars	2	2
48.194	Project	8	16
48.404	Advanced Polymer Science	2	0
	General Education Subject	<u>2</u>	<u>2</u>
		<u>25</u>	<u>24</u>

Plus one of the following:*

48.115	Industrial Electrochemistry	2	
48.116	Water Chemistry	2	
48.166	Microprocessors in Analytical Instrumentation	2	
48.303	Fuel Science for Industrial Chemists	2	

*Only one of these is offered in any one year as selected by student preferences.

Year 2**Revised Year 2 Industrial Chemistry**

		S1	S2
1.9222	Electronics	3	0
2.102A	Physical Chemistry	6	0
2.102C	Inorganic Chemistry	0	6
2.102B	Organic Chemistry	2	4
10.031	Mathematics	2	2
10.301	Statistics SA	2	2
48.122	Instrumental Analysis	3	3
3.220	Introduction to Fluid Flow	2	0
3.221	Mass and Energy Balances	2	0
3.222	Heat Transfer and Temperature Measurement	0	2
3.022	Computing	1½	1½
	General Education Subject	<u>2</u>	<u>2</u>
		<u>25½</u>	<u>23½</u>

3110**Industrial Chemistry — Part-time Course****Bachelor of Science (Technology)
BSc(Tech)****Stages 1 and 2***

		Hours per week	
		S1	S2
1.001	Physics 1	6	6
2.121	Chemistry 1A and	6	0
2.131	Chemistry 1B	0	6
3.210	Industrial Chemistry 1	2	2
10.001	Mathematics 1	0	6

Plus:

5.0011	Engineering Mechanics 1	0	4
or			
17.031	Biology A	6	0
or			
25.110	Earth Materials and Processes†	6	0
and			
5.0302	Engineering Drawing and Descriptive Geometry	4	0

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

		Hours per week	
		S1	S2
2.102A	Physical Chemistry	6	0
10.031	Mathematics	2	2
10.301	Statistics SA	2	2
48.122	Instrumental Analysis	3	3
	General Education Subject	2	2
		15	9

Stage 4			
1.9222	Electronics	3	0
2.102B	Organic Chemistry	6	0
2.102C	Inorganic Chemistry	0	6
3.220	Introduction to Fluid Flow	2	0
3.221	Mass and Energy Balances	2	0
3.222	Heat Transfer and Temperature Measurement	0	2
3.022	Computing	1½	1½
		14½	9½

Stage 5			
48.121	Corrosion in the Chemical Industry	0	2
48.135	Thermodynamics	3	0
48.136	Reactor Design 1	1	2
48.137	Industrial Chemistry 2A	2	0
48.138	Industrial Chemistry 2B	0	3
48.139	Experimental Design	0	2
48.171	Chemistry of High Temperature Materials	0	2
48.172	Instrumental Analysis 2	4	0
	General Education Subject	2	2
		12	13

Stage 6			
2.030	Organic Chemistry	6	0
48.113	Chemistry of Industrial Processes	3	3
48.163	Instrumentation and Process Control 1	0	3
48.403	Polymer Science	3	3
		12	9

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.

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 Mechanical Engineering, Civil Engineering or Mining degree course 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
6.854	Electrical Power Engineering	0	3
8.6110	Structures	3	0
10.032	Mathematics	2	2
20.301	Properties and Phase Behaviour of Petroleum Reservoir Fluids	0	2
20.302	Reservoir Rock Properties and Fluid Flow in Porous Media	2	0
20.303	Well Drilling and Completions	3	0
20.304	Reservoir Engineering 1	0	2
20.305	Drilling and Production Lab	3	0
20.306	Petroleum Production Economics	0	1
20.307	Petroleum Thermodynamics	2	0
20.308	Formation Evaluation 1	2	2
20.5331	Physical Geology for Petroleum Engineers 1	3	0
25.5332	Physical Geology for Petroleum Engineers 2	0	3
25.5302	Structural Geology	0	3
3.132	Mass Transfer and Separation	3	3
3.034	Process Control	1	1
	General Education Subject	2	2
		26	27

Year 4

20.401	Reservoir Engineering 2	0	3
20.402	Reservoir Fluids Laboratory	3	0
20.403	Production Engineering	3	0
20.404	Formation Evaluation	2	2
20.405	Oil and Gas Law and Regulation	0	2
20.406	Reservoir Simulation	0	3
20.407	Advanced Recovery Methods	0	3
20.408	Natural Gas Engineering	0	3
20.409	Petroleum Engineering Project	8	4
20.410	Well Pressure Testing	2	0
3.134	Process Plant Engineering 1 (Modified for Petroleum Engineers)	3	3
3.141	Process Dynamics and Control	3	2
3.145	Safety and Environmental	2	0
		<hr/> 26	<hr/> 25

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 and Petroleum Engineering	Course 8060
	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 (generally designated as subjects without a suffixed G number), 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 (48.900G) amounting to six hours per week for a year or take a Minor Project (48.901G) 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 engineering for graduates in science, applied science or engineering who have not had substantial previous formal education in these subjects.

The course is based on the general formula for a MAppSc degree program, whereby the subject 3.331 can comprise the undergraduate component, the project (30% or 15% of the program) is 3.900G or 3.901G, and the remainder of the hours can be taken from the units offered in the 3.38G and 3.39-G 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.

5010

Corrosion Technology Graduate Diploma Course

Graduate Diploma GradDip

The Graduate Diploma course in Corrosion Technology is open to graduates in Engineering, Applied Science or 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. Its aim is to develop an appreciation of the fundamentals, principles of corrosion and of 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.

*For additional information on the MAppSc degree course see earlier this section.

Year 1		Hours per week	
		S1	S2
48.121	Corrosion in the Chemical Industry	0	2
48.180G	Corrosion Materials	2	2
48.181G	Industrial Coatings for Corrosion Protection	2	0
		4	4

Year 2

		Hours per week	
		S1	S2
48.171	Chemistry of High Temperature Materials	0	2
48.182G	Non-metallic Materials for Corrosion Resistance	2	0
48.183G	Corrosion Technology	3	3
48.184G	Corrosion Project	6	6
		11	11

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.

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

Subject Code	Subject	Hours Per Week
20.302	Reservoir Rock Properties	2
20.303G	Well Drilling & Completions	3
20.3035G	Drilling & Production Lab.	3

20.403G	Production Engineering	3
20.410G	Well Pressure Testing	2
20.411	Formation Evaluation	2
25.5331	Physical Geology for Petroleum Engineering I	3
		<hr/> 18

Session 2

Subject Code	Subject	Hours Per Week
20.301	Properties and Phase Behaviour	2
20.306G	Petroleum Production Economics	1
20.309G	Reservoir Engineering	2
20.406G	Reservoir Simulation Fundamentals	3
20.409G	Petroleum Engineering Project	6
20.411G	Formation Evaluation	2
25.5332	Physical Geology for Petroleum Engineering II	3
20.501G	Practical Assignment*	3
		<hr/> 19

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

Subject Descriptions

Undergraduate Study

Centre for Petroleum Engineering

20.301 Properties and Phase Behaviour of Petroleum Reservoir Fluids S1 L3

Chemical, physical and thermodynamic properties of petroleum and reservoir fluids. Phase behaviour of multicomponent hydrocarbon systems. Use of computers to predict complex phase behaviour, real gas law, liquid mixtures, flash calculations, pressure, volume and temperature calculations for reservoir fluids. Application of these concepts to the prediction of gas and gas-condensate reservoir behaviour.

20.302 Reservoir Rock Properties and Fundamentals of Fluid Flow in Porous Media S1 L3

Structure, properties and fluid content of reservoir rocks. Darcy's Law and the concept of permeability for single and multiple flow. Capillary phenomena and static distribution of fluids. Calculation of hydrocarbon volume in place. Elementary flow processes in reservoirs.

20.303 Well Drilling and Completions S2 L3

Well drilling methods and elements of rock mechanics. Rheology of Newtonian and non-Newtonian fluids, chemical properties and carrying capacity of drilling fluids, rotary drilling hydraulics, bit hydraulics and factors affecting rate of penetration. Prediction and control of abnormal pressures. Casing and tubing design, principles of cementing, well completion materials, well perforating, equipment and operative standards, acidizing, fracturing, problem well analysis and remedial treatment design.

20.304 Reservoir Engineering I S2 L3

Prerequisite: 20.301, 20.302.

Classification of reservoirs by type and recovery mechanism, reserve and production rate estimates based on material balance calculations. Introduction to displacement processes in petroleum reservoirs. Design of reservoir development.

20.305 Drilling and Production Lab S2 L3

Prerequisite: 20.301, 20.302. *Co-requisite:* 20.303.

Properties of drilling fluids. The design, composition and measurement of the properties of drilling fluids. Measurement of basic rock properties such as porosity, permeability and capillary pressure.

20.306 Petroleum Production Economics S1 L1

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

20.307 Petroleum Thermodynamics S1 L2T1

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.

20.308 Formation Evaluation I F L2

Principles of petrophysics. Petrophysical parameters: their measurement with well logs. Relationships between log and reservoir parameters. Study of resistivity and porosity logs. Case study in an Australian oilfield. A course of lectures and practical problem solving.

20.401 Reservoir Engineering II SI L3

Prerequisite: 20.304.

Basic unsteady-state flow for single phase fluids in porous media. Diffusivity equation and solutions. Application to practical well test analysis methods. Pressure build-up, drawdown, interference and pulse testing to evaluate reservoir properties. Extension to multiphase flows and introduction to displacement processes in petroleum reservoirs.

20.402 Reservoir Fluids Laboratory S1 L3

Prerequisite: 20.301.

Physical properties of petroleum and its products, gravity, viscosity, surface tension, chromatography. PVT analysis of reservoir fluids.

20.403 Production Engineering S1 L3

Prerequisite: 20.304

Analysis, specification and characteristics of production systems. Well inflow performance. Single and multiphase flow in vertical pipes. Methods and design of artificial lift systems. Surface separation, fluid transmission and processing.

20.404 Formation Evaluation 2 F L2

Prerequisite: 20.308

Study of open-hole crossplots. Irreducible water saturation, permeability index. Shaly sands. Carbonates. Fracture detection. Sample taking. Case studies in 2 Australian oilfields. Cased-hole logs. Gun perforating. A course of lectures and practical problem solving.

20.405 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.

20.406 Reservoir Simulation Fundamentals**S2 L3**

Prerequisite: 20.401, 10.032, 48.032.

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.

20.407 Advanced Recovery Mechanisms**S2 L3**

Prerequisite: 48.041, 20.401.

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.

20.408 Natural Gas Engineering**S2 L3**

Basic gas reservoir engineering. Study of the composition and properties of natural gas, production methods, estimation of gas reserves, recovery of liquifiable products from gas, conditioning, transmission, compression and measurement of natural gas. Gas well testing including flow-after-flow, isochronal testing, transient testing, deliverability forecasting.

20.409 Petroleum Engineering Project**S14 S2 L11**

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.

20.410 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 heterogeneity, multiphase flow. Study of production, DST and formation interval tests. Pulse testing and multi-well tests. Computer assisted well test analysis techniques.

General

Students are expected to possess a calculator having exponential capabilities (in 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 Chemical Engineering 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.

3.021 Instrumental Analysis**FL1T2**

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 absorption, X ray diffraction and fluorescence. Chromatographic analysis — gas chromatography, high performance liquid chromatography, and ion chromatography.

3.210 Industrial Chemistry I**FL1T1**

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.

3.022 Computing**FL1T½**

Prerequisite: 10.001

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.

3.031 Engineering Thermodynamics**S1 L2T1 S2L1**

Co or Prerequisite: 2.102A

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.

Chemical Engineering and Industrial Chemistry

3.032 Reaction Engineering

S1L1 S2 L1T1

Prerequisites: 2.102A, 3.121, 3.122, 3.123.

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.

3.033 Numerical Methods

S1L1 S2 L1 T1

Prerequisite: 3.022

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.

3.034 Process Control

FL1

Prerequisites: 3.022, 10.031

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.

3.110 Introduction to Chemical Engineering

FL1T1

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 stoichiometry. Introduction to material balancing. Process calculations associated with gases, vapours and liquids.

3.121 Material and Energy Balances

FL1T1

Prerequisites: 2.121, 3.110, 10.001

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 3.110 will be required to complete a 28-hour bridging course offered by the School early in Session 1.

3.122 Flow of Fluids

FL1T1

Prerequisites: 1.001, 10.001.

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.

3.123 Heat Transfer

S2L2T1

Prerequisite: 3.122

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.

3.124 Chemical Engineering Laboratory I

FT1

Prerequisites: 1.001, 2.121, 2.131 or 2.141, 10.001

An introduction to laboratory work in chemical engineering including information retrieval techniques.

3.125 Materials and Corrosion

S2 L1T1

Prerequisite: 2.102A

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. Design factors for corrosion prevention. Methods of corrosion prevention.

3.131 Fluids 2

FL1

Prerequisite: 3.122

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

3.132 Mass Transfer and Separation

FL2T1

Prerequisites: 2.102A, 3.122, 3.123

Fundamentals: Diffusion. Models for mass transfer at fixed and free interfaces. Calculation of mass transfer rates at surfaces with simple geometry. Mass transfer in dispersions. *Stagewise Processes:* Phase equilibrium. Absorption. Binary distillation. Liquid-liquid extraction. *Design of Mass Transfer Equipment:* Equipment de-

sign 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.

3.133 Particle Mechanics

S2L2T1

Prerequisite: 3.122

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.

3.134 Process Plant Engineering 1

FL2T1

Prerequisites: 3.121, 3.122, 3.123

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*: Procedures for the selection, design, specification and representation of process equipment. Pressure vessel and heat exchanger design. Engineering standards and procedures. *Process Economics I*: Capital and operating costs of a process plant. Fixed and variable costs. Break-even analysis. Cost estimation methods.

3.135 Chemical Engineering Laboratory 2

FT 1½

Prerequisites: 2.102A, 3.021, 3.022, 3.121, 3.122, 3.123, 3.124.

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.

3.136 Chemical Engineering Applications

F L2T2

Prerequisites: 2.102A, 3.121, 3.122, 3.123

Application of chemical engineering principles of biotechnology,

fuel engineering and minerals processing and extractive metallurgy. Integrated problem illustrating skills in process analysis. Lectures in this subject will be given by staff drawn by agreement from appropriate Schools.

3.140 Research Project

FT6

Prerequisites: Successful completion of all Year 3 subjects.

The experimental investigation of some aspect of chemical engineering.

3.141 Process Dynamics and Control

S1L2T1 S2L1T1

Prerequisites: 3.033, 3.034

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.

3.142 Advanced Reaction Engineering

S1L1T1

Prerequisite: 3.032

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.

3.143 Multicomponent Separation Processes

S2L1T1

Prerequisite: 3.132

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.

3.144 Process Plant Engineering 2

S1L2T2

Prerequisite: 3.134

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.

3.145 Safety and Environmental**S1L2***Prerequisite: 3.134*

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 — 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.

3.146 Process Plant Operation**S1L1T2**

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

3.147 Management**S2L2**

A workshop comprising exercises and case studies to introduce the human and organizational aspects of managing process or engineering enterprises. Includes discussion of typical organization structures and reasons for choosing them; problems of managing people in organizations, industrial relations questions.

3.148 Design Project**S1T1 S2T4**

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.

3.149 Professional Electives**FL2T2**

To be chosen from offerings yet to be finalised in:

Biochemical Engineering
Industrial Chemistry
Materials Science and Engineering
Minerals Processing and Extractive Metallurgy
Polymer Science

which will be offered by the relevant Schools or Departments.

3.220 Introduction to Fluid Flow**S1 L1 T1***Prerequisites: 1.001, 10.001*

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.

3.221 Mass and Energy Balances**S1 L1 T1***Prerequisites: 2.121, 3.110, 10.001*

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 3.110 will be required to complete a 28 hour bridging course offered by the School early in Session 1.

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

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.

3.331 Fuel Engineering 1**FL3T1**

Sources, properties and evaluation of fossil fuels. Energy conversion and fundamentals of combustion science. Radiation heat transfer in flames and furnaces. Introductory fuel plant design. Integrated problem. Fuel Testing Laboratory.

3.340 Fuel Research Projects**S1T6 S2T6**

The experimental investigation of some aspect of fuel engineering.

3.341 Fuel Engineering 2**S1L5T4 S2L2T2**

Fuel processing: refinery operations, shale oil; carbonisation, gasification and liquefaction of coals. Combustion engineering. Furnace and fuel plant design. Energy management. Combustion Laboratory.

48.025 Chemical Engineering for Ceramic Engineers

Consists of Units 1 and 3 of 48.022.

48.031 Chemical Engineering 2A**Unit 1 Mass Transfer (Theory)****S1 L1T1***Prerequisites: 2.102A, 48.021.*

Molecular diffusion in gases, liquids and solids and the measurement and calculation of diffusion coefficients. Diffusion at an interface — one component unidirectional diffusion and equimolar counterdiffusion under steady state conditions. Mass transfer coefficients. Estimation and application of chemical and phase equilibria. Stage calculations applied to liquid/liquid, vapour/liquid and other mass transfer operations. The two film theory and the transfer unit concept in gas/liquid, vapour/liquid, and other operations.

Unit 2 Heat Transfer 2 (Theory)**S1 L1***Prerequisite: 48.022 Unit 1. Co-requisite: 10.032.*

An extension of the work covered in 48.022, Unit 1, with an

emphasis on the fundamentals of conduction, convection and unsteady state heat transfer.

Unit 3 Plant Layout

S1T1

Factory Layout: Factors governing location of processing plant. Typical dispositions of process batteries, central utilities, laboratories, workshops, amenities, storage areas, effluent treatments. Distribution of electricity, steam, process and reticulated cooling water. Boiler plants and cooling towers, steam turbine versus electric motors, local versus central location of particular utilities. Provision for expansion. **Piping and Fittings:** Fabrication, standards, most used sizes and types, welded, screwed and bolted connections, common valve types, their flow and serviceability characteristics, relative costs and integrity; blinds and blanking valves. Practical assessment of pressure loss and line sizing in straight runs and simple networks involving pumps, or blowers, valves and bends. **Process Battery:** Considerations of accessibility for maintenance, operator convenience and safety. Distribution of utility fluids. Methods of erecting major process units.

Unit 4 Process Engineering 1

S1 L1

The role of the Process Engineer. Process development, and the creation and screening of alternatives. Block diagrams and process flowsheets, presentation of material properties, mass and energy flows at various points. Preparation and critical examination of Engineering Flowsheets. Preparation of operating instructions. Process engineering (or performance) specifications for equipment items. Practice in preparation of engineering designs and drawings.

Unit 5 Safety and Failure Tolerance

S1 L1

Co-requisite: 48.031 Unit 4.

Safe practices. Safety equipment. Handling and storage of hazardous materials. Disaster propagation, implications for plant and storage layout. Failure models, the 'bath-tub' curve. Reliability theory, replacement and standby equipment. Criteria for reliability. Fault tree analysis. Accident analysis. Case histories. Factory visit.

Unit 6 Economics 1

S1 L1

Estimation of capital and operating costs. Components of fixed and variable costs. Break-even charts. Methods of comparing alternatives: rate of return, minimum payback time, incremental return rate, optimization. Depreciation and taxation and their effect on economic analyses. Economic design.

48.032 Chemical Engineering 2B

Unit 1 Solids Handling

S2 L1

Prerequisite: 48.021 Unit 1.

Classification of granular solids and powders according to properties which affect their storage and movement. Storage in and retrieval from stacked piles, silos and hoppers, rules for their design. Feeders and their suitability to various kinds of granular solids. Mechanical conveyors and elevators, distance limitations; hoist height limitations. Rules for design of mechanical conveyors and elevators. Fluid-particle conveyors. Introduction to hydraulic and pneumatic conveyors, feeders and fluid-particle separation

systems. Rules for design of simple slurry transportation and dilute phase pneumatic transportation systems. Practical and economic considerations determining choice of system.

Unit 2 Computation 2

S2 L1T1

Prerequisites: 10.301 or 10.031, 48.022 Unit 2.

Extends material given in Computation 1, and places emphasis on efficient use of FORTRAN AND BASIC, and use of job control language, files and programme packages. Numerical methods are considered for solving linear and non-linear algebraic equations, systems of linear equations (in particular those connected with regression analysis), ordinary and partial differential equations and simple optimization problems. Examples will be drawn from problems arising in chemical process industries; these applications will include formulation and solution of computer models of physical processes, and analysis of laboratory and plant results and fitting of empirical equations to data.

Unit 3 Engineering Thermodynamics

S2 L1

Prerequisite: 48.135.

Engineering applications of thermodynamics. Heat engines, refrigeration.

Unit 4 Economics 2

S2 L1

Prerequisite: 48.031 Unit 6.

Cash flow from trade and investment. Investment, decision criteria. Cost of capital, debt and equity capital, interest rates and opportunity cost. Depreciation, investment allowances and taxation, working capital, liquidity. Discounted cash flow methods of evaluating and comparing alternatives. Comparison of these methods, replacement studies, market forecasts, total demand, leasing versus investment studies, market growth, competition and market share. Plant size and utilization, sizing for future development, simulation studies. Venture analysis, treatment of technological and commercial uncertainties, sensitivity analysis, quantifying risk and combining probabilities. Treatment of risk and ranking of ventures. Case studies.

Unit 5 Surface Separation Processes

S2 L1

Prerequisite: 48.031 Unit 1.

Principles of membrane processes, reverse osmosis, ultrafiltration, dialysis and electrodialysis. Design calculations for batch and continuous operation of reverse osmosis and ultrafiltration equipment. Principles of sorption processes, such as adsorption ion exchange and molecular sieves. Design of fixed-bed sorption equipment. Principles and design of other surface separation processes such as foam and bubble fractionation.

48.033 Chemical Engineering 2C

Unit 1 Mass Transfer (Design)

S2 L1T½

Prerequisite: 48.031 Unit 1.

The design of equipment for absorption, distillation and liquid-liquid extraction. Selection of column type. Design of sieve and other types of plate for plate columns. Design of packed columns. Performance characteristics of plate and packed col-

umns. Selection of equipment for liquid-liquid extraction. Design of mixer settlers and column-type extractors. Factors affecting the performance of liquid-liquid extraction equipment. Other mass transfer equipment.

Unit 2 Heat Transfer 2 (Design) S2 L1

Prerequisite: 48.031 Unit 2.

Thermal design procedures for shell and tube heat exchangers and fin-fan coolers. Service fluids for heating and cooling duties.

Unit 3 Process Vessels S2 L1T½

Prerequisite: 8.6110.

Mechanical design and fabrication of pressure vessels. Code and legal requirements. Design of supports for vertical and horizontal cylindrical vessels. Visualization, freehand sketching and presentation of formal drawings and specifications for pressure vessels and equipment components. Relief valves, bursting discs, venting and draining systems.

Unit 4 Fluid-particle System 1 S2 L1T1

Prerequisite: 48.021 Unit 1.

Interaction between particles and fluids: drag, terminal velocity, sedimentation. Flow through porous media; pressure gradient, filtration, fluidization, dispersion; multiphase flow, irrigated packed columns.

48.036 Chemical Engineering Laboratory 1

Unit 1 and 2 S1 T2 S2 T2

Prerequisites: 48.021, 48.022, 2.102A.

An integrated chemical engineering laboratory incorporating experiments in fluid flow, heat transfer, mass transfer, thermodynamics and kinetics, instrumentation, process dynamics and control. The objectives of this laboratory are: to demonstrate, reinforce and extend the principles of chemical engineering which are covered in Chemical Engineering 1A and B and 2 A-C, 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.

48.039 Electrochemical Engineering 1 S1L1½ T1½

A broad introduction to electrochemistry and its use in the process industries, including caustic/chlorine manufacture and aluminum production.

48.0393 Computer Simulation S2L1½ T1½

An introduction to the use of large scale computer packages for process design and plant management.

48.040 Chemical Engineering Project S1 T1 S2 T11

Prerequisites: 48.031, 48.032, 48.033, 48.036, 48.135, 48.136, 48.163.

The design of plant for the production of chemicals and the

estimation of product costs or an experimental investigation of some aspect of chemical engineering.

48.041 Chemical Engineering 3A

Prerequisite: 48.031.

Unit 1 Convective Mass Transfer S1 L1

Models for convective mass transfer are fixed and free interfaces. Calculation of mass transfer rates at surfaces with simple geometry. Mass transfer in dispersions and in systems involving chemical reaction.

Unit 2 Simultaneous Heat and Mass Transfer S1 L1

Psychometry, principles of design calculations for cooling towers and for humidification-dehumidification operations. Topics selected from: drying of solids, crystallization, sublimation, molecular distillation, gaseous and thermal diffusion.

Unit 3 Multicomponent Separation S1 L1

Prerequisites: 48.031 Unit 1, 48.135.

The separation of multicomponent systems by stagewise operations. Brief review of conventional graphical calculation methods leading to a graphical treatment of ternary distillation. Multicomponent separations using modern computer techniques. Phase equilibrium relationships for liquid-vapour and liquid-liquid systems. Azeotropes and azeotropic distillation.

Unit 4 Transport Phenomena S1 L1

A generalized treatment of the continuum approach to momentum, energy and mass transport. Application of the conservation equations to chemical engineering problems. Discussion of the advantages and limitations of the transport approach.

48.042 Chemical Engineering 3B

Prerequisites: 10.032, 48.163.

Unit 1 Process Dynamics and Control 1 S1 L2T1

Analysis of dynamic systems: derivation of equations for lumped parameter systems, linearization, reduction to transfer functions, numerical solutions. *Control hardware:* basic measuring instruments, control valves, analog controllers, digital computer-based controllers. *Process control:* analysis and synthesis of single feedback loops, using root-locus techniques, stability criteria, and criteria for satisfactory control.

Unit 2 Optimization S1 L1

An introduction to some of the techniques of optimization and their application to problems from the process industries. The methods covered will include single and multiple dimensional search, linear programming and dynamic programming.

48.043 Chemical Engineering 3C

Prerequisites: 48.031, 48.032.

Unit 1 Design Workshop S1 L1T2

Consideration of the ways and means of attempting a design

project, emphasizes to students the need **1.** to study the history and alternatives to the design project, and **2.** to use proper design techniques for the assigned process and equipment. Students are each given a design project or some aspect of it and are expected to produce an appropriate report on their assignments.

Unit 2 Industrial Pollution Control **S1 L2**

Introduction, atmospheric dispersion of pollutants, source and ambient measurement and monitoring. Industrial air pollution control. Water usage in the chemical industry. Pollutants and their effects. Water quality standards. Industrial options, source reduction, water reuse, effluent disposal. Performance and selection of treatment methods. Reliability of treatment methods. Economic aspects. Legislative aspects. Factory visit. Solid waste management. Noise pollution.

48.044 Chemical Engineering Laboratory 2 **S1 T3**

Prerequisites: 48.031, 48.032, 48.033, 48.036, 48.136, 48.163.

An integrated chemical engineering laboratory at a more advanced level than the 48.036 laboratory and with an emphasis on open-ended experiments.

48.046 Chemical Engineering Project **F T6**

Prerequisites: Meritorious performance in Year 3 Chemical Engineering subjects.

48.047 Chemical Engineering 3D

Prerequisites: 48.031, 48.032, 48.033, 48.163, 48.042.

Unit 1 Management **S2 L2**

A workshop comprising exercises and case studies to introduce the human and organizational aspects of managing process or engineering enterprises. Includes discussion of typical organization structures and reasons for choosing them; problems of managing people in organizations, industrial relations questions.

Unit 2 Process Engineering 2 **S1L1 S2T1**

Process synthesis and analysis with particular reference to separation process sequences and heat exchanger networks. Process diagnostics: detection, location and identification of malfunctions in a simulated chemical plant. Selection of most appropriate remedies. Studies of repair and maintenance practices, onstream corrections versus those requiring process shut-down. Temporary and permanent corrections. Exercise in fault analysis and correction using cases from practice.

Unit 3 Process Dynamics and Control 2 **S2 L1T1**

Frequency response analysis and synthesis techniques. Control of dead time and distributed systems. Cascade feedforward and other multiloop systems. Introduction to analysis of multivariable systems. Identification and estimation techniques. Digital implementation of control algorithms.

48.090 Industrial Experience

Students are expected to accumulate, by the end of the four year course, twelve weeks of industrial experience gained during recesses.

48.113 Chemistry of Industrial Processes **F L1T2**

Prerequisite: 2.102A. *Co- or prerequisites:* 2.102B, 2.102C.

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 ethylene and acetylene, elastomers. *Laboratory:* students are required to attend lectures on report writing, carry out laboratory assignments and attend factory inspections at local and country centres as required.

48.115 Industrial Electrochemistry **S1 or S2 L2**

Prerequisites: 48.113, 48.138.

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.

48.116 Water Chemistry **S1 or S2 L2**

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

48.124 Applied Kinetics **S1 L1T1**

Prerequisites: 48.138, 48.136.

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

48.125 Industrial Chemistry 1A **S1 L1½T2½ S2 L½T½**

Comprises 48.021 Units 1 and 2.

48.126 Industrial Chemistry 1B **S1 L1 and S2 L3**

Comprises 48.022 Units 1 and 2.

48.134 Applied Thermodynamics **S1 L1T1**

Prerequisites: 48.135, 48.171.

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.

48.135 Thermodynamics

S1 L2T1

Co- or prerequisite: 2.102A.

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.

48.136 Reactor Design 1

S1 L1 S2 L2

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 in series and parallel, mixed flow reactors of different sizes in series, recycle reactor, 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.

48.137 Industrial Chemistry 2A

S1 L2

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

48.138 Industrial Chemistry 2B

S2 L2T1

Consists of Computation 2, normally given to chemical engineering students in 48.032, and a course on electro chemical kinetics to complement material given in 48.136.

48.139 Experimental Design

S2 L1T1

Design of experiments, correlation and regression, quality control. Use of graphical methods, fitting empirical equations to experimental data. Preparation of nomograms using constructional determinants.

48.143 Introduction to Analog Computation

Eight two-hour periods devoted to lectures, demonstrations and laboratory exercises. Analog computation, theory and application of analog computing elements, analog computer programming, solution of linear differential equations with constant

coefficients, equation ordering and the elementary principles of modelling. Illustration by examples.

48.163 Instrumentation and Process Control 1

S2 L2T1

Prerequisites: 10.031, 48.122 or 2.102D. Co- or prerequisite: 48.113.

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 parameter dynamics systems; first, second and higher order and integrating systems. *Process Control:* closed loop, block diagrams, controllers and controller tuning.

48.165 Laboratory Automation Science

S1 L1½T2½

Prerequisite: 48.163.

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.

48.166 Microprocessors in Analytical Instrumentation

S1 or S2 L1T1

Prerequisite: 1.9222. Co-requisite 48.165.

Computer interfacing to analytical instrumentation at a more fundamental level than that encountered in 48.165, Laboratory Automation Science, and is suited to students who envisage working in a research and development environment, where greater flexibility and a more innovative approach are needed in data acquisition and control operations. Transducers. Instrumentation amplifiers. Signal filtering, conditioning, and processing. Data conversion systems. Principles of instrument interfacing. Interface hardware. Typical analytical instrumentation interfaces.

48.171 Chemistry of High Temperature Materials

S2 L2

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.

48.172 Instrumental Analysis 2

S1 L2T2

Theory and application of: high performance liquid chromatography. G.C./mass spectroscopy, non-dispersive infra-red spectroscopy and particle size analysis. The case of continuous analysis. The interfacing of analytical instruments to computers. On-line sampling techniques with particular reference to chromatographic analyses. Water quality analysis.

48.174 Seminar**F T2**

Students are required to delivery 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.

48.194 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.

Servicing Subjects

These are subjects taught within courses offered by other faculties.

For further information regarding the following subjects see the Combined Sciences Handbook.

48.101 Computation and Modelling in Applied Chemistry

Not offered in 1988.

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

48.412 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.

42.105 Biological Process Engineering**F L2T4**

Prerequisite: 44.101.

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 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.

48.240 Biological Process Engineering Project**S1 T1 S2 T11**

Project in Biological Process Engineering for students in Chemical Engineering.

Department of Fuel Technology

48.301 Fuel Engineering (for Mining Engineers) **F L2T1**

An elective introductory subject in fuels and energy for Mining Engineering students based on the subject 48.311 Fuel Engineering 1, supplemented by appropriate laboratory experiments (consisting of 28 lectures and 14 hours of laboratory classes per session, taught over two sessions).

48.302 Fuels and Energy**S2 L2T2**

A servicing subject for students in Electrical Engineering which deals with sources and properties of fuels (with particular emphasis on coal, crude oil and natural gas), principles of combustion including combustion calculations and the technology of boilers and other fuel plant. Other energy sources including solar energy and nuclear energy are discussed. The national and global situation is reviewed.

48.303 Fuel Science for Industrial Chemists**S1 or S2 L2**

Units 1 and 4 of 48.321 Fuel Engineering 2.

Reaction mechanisms of various oxidation reactions. Combustion in internal combustion engines. Types of flames: laminar, turbulent, diffusion, aerated. Formation of carbon and NO in flames. Gas flow, gas analysis, solids. Measurement of temperatures of flames and surfaces. Temperature calculation: theoretical, graphical. H-t charts and their applications.

48.311 Fuel Engineering 1**F L2**

Prerequisites: 1.001 or 1.011, 2.121, 2.131, or 2.141, 5.010, 5.030, 10.001 or 10.011.

Unit 1 Fuels and Energy Sources and Properties**S1 or S2 L1**

Fossil Fuels: coal, oil, gas; origin, occurrence in Australia; storage, sampling and analysis; properties and their significance; classification. Other energy sources; nuclear, solar, wind, water, etc.

Unit 2 Energy Conversion**S1 or S2 L1**

Principles of combustion of solid, liquid and gaseous fuels. Limits of inflammability, burning velocity, ignition temperature. Design principles of burners, combustion efficiency, excess air, air supply.

Unit 3 Fuel Processing

S1 or S2 L1

Crude oil, refinery flow patterns. General methods of gas making. Carbonization and the production of metallurgical coke.

Unit 4 Fuel Plant Technology

S1 or S2 L1

Design principles of boilers. Boiler water conditioning. Introduction to furnaces, ovens, kilns, etc.

48.321 Fuel Engineering 2

Unit 1 Combustion — Fundamentals and Science

S1 or S2 L1

Reaction mechanisms of various oxidation reactions. Combustion in internal combustion engines. Types of flames; laminar, turbulent, diffusion, aerated. Formation of carbon and NO in flames.

Unit 2 Principles of Gasification

S1 or S2 L1

Thermodynamics of basic reactions and calculation of equilibrium compositions. The production of fuel and synthesis gases, controlled furnaces atmospheres; gas purification.

Unit 3 Radiation Heat Transfer and Engineering Applications

S1 or S2 L1

Numerical and analogue methods of problem solution in radiative heat transfer. Gas and flame radiation in combustion systems (non-luminous and luminous).

Unit 4 Measurements in Flames and Furnaces

S1 or S2 L1

Gas flow, gas analysis, solids. Measurement of temperatures of flames and surfaces. Temperature calculation, theoretical, graphical, H-t charts and their application.

Unit 5 Laboratory

F T1

Analysis and characterization of solid, liquid and gaseous fuels.

48.331 Fuel Engineering 3

Unit 1 Combustion Engineering

S1 or S2 L1

Droplet burning, combustion of sprays. Flame stabilization. Coal combustion, burn out. Effects of fuel impurities.

Unit 2 Furnace Design

S1 or S2 L1

Furnace design for continuous or intermittent operation.

Unit 3 Fuel Plant Design

S1 or S2 L1

Heat recovery plant design. Flow in furnaces. Refractories. Process steam.

Unit 4 Fuel Conservation and Efficiency

S1 or S2 T1

A case history and investigative approach to energy saving in industrial, commercial and domestic applications.

Unit 5 Liquid Fuels

S1 or S2 L1

Constitution of mineral oils. Classification. Specifications. Correlation of properties. Properties of liquid fuels from petroleum and for synthesis, hydrogenation and pyrolysis of coal.

Unit 6 Coal and its Evaluation

S1 or S2 L1

Constitution, classification and evaluation of coals. Carbonization: blending, additives, plastic behaviour.

Unit 7 Laboratory

F T3

48.340 Fuel Engineering Project

S1 T1 S2 T11

Projects selected involving the design of fuel plant or experimental aspects of fuel science and/or processing and utilization.

Department of Polymer Science

48.403 Polymer Science

F L2T1

Prerequisites: 2.102A, 2.102B, 10.031, 10.301. *Co- or prerequisites:* 48.001, 48.113.

Polymerization processes; step growth and chain growth (free radical and ionic), stereospecific catalysts. Methods of polymerization: bulk suspension, emulsion, solution, high pressure. Industrial examples. Principles of analysis of polymers using chemical and instrumental methods. Molecular weight applied to macromolecules: number-, weight-, viscosity- and z-average weights. Molecular weight distribution. Thermodynamics of polymer solutions, theta solvent. Measurement of molecular weight. Fractionation methods. Conformation of a polymer chain. The crystalline state. The amorphous state. Stress/strain behaviour. Creep. Impact. Rubber elasticity. Dynamic mechanical properties. Principles of operation of polymer processing equipment; safety procedures. Polymer compound design.

48.404 Advanced Polymer Science

S1 or S2 L2

Prerequisite: 48.403.

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

20.303G Well Drilling & Completions

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.

20.305G Drilling & Production Laboratory

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

20.306G Petroleum Production Economics

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.

20.309G Reservoir Engineering

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.

20.403G Production Engineering

Well inflow performance. Simple and multiphase flow in horizontal, vertical and inclined pipe. Choke performance. Natural flow. Methods and design of artificial lift systems. Gas lift. Plunger lift. Sucker rod pumping. Hydraulic pumping. Jet pumping. Electric submersible pumps and others. Surface facilities.

20.406G Reservoir Simulation Fundamentals

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.

20.409G Petroleum Engineering Project

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.

20.410G Well Pressure Testing

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.

20.411G Formation Evaluation

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.

20.501G 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.

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.

48.063G Industrial Water and Wastewater Engineering

S1 or S2 L3

Environmental consequences of water pollution. Water quality criteria and regulations related to industrial use and disposal. Water sources and requirements of industry. Theoretical and practical aspects of treatment methods, including screening, sedimentation, oil separation, coagulation and flocculation, filtration, biological treatment, adsorption, ion exchange, membrane processes. Strategies for industry including waste surveys, prevention at source, correction before discharge water reuse. Economic aspects. Seminars. Factory visits/laboratory.

48.070G Process Principles

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

48.081G 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.

48.082G 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.

48.084G 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 multi-loop systems; non-linear systems; digital control and data-logging, sequencing control.

48.085G 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.

48.086G Fluid Particle Interactions

Fundamentals. Particle drag in an infinite laminar fluid, effect of turbulence and acceleration. Drag and rotation in shear flow. Multiparticulate 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, bubble-phase 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.

48.089G 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.

48.090G Specialist Lectures

48.091G 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:* partition 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.

48.092G 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.

48.093G 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.

48.131G Catalysts and Applied Reaction Kinetics

S1 or S2 L2T4

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.

48.150G Instrumental Analysis for Industry

F L1T2

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.

48.161G Electrochemical Techniques for Control and Analysis

S1 or S2 L2T4

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.

48.180G Corrosion Materials

F L2

Metallic: types available, properties and applications for each of the following: cast irons, alloy cast irons, carbon steels, low alloy steels, stainless steel, special alloys. The following metals and their alloys: aluminium, copper, nickel, titanium, lead, zinc, magnesium, tin, cadmium, chromium, cobalt. Refractory metals: molybdenum, tantalum, tungsten, zirconium. Noble metals: gold, platinum, silver.

48.181G Industrial Coatings for Corrosion Protection

S1 L2

Special topics on heavy-duty organic, inorganic and metallic coatings used in atmospheric, marine and industrial environments.

48.182G Non-metallic Materials for Corrosion Resistance

S1 L2

Thermosetting and thermoplastic polymers; natural and synthetic rubbers; glasses and glass linings; acid resisting ceramics; refractories.

48.183G 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.

48.184G Corrosion Project

A substantial project on some aspect of corrosion science or technology.

48.382G 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.

48.383G 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.

48.384G 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.

48.385G 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.

48.386G 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.

48.388X Unit Operations in Wastewater, Sludge and Solid Waste Management

Physical wastewater treatment processes including sedimentation, flotation, flocculation, precipitation. Sludge management including conditioning, filtering, lagoons, drying. Introductory fuel engineering. Combustion principles. Incineration. Pyrolysis. Gasification. Resource recovery and recycling. Incinerator and afterburner design.

48.387G Fuel Technology Practice

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

48.391G Atmospheric Pollution and Control (Theory)

S1 or S2 L3

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

Department of Fuel Technology

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

48.380G Fuel Seminar

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

**48.391X Atmospheric Pollution
and Control (Theory)**

S1 or S2 L3

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

**48.392G Practical Aspects of Air Pollution
Measurement and Control**

S1 or S2 T3

Prerequisite: 48.391G 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.

48.900G Major Project

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

48.901G Minor Project

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

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.

**48.410G Analytical Characterization
of Polymers**

S1 or S2 L3T3

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.

48.430G Polymer Engineering

S1 or S2 L4T2

Natural and synthetic elastomers; vulcanization, theory and method. Cross-linked thermoplastics. Extrusion. Press, injection and transfer moulding. Adhesives. Heat sealing and welding. Latexes. 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.

48.440G Polymer Physics

S1 or S2 L4T2

Chain dimensions. Diffusion and viscosity. Segmental motion and the glass temperature T_g ; factors affecting T_g . 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.

48.900G Major Project

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

48.901G 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

48.400G Polymer Science

F L3T3

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-

**School of
Fibre Science and Technology**

School of Fibre Science and Technology

Head of School

Associate 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 streams 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 the rural and manufacturing industries, both of which are critically important in the economy of Australia.

Department of Textile Technology

Head of Department

Associate Professor R. 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

School of Fibre Science and Technology

Associate Professor, Head of School and Head of Department of Textile Technology

Ross Ernest Griffith, BSc N.S.W., PhD Leeds, CText, ATI

Department of Textile Technology

Associate Professor and Head of Department

Ross Ernest Griffith, BSc N.S.W., PhD Leeds, CText, ATI

Professor of Textile Physics

Ronald Postle, BSc N.S.W. PhD Leeds, CText, FTI, FAIP

Senior Lecturers

John Ilmar Curiskis, BSc PhD N.S.W., GAIP

Nigel Anthony Gull Johnson, BSc N.S.W., PhD Leeds, CText, ATI

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

Lecturer

Shontha David MSc Waik. N.Z. PhD Br.Col.

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., FTI

Michael David Young, BSc PhD N.S.W., CText, ATI

Associate Professors

John William James, BA Wld., DSc N.S.W.

Walter Ragnall McManus, BScAgr Syd., PhD N.S.W.

Euan Maurice Roberts, MAgrSc N.Z., PhD N.S.W.

Senior Lecturers

Stephen James Filan, BAgEc N.E., MSc N.S.W., MAIAS

Douglas McPherson Murray, BAgSc PhD Melb., MRurSc N.E.

Dennis Charles Teasdale, BSc MBA N.S.W. CText, ATI

Lecturer

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

Senior Instructor

Ronald Edward Sallaway

Professional Officers

David John Petrie, BSc N.S.W.

Ian Rowden McRae, BSc (Forestry) A.N.U., MSc N.S.W.

Department of Wool and Animal Science

Associate Professor and Head of Department of Wool and Animal Science

John Patrick Kennedy, MSc N.S.W., Bsc Oxf., FAIAS

Course Outlines

Undergraduate Study

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.

General Education Electives

For details of changes in the General Education requirements refer to the table earlier in this section.

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.

Year 1 (All courses)

		Hours per week	
		S1	S2
1.001	Physics 1	6	6
2.121	Chemistry 1A	6	0
2.131	Chemistry 1B	0	6
5.0011	Engineering Mechanics 1, and	4	0
5.0012	Introductory Engineering Design and Material Science, or	2	0
9.510	Natural Fibre Production	6	0
10.001	Mathematics 1	6	0
13.100	Fibre Science	0	6
		24	24

*Students may be allowed, at the discretion of the Head of School, to substitute 1.021 Introductory Physics for 1.001 Physics 1. It should be noted that 1.021 Introductory Physics is not sufficient for entry into the Textile Physics or Textile Engineering options.

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.

Textile Chemistry

Year 2

		Hours per week	
		S1	S2
2.102A	Physical Chemistry	6	0
2.102B	Organic Chemistry	0	6
10.301	Statistics SA	2	2
13.200	Computing Applications	4	0
13.201	Textile Science 1	0	2
13.202	Textile Testing 1	0	4
13.203A	Yarn Technology 1A	2½	0
13.203B	Yarn Technology 1B	0	2½
13.204A	Fabric Technology 1A	2½	0
13.204B	Fabric Technology 1B	0	2½
13.208	Textile Engineering 1	2	0
48.122	Instrumental Analysis	3	3
	General Studies Elective	2	2
		24	24

Year 3

2.103B	Organic Chemistry	6	0
13.301	Textile Science 2	4	0
13.302A	Textile Testing 2A	3	0
13.302B	Textile Testing 2B	0	4
13.303A	Yarn Technology 2A	3½	0
13.303B	Yarn Technology 2B	0	2½
13.304A	Fabric Technology 2A	3½	0
13.304B	Fabric Technology 2B	0	2½
13.306A	Colour Science	3	0
13.306B	Colouration Technology	0	4
13.308	Textile Engineering 2	0	4
	General Studies Elective	2	2
		25	19

Plus one of the following Chemistry electives

2.102C	Inorganic Chemistry and Structure	0	6
2.113B	Synthetic Organic Chemistry	0	6
2.133B	Applied Organic Chemistry	0	6

Textile Physics

Year 2		Hours per week	
		S1	S2
1.002	Mechanics, Waves and Optics	4	0
1.012	Electromagnetism and Thermal Physics	0	4
10.301	Statistics SA	2	2
10.2111	Vector Calculus	2½	0
10.2112	Mathematical Methods for Differential Equations	0	2½
13.200	Computing Applications	4	0
13.201	Textile Science 1	0	2
13.202	Textile Testing 1	0	4
13.203A	Yarn Technology 1A	2½	0
13.203B	Yarn Technology 1B	0	2½
13.204A	Fabric Technology 1A	2½	0
13.204B	Fabric Technology 1B	0	2½
13.208	Textile Engineering 1	2	0
	General Studies Elective	2	2
		<u>21½</u>	<u>21</u>

Plus one of the following subjects

1.022	Modern Physics*	2	2
1.032	Laboratory*	3	3

*Students should note that particular electives in Year 3 require one or other of these subjects as pre-requisites.

Year 3

13.301	Textile Science 2	2	2
13.302A	Textile Testing 2A	3	0
13.302B	Textile Testing 2B	0	4
13.303A	Yarn Technology 2A	3½	0
13.303B	Yarn Technology 2B	0	2½
13.304A	Fabric Technology 2A	3½	0
13.304B	Fabric Technology 2B	0	2½
13.306A	Colour Science	3	0
13.306B	Colouration Technology	0	4
13.308	Textile Engineering 2	0	4
	General Studies Elective	2	2
		<u>19</u>	<u>19</u>

Plus one of the following subjects

1.022	Modern Physics*	2	2
1.032	Laboratory*	3	3

*The subject to be taken will be that one not chosen in Year 2.

Plus Physics electives (minimum 6 session hours)

1.023	Statistical Mechanics and Solid State Physics	4	0
1.0343	Advanced Optics	0	2
1.0533	Experimental Physics B1	4	0
1.0543	Experimental Physics B2	0	4
1.1433	Biophysics	3	0
1.1533	Biophysics Techniques	0	3
1.3033	Mechanical Properties of Materials	2	0
1.713	Advanced Laser and Optical Applications	2	2
1.9422	Introduction to Physics of Measurement	3	0

Textile Engineering

Year 2		Hours per week	
		S1	S2
5.0300	Graphical Analysis and Communication	0	3
5.3021	Engineering Mechanics 2A	3	0
5.3022	Engineering Mechanics 2B	0	2
5.620	Fluid Mechanics 1	2	2
8.6110	Structures	3	0
10.031	Mathematics	2	2
10.301	Statistics SA	2	2
13.200	Computing Applications	4	0
13.201	Textile Science 1	0	2
13.202	Textile Testing 1	0	4
13.203A	Yarn Technology 1A	2½	0
13.203B	Yarn Technology 1B	0	2½
13.204A	Fabric Technology 1A	2½	0
13.204B	Fabric Technology 1B	0	2½
13.208	Textile Engineering 1	2	0
	General Studies Electives	2	2
		<u>25</u>	<u>24</u>

Year 3

5.626	Thermodynamics 1	2	2
6.854	Electrical Power Engineering	0	3
6.856	Electronics for Measurement & Control	3	0
13.301	Textile Science 2	4	0
13.302A	Textile Testing 2A	3	0
13.302B	Textile Testing 2B	0	4
13.303A	Yarn Technology 2A	3½	0
13.303B	Yarn Technology 2B	0	2½
13.304A	Fabric Technology 2A	3½	0
13.304B	Fabric Technology 2B	0	2½
13.306A	Colour Science	3	0
13.306B	Colouration Technology	0	4
13.308	Textile Engineering 2	0	4
	General Studies Electives	2	2
		<u>24</u>	<u>24</u>

Year 4 (All Options)

13.400	Textile Industry Studies	2	0
13.401A	Textile Science 3A	2	0
13.401B	Textile Science 3B	0	2
13.404	Fabric Technology 3	2	0
13.405A	Finishing Technology A	4	0
13.405B	Finishing Technology B	0	4
13.460	Processing Laboratory	1½	1½
13.470	Seminar	1½	1½
13.480	Project	7	7
18.1211	Production Management A	3	0
18.1212	Production Management B	0	3
	General Studies Electives	2	2
		<u>25</u>	<u>21</u>

Plus one advanced Textile Option

13.451	Advanced Textile Physics	0	2
13.456	Advanced Textile Chemistry	0	2
13.458	Advanced Textile Engineering	0	2

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, Managerial Marketing.

Year 1		Hours per week	
		S1	S2
1.001	Physics 1, or	6	6
1.021	Introductory Physics		
2.111	Introductory Chemistry, or	6	0
2.121	Chemistry 1A		
10.001	Mathematics 1, or	6	6
10.021B	General Mathematics 1B and		
10.021C	General Mathematics 1C		
13.100	Fibre Science	0	6
15.101E	Microeconomics 1	3½	0
15.102E	Macroeconomics 1	0	3½
		<u>21½</u>	<u>21½</u>

Year 2			
10.301	Statistics SA	2	2
13.200	Computing Applications	4	0
13.201	Textile Science 1	0	2
13.202	Textile Testing 1	0	4
13.203A	Yarn Technology 1A	2½	0
13.203B	Yarn Technology 1B	0	2½
13.204A	Fabric Technology 1A	2½	0
13.204B	Fabric Technology 1B	0	2½
13.208	Textile Engineering 1	2	0
14.501	Accounting and Financial Management 1A	4½	0
14.511	Accounting and Financial Management 1B	0	4½
28.012	Marketing Systems	4	0
28.052	Marketing Research	0	4
	General Studies Elective	2	2
		<u>23½</u>	<u>23½</u>

Year 3			
13.301	Textile Science 2	4	0
13.302A	Textile Testing 2A	3	0
13.302B	Textile Testing 2B	0	4
13.303A	Yarn Technology 2A	3½	0
13.303B	Yarn Technology 2B	0	2½
13.304A	Fabric Technology 2A	3½	0
13.304B	Fabric Technology 2B	0	2½
13.306A	Colour Science	3	0
13.306B	Colouration Technology	0	4
13.308	Textile Engineering 2	0	4
	General Studies Electives	2	2
		<u>19</u>	<u>19</u>

Plus 2 of the following Commerce electives

14.522	Accounting and Financial Management 2A	4½	or	4½
14.542	Accounting and Financial Management 2B	4½	or	4½
14.602	Computer Information Systems 1	3	or	3
14.606	Management Information Systems Design	0		3
14.613	Business Finance 2A	3	or	3
14.774	Legal Environment of Commerce	3	or	3
14.776	Legal Regulation of Commerce	3	or	3
15.203E	Applied Microeconomics	3½	or	3½
15.204E	Applied Macroeconomics	3½	or	3½
15.246H	Management Strategy and Business Development	0		3½
15.511	Industrial Relations 1A	3½	or	3½
28.073	Strategic Marketing	4		0
28.083	Managerial Marketing	0		4

Year 4			
13.400	Textile Industry Studies	2	0
13.401A	Textile Science 3A	2	0
13.401B	Textile Science 3B	0	2
13.404	Fabric Technology 3	2	0
13.405A	Finishing Technology A	4	0
13.405B	Finishing Technology B	0	4
13.457	Advanced Textile Management	0	2
13.460	Processing Laboratory	1½	1½
13.470	Seminar	1½	1½
13.480	Project	7	7
18.1211	Production Management A	3	0
18.1212	Production Management B	0	3
	General Studies Electives	2	2
		<u>25</u>	<u>23</u>

Note: Students who enrolled in Year 1 1987 will substitute 15.001 and 15.011 for 28.012 and 28.052 in Year 2. In Year 3 those students must take 28.012 and 28.052 in lieu of Commerce electives.

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, rangeland 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 Agriculture Science.

The Department also offers a course requiring one year of full-time or two years of part-time study leading to the award of the Graduate Diploma in Wool and Pastoral Sciences. Research may also be undertaken for the award of the degrees of Master of Science and Doctor of Philosophy.

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.

General Education Electives

For details of changes in the General Education requirements refer to the table earlier in this section.

3220

Wool and Pastoral Sciences — Full-time Course

Bachelor of Science BSc

Year 1

		Hours per week	
		S1	S2
2.121	Chemistry 1A	6	0
2.131	Chemistry 1B	0	6
9.510	Natural Fibre Production	6	0
10.001	Mathematics 1 or	6	6
10.011	Higher Mathematics 1 or	6	6
10.021B	General Mathematics 1B and	6	0
10.021C	General Mathematics 1C	0	6
13.100	Fibre Science	0	6
17.031	Biology A	6	0
17.041	Biology B	0	6
		24	24

Year 2

2.003J	Agricultural and Biological Chemistry	6	0
9.111	Livestock Production 1	2	2
9.201	Agronomy	3	6
9.301	Agricultural Economics and Management	3	3
9.501	Wool Science 1	3	3
9.601	Animal Physiology 1	0	6
10.301	Statistics SA	2	2
13.200	Computing Applications	4	0
	General Education Elective	2	2
		25	24

Year 3

9.131	Animal Health and Welfare	3	0
9.202	Pastoral Agronomy	4	4
9.421	Animal Nutrition	0	4
9.502	Wool Science 2	3	3
9.801	Genetics 1	3	3
9.811	Biostatistics 1	4	0
41.101	Biochemistry	6	6
	General Education Elective	2	2
		25	22

Plus one of the three available options

9.112	Livestock Production 2	0	3
9.203	Crop Agronomy*	0	3
9.204	Range Management*	0	3
9.504	Wool Marketing	0	3
		25	25

* Available in alternate years

Year 4

9.001	Project	6	6
9.002	Seminar	2	2
	General Education Elective	2	2

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

Optional subjects**Group A**

9.112	Livestock Production 2	0	3
9.113	Livestock Production 3	3	3
9.132	Animal Health 2	3	0
9.203	Crop Agronomy*	0	3
9.204	Range Management*	0	3
9.503	Wool Science 3	4	4
9.504	Wool Marketing	0	3
9.802	Genetics 2	4	4
9.812	Biostatistics 2	0	4
9.901	Rural Extension	4	0

*Available in alternate years

Group B

27.175	Introduction to Remote Sensing	4	0
27.176	Remote Sensing Applications	0	4
28.012	Marketing Systems	4	0
28.052	Marketing Research	0	4
43.121	Environmental Physiology	0	6
43.142	Environmental Botany	6	0
44.101	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.

The Head of the Department is pleased to give information about research scholarships, fellowships and Department research activities. Graduates are advised to consult the Head of Department before making a formal application for registration.

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.

Core Subjects	Hours per week	
	S1	S2
13.711G Fibre Science A	2	0
13.721G Fibre Science B	0	2
13.712G Textile Testing A	4	0
13.722G Textile Testing B	0	4
13.717G Textile Technology	1½	1½
13.727G Textile Technology Dissertation	1½	1½
	<u>9</u>	<u>9</u>

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the School of Fibre Science and Technology and Heads of the other School's concerned, to complete a program equivalent to an average of 18 hours per week for two sessions of full-time study.

Optional Subjects

13.713G Yarn Technology A	4½	0
13.723G Yarn Technology B	0	4½
13.714G Fabric Technology A	4½	0
13.724G Fabric Technology B	0	4½

13.715G	Finishing Technology A	5	0
13.725G	Finishing Technology B	0	5
13.716G	Colour Science	4	0
13.726G	Dyeing Technology	0	4

Candidates wishing to specialize in the theory and practice of yarn and fabric technology (engineering/physics orientation) should undertake the optional subjects 13.713G, 13.723G, 13.714G and 13.724G. Candidates wishing to specialize in the science and technology of textile dyeing and finishing (chemistry orientation) should undertake the optional subjects 13.715G, 13.725G, 13.716G, and 13.726G.

		Hours per week
9.105G	Livestock Production	6
9.205G	Range Management	4
9.504G	Wool Science	6
9.803G	Animal Breeding	4
9.813G	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.

Department of Wool and Animal Science

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 either in one year on a full-time basis or over two years on a part-time basis. Students are required to carry out full-time study or its equivalent 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:

5025 Arid Land Management Graduate Diploma Course

Graduate Diploma GradDip

- Range Management
- Management of Pastoral Enterprise

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

Subject Descriptions

Undergraduate Study Fibre Science

Department of Wool and Animal Science

9.001 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.

9.002 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.

9.111 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.

9.112 Livestock Production 2

S2 L2T1

Prerequisite: 9.111.

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.

9.113 Livestock Production 3

F L1T2

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.

9.131 Animal Health and Welfare 1

S1 L2T1

Prerequisite: 9.111.

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.

9.132 Animal Health 2

S1 L2T1

Prerequisite: 9.131.

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. Applied Science

9.201 Agronomy

S1 L2T1 S2 L3T3

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.

9.202 Pastoral Agronomy

F L3T1

Prerequisite: 9.201.

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.

9.203 Crop Agronomy

S2 L2T1

Prerequisite: 9.201.

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

9.204 Range Management

S2 L1T2

Co- or prerequisite: 9.202.

Basic range ecology and rangeland ecosystems. Plant physiology — growth and development of rangeland plants. Rangeland management practices. Monitoring of long-term 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 semi-arid 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.

9.301 Agricultural Economics and Management 1

F L2T1

The subjects covers two broad strands: basic economic principles, and applied methods for farm management planning. The material on economic principles centres on 1. the theory of production economics, which provides the background for many of the tools of applied farm management; and 2. price theory with emphasis on agricultural markets.

The management planning strand emphasizes basic farm planning procedures such as partial, whole-farm and parametric budgeting, and gross margins analysis. As necessary background for the application of such methods, the course also includes coverage of valuation principles, land tenure, systems of title, discounting procedures, depreciation methods, tax and credit structures, and discussion of the design and use of farm record systems.

9.421 Animal Nutrition

S2 L3T1

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.

9.501 Wool Science 1

F L2T1

Fibre structure; physical and chemical properties, variability of fibre properties. Physical fleece characteristics; fleece defects. Early stage processing and yarn manufacture.

9.502 Wool Science 2

F L2T1

Clip preparation. Wool metrology (raw wool). Wool marketing procedures. Fabric manufacture, dyeing and finishing.

9.503 Wool Science 3

F L2T2

Evaluation and typing of wool. Topmaking and special processes. Wool metrology (semi-processed and processed). Controlling mill quality control. The cashmere and mohair industries. Research developments.

9.504 Wool Marketing

S2 L2T1

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

9.510 Natural Fibre Production

S1 L3T3

Wool and other animal fibres: fibre and skin biology; mechanisms of, and factors affecting, fibre growth, fibre morphology; introduction to fibre production, harvesting, preparation for sale

and marketing. Cotton: cotton growth; fibre morphology; factors affecting fibre growth; fibre production harvesting, handling and marketing.

Production statistics and economics of natural fibre production in Australia contrasted to world fibre production.

9.601 Animal Physiology 1

S2 L3T3

Prerequisite: 17.041.

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.

9.801 Genetics 1

F L2T1

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 cross-breeding. Genetics applied to animal and plant improvement. Applications of genetics in sheep and wool production.

9.802 Genetics 2

F L2T2

Prerequisite: 9.801.

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. Genetic homeostasis, Genotype — environment interaction. Heterosis and its utilization. Interaction of natural and artificial selection. Limits of selective progress.

9.811 Biostatistics 1

S1 L2T2

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.

9.812 Biostatistics 2

S2 L2T2

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

9.901 Rural Extension

S1 L2T2

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.

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 School.

13.100 Fibre Science S2 L3T3

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

13.200 Computing Applications SS L2T2

Introduction to computer architectures: microcomputers and mainframes; peripheral devices; communications networks. Hardware and software concepts; firmware and operating systems. Introduction to computer programming: program control, structure, logic and debugging; levels of programming languages; simple algorithms; 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; data analysis, statistical packages; modelling and optimisation techniques; databases, spreadsheets, text/wordprocessing; recent developments and future trends.

13.201 Textile Science 1 SS L2

Fibre structure, reflection and lustre. Optical microscopy. Electron microscopy. Morphological and fine structure of fibres. Crystallinity of synthetic polymers. X-ray diffraction. Molecular structure of proteins. Optical properties and molecular chain orientation of fibres. Infra-red spectroscopy. Production of man-made fibres. Fibre rheology, moisture sorption. Addition and condensation polymerisation. Chemical constitution and reactivity of natural and man-made fibres.

13.202 Textile Testing 1 SS L2T2

Historical development. Significance and use of textile testing and quality control. The statistical basis of sampling. Practical and economic aspects of sampling. Length and transverse dimensions. Moisture measurement. Yarn properties; linear density, twist, evenness, tension and friction. Fabric properties; mechanical.

13.203A Yarn Technology 1A SS L1T1½

Principles of staple fibre preparation: cleaning, blending, carding, drawing, combing.

13.203B Yarn Technology 1B SS L1T1½

Yarn forming principles; properties of twisted fibrous assemblies; twist insertion; ring spinning; winding; rotor spinning; yarn twisting.

13.204A Fabric Technology 1A SS L1T1½

Principles of weaving. Mechanics of shedding, picking, and beating up; shuttle and gripper/projectile weaving. Secondary and auxiliary mechanisms of looms. Woven cloth construction principles and weave representation; basic weave structures. Yarn preparation for weaving.

13.204B Fabric Technology 1B SS L1T1½

Principles of Knitting. Techniques of loop formation in weft and warp knitting; essential knitting machine mechanisms. Knitted cloth construction principles and knitted structure representations; basic knitted structures. Yarn preparation for knitting.

13.208 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.

13.301 Textile Science 2 SS L2T2

Fibrous structures. Friction and viscoelasticity. Heat and moisture. Yarn structures. Fibre migration in yarns. Mechanics of continuous filament yarns, staple-fibre yarns and textured yarns. Friction and lubrication of textiles. Friction in textile processing. Static electrification of textiles.

13.302A Textile Testing 2A SS L1T2

Significance and measurement of drape, handle, crease resistance and recovery. Wear testing; abrasion and pilling. Colourfastness. Dimensional stability.

13.302B Textile Testing 2B SS L2T2

Permeability properties; air, water, water vapour. Textile flammability. Damage in textiles. User serviceability testing. Consumer problems. Care-labelling. Process and quality control.

13.303A Yarn Technology 2A SS L2T1½

Traditional staple fibrous systems: cotton, worsted, woollen. Special systems for other fibres such as mohair, silk, flax, etc. Productivity and quality in yarn production. Alternative yarn forming methods. Automation.

13.303B Yarn Technology 2B SS L1T1½

Processing of continuous filament yarns; throwing, false-twist texturing, air-jet texturing, other texturing methods. Staple conversion of man-made fibres.

13.304A Fabric Technology 2A**SS L2T½**

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 auxiliary mechanisms for extended design effects in Tricot and Raschel warp knitting; derivative warp knitted structures. Double needle bed warp knitting; applications. Stitch-bonded and non woven fabric manufacture.

13.304B Fabric Technology 2B**SS L1T1½**

Elements of woven fabric design; colour and weave effects; derivative woven structures; compound cloth structures. Single-phase shuttleless weaving; rapier and jet weaving. Multiphase weaving; warp and weft-way phasing; circular weaving. Leno and narrow fabric weaving.

13.306A Colour Science**SS L2T1**

Aspects of colour, colour mixing and colour vision. Introduction to absorptiometry, spectrophotometry and tristimulus colorimetry. Measurement and specification of colour. Applications of colour measurement. Computer aided colour matching.

13.306B Colouration Technology**SS L2T2**

Classification of dyes and their methods of application, general properties of dyes, dyeing auxiliaries and after treatments. Mill water supplies and their treatment, dyehouse effluent treatment. Textile printing methods. Textile dyeing machinery. Recent developments in dyeing technology.

13.308 Textile Engineering 2**SS L3T1**

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

13.400 Textile Industry Studies**SS LT2**

Garment manufacturing technology. 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.

13.401A Textile Science 3A**SS L2**

Structure of fabrics. Fabric mechanical properties. Woven, knitted and non-woven fabrics. Composite materials, fabric membrane properties, clothing mechanics. Physical equilibration processes in fabrics. Thermal insulation properties. Clothing comfort and physiology. Sorption. Swelling. Fabric rheology. Diffusion of moisture. Heat and mass transfer. Capillary action of textiles.

13.401B Textile Science 3B**SS L2**

Properties of surfactant solutions, micelle formation, surfactants as emulsifiers and detergents, detergency. Manufacture, chemical constitution and properties of special purpose polymers.

13.404 Fabric Technology 3**SS L2**

Manufacture of carpets and other floor coverings; Wilton and Axminster systems; tufting systems; other minor systems. Pile fabric manufacture; weft and warp pile woven structures; terry towel-ling; weft and warp knitted pile fabrics. Mechanics of fabric formation in weaving and in knitting. Introduction to industrial/technical fabrics. Recent developments in fabric-forming technology; microprocessor and computer applications.

13.405A Finishing Technology A**SS L2T2**

Objects of finishing and typical flow diagrams. The principles and technology of textile finishing processes: the removal of impurities and discoloration, the elimination or minimisation of deficiencies in properties of textile fibres, the development of specific properties.

13.405B Finishing Technology B**SS L2T2**

The production of specified dimensions in textile fabrics, mechanical processes, surface finishes, protective finishes. The application of special finishes including flame-proof finishes, crease-resistant finishes, etc. Recent developments in finishing technology.

13.451 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.

13.456 Advanced Textile Chemistry**SS L2**

Dyestuff aggregation in the dyebath and in the fibre. Fibre structure and dye sorption. Physical chemistry of dyeing; dyeing equilibria and dyeing kinetics. Application of the theory to particular dye-fibre systems. Environmental considerations. Elements of effluent and pollution control.

13.457 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.

13.458 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.

13.460 Processing Laboratory**F T1½**

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.

13.470 Seminar**F T1½**

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 post-graduate students, on a subject of topical and specific interest in the field of textile science, technology or commerce, and subsequently submit the seminar in writing.

13.480 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 strand they are studying.

Graduate Study

Department of Wool and Animal Science

9.105G Livestock Production F L2 T4

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

9.205G 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.

9.206G Project In Range Management F T9

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

9.424G Minerals and Their Effects on Grazing Animals C2

The importance of minerals for mammals. The nutritional significance of the important elements and the effect of ingestion, inhalation, or absorption or excessive amounts of these elements will be discussed. Emphasis on grazing sheep and cattle, but with other examples where appropriate.

9.504G 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.

9.803G Animal Breeding F L2 T2

Co-requisite: 9.802.

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.

9.813G Quantitative Methods F L2 T2

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

Department of Textile Technology

13.711G Fibre Science A SS L2

Chemical constitution and reactivity of the natural and man-made fibres. Production of textile fibres, addition and condensation polymerisation, polymerisation kinetics, molecular weights of polymers and co-polymers, crystallinity and orientation of polymers.

13.712G Textile Testing A SS L2 T2

The statistical basis of sampling for textile testing and quality control and assurance. Identification and selection of textile and raw materials. Measurement of fibre and yarn properties and of intermediate products which affect yarn quality (linear density, twist, irregularity).

13.713G Yarn Technology A SS L3 T1½

Principles of yarn preparatory processes for long and short staple fibres (cleaning, blending, carding, combing, drawing, winding). Tow conversion. Wool scouring.

13.714G Fabric Technology A SS L3 T1½

Principles of weaving; mechanics of shedding, picking, and beating-up; secondary and auxiliary loom mechanisms; elements of woven fabric design and construction; recent developments, microprocessor and computer applications. Mechanics of woven fabric formation. Introduction to woven fabric mechanics, objective measurement technology. Principles of carpet manufacture, non-woven fabric manufacture.

13.715G Finishing Technology A SS L3 T2

Objects of finishing and typical flow diagrams. The principles and technology of textile finishing processes: the removal of impurities and discolouration, the elimination or minimisation of deficiencies in the properties of textile fibres, the development of specific properties.

13.716G Colour Science**SS L2 T2**

Measurement and specification of colour and aspects of colour such as colour mixing and colour vision. Computer aided colour matching.

13.717G Textile Technology**F T1½**

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.

13.721G Fibre Science B**SS L2**

Molecular and morphological structure of textile fibres. Production of textile fibres, molecular weights of polymers and copolymers, crystallinity and orientation of polymers. Relationships between molecular structure and mechanical properties of fibres.

13.722G Textile Testing B**SS L2 T2**

Properties of woven, knitted and non-woven fabrics and their measurement (mechanical properties, serviceability, etc.). Measurement of consumer orientated properties (colourfastness, dimensional stability, seaming etc.). Modification and performance testing. Care-labelling and associated test requirements.

13.723G Yarn Technology B**SS L3 T1½**

Structural analysis of staple fibre and continuous filament yarns. Texturing; spinning and twisting of staple yarns; worsted, woollen and cotton processing systems. Unconventional techniques of yarn forming.

13.724G Fabric Technology B**SS L3 T1½**

Principles of knitting; techniques of loop formation in warp and weft knitting; needle selection in weft knitting; Raschel knitting; elements of knitted fabric design and construction; shaped knitted structures; recent developments, microprocessor and computer applications. Mechanics of loop formation in knitting. Introduction to knitted fabric mechanics. Principles of stitch-bonded fabric manufacture.

13.725G Finishing Technology B**SS L3 T2**

The production of specified dimensions in textile fabrics, mechanical processes, surface finishes, protective finishes, detergency, properties of surfactant solutions, micelle formation, emulsification. The chemistry of the application of specialised finishes such as flameproof finishes, crease-resistant finishes, etc. Recent developments in finishing technology.

13.726G Dyeing Technology**SS L2 T2**

Prerequisite: 13.716G or equivalent.

Classification of dyes and their methods of application, general properties of dyes, dyeing auxiliaries and after-treatments. Mill water supplies and their treatment, dyehouse effluent treatment.

Textile printing methods. Dyestuff aggregation and its measurement. Influence of fibre structure on dye uptake. Effects of the thermal and mechanical history of fibres on dye uptake. Physical-chemistry concepts in dyeing including dyeing equilibria, dyeing kinetics, steady state and non-steady state diffusion processes. Textile dyeing machinery. Recent developments in dyeing technology.

13.727G Textile Technology Dissertation**F T1½**

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.

School of Geography

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 changes in the General Education requirements refer to the table earlier in this chapter.

Staff

Professor of Geography and Head of School

Barry Jardine Garner, BA Nott., MA PhD Northwestern

Associate Professor

Ian Harry Burnley, MA Cant., PhD Well.

Senior Lecturers

Frederick Charles Bell, BSc Syd., MSc PhD N.S.W., MSocSigmaXi
 John Richard Dodson, MSc Monash, PhD A.N.U.
 Stephen James Filan, BAgEc N.E., MSc N.S.W.
 Michael Dick Melville, BScAgr PhD Syd.
 Colin Frederick Pain, MA Auck., PhD A.N.U.
 Morgan Eugene Cyril Sant, BA Keele, MSc PhD Lond.
 Peter Leon Simons, BA PhD Syd.
 Susanne Rae Walker, MA Well., DPhil Oxf.

Lecturers

Wayne David Erskine, BA PhD N.S.W.
 Geoffrey Steel Humphreys, BA PhD Macq.
 Bruno Peter John Parolin, BA Monash, MS Oklahoma State,
 PhD Ohio State, MIAG, MAAG, MRSA

Tutors

David John Edwards, BSc N'cle (N.S.W.)
 Scott David Mooney, BSc N.S.W.
 Beverley Ann Scott, BA Macq.

Administrative Assistant

Toni Bean

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.

A major sequence in Science and Mathematics course **3970**, program **2700** studies the relationships between man and his 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 Land and Geographic Information Systems **8024**; Masters' and Diploma courses in Remote Sensing **8026** and **8056**, or Masters' and Diploma in Arid Lands Management **8025** and **5025**, 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 geography), 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 formal work, 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.

3010 Applied Geography — Full-time Course

Bachelor of Science BSc

Students should consult the School before enrolling, as there may be some significant changes to these courses (especially for Year 3) before the start of the 1988 teaching year.

Applied Physical Geography, Applied Economic Geography and Human and Physical Resources

Year 1		Hours per week	
		S1	S2
10.021B	General Mathematics 1B and	6	6
10.021C	General Mathematics 1C or		
10.001	Mathematics 1 or		
10.011	Higher Mathematics 1	6	6
27.010	Land Studies*	4	0
27.020	Locational Processes	0	4
27.030	Environmental Processes	0	4
27.040	Data Processing Systems	2	2
27.100	Field Project 1	0	3
	and either		
15.001	Microeconomics 1 and	3½	0
15.011	Macroeconomics 1 and	0	3½
27.829	Australian Social Environments	4	0
	or		
17.031	Biology A and	6	0
17.041	Biology B	0	6
	or		
25.110	Earth Materials and Processes**	6	0
	and		
25.120	Earth Environments and		
	Dynamics**	0	6
		19½/18	22½/25

*Up to 5 days field work, equivalent to 40 tutorial hours, is an essential part of the subject.

**Up to 1½ days of field tutorials in 25.110 and up to 3½ days in 25.120 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

Year 2		Hours per week	
		S1	S2
27.050	Geographical Data Analysis	4	4
27.175	Introduction to Remote Sensing	4	0
27.183	Geomorphology	0	5
27.200	Field Project 2	0	3
27.824	Spatial Population Analysis*	0	4
and one			
General Education Subject			
and either			
2.111	Introductory Chemistry	6	0
or			
2.121	Chemistry 1A	6	0
and one			
General Education Subject		0	4
and either			
25.211	Earth Materials 1 and	6	0
25.221	Earth Materials 2**	0	6
or any two of the following (one each session)			
43.111	Flowering Plants	6	0
45.152	Population and Community Ecology***	6	0
45.201	Biology of Invertebrates	0	6
45.301	Vertebrate Zoology	6	0
		19	19

*An alternative, selected from the Servicing Subjects in Geography listed in this handbook, may be substituted with the permission of the Head of School.

**Field work of up to 3 days, equivalent to 7 tutorial hours, is an essential part of this subject.

***May be taken in either Year 2 or Year 3.

Note: Students will incur personal costs in connection with the Field Project.

Year 3

27.300	Field Project 3	0	3
27.503	Project Design and Formulation	0	4
27.652	Geographic Information Systems	0	4
27.133	Pedology	5	0
27.143	Biogeography	5	0
and one			
General Education Subject		2	2
Plus two of the following			
27.193	Environmental Impact Assessment	0	4
27.176	Remote Sensing Applications	0	4
27.213	Soils and Landforms	4	0
27.223	Environmental Change	0	4
and one of			
25.510	Geology for Geomorphologists and Pedologists and	2	4
25.622	Hydrological and Coastal Surveying	3	3
43.142	Environmental Botany	6	0
45.152	Population and Community Ecology†	6	0
		19/23	16/20

Applied Economic Geography

Year 2		Hours per week	
		S1	S2
15.201E	Microeconomics 2 or	4	0
15.202E	Macroeconomics 2 or	0	4
15.203E	Applied Microeconomics†	4	0
15.204E	Applied Macroeconomics†	0	4
27.200	Field Project 2	0	3
27.520	Regional Theory	4	0
27.672	Transport and Land Use	4	0
27.050	Geographic Data Analysis	4	4
27.500	Mathematical Methods for Spatial Analysis	4	0
27.510	Project in Spatial Analysis	0	4
27.223	Environmental Change	0	4
and one			
General Studies Subject		0	4
		20	20

†May be taken in either Session 1 or Session 2.

Note: Students will incur personal costs in connection with the Field Project.

Year 3

27.431	Computer Cartography	4	0
27.300	Field Project 3	0	3
27.193	Environmental Impact Assessment	0	4
27.503	Project Design and Formulation	0	4
27.633	Geographic Data Analysis	0	4
27.643	Sample Surveys and Questionnaire Design	4	0
27.713	Marketing Geography	4	0
27.743	Regional Population Analysis	4	0
27.753	Social Welfare and Urban Development	0	4
and one			
General Education Subject		4	0
Plus two of the following subjects (one each session)**			
15.003	Macroeconomics 3	0	4
14.043	Marxian Political Economy	3	0
15.053	Economics of Developing Countries	0	3
15.073	Natural and Environmental Resources Economics	0	3
15.083	Public Finance	03	
15.093	Public Sector Economics	3	0
15.143	Microeconomics 3	0	4
15.163	Industrial Organization and Policy	3	0
		23	24
		23/24	22/23

†May be taken in either Year 2 or Year 3. 10.001 or 10.011 is a prerequisite.

Note: Students will incur personal costs in connection with the Field Project.

**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

Year 2		Hours per week	
		S1	S2
27.175	Introduction to Remote Sensing	4	0
27.200	Field Project 2	0	3
27.050	Geographical Data Analysis	4	4
27.183	Geomorphology	0	5
27.520	Regional Theory	4	0
and one			
	General Education Subject	0	4
	and one of the following		
27.825	Urban Activity Systems**	4	0
27.223	Environmental change	0	4
and either			
15.062	Applied Macroeconomics***	0	4
	and		
15.072	Applied Microeconomics***	4	0
	or		
25.211	Earth Materials 1 and	6	0
25.221	Earth Materials 2**	0	6
or two of			
43.111	Flowering Plants	6	0
45.201	Biology of Invertebrates	0	6
45.301	Vertebrate Zoology	6	0
		18/20	20/26

*An alternative, selected from the Servicing Subjects in Geography listed in this handbook, may be substituted with the permission of the Head of School.

**Field work of up to 3 days, equivalent to 7 tutorial hours, is an essential part of this subject.

***May be taken in either Year 2 or Year 3. 10.001 to 10.011 is a prerequisite.

Note: Students will incur personal costs in connection with the Field Project.

Year 3

27.193	Environmental Impact Assessment	0	4
27.300	Field Project 3	0	3
27.431	Computer Cartography	4	0
27.503	Project Design and Formulation	0	4
and one			
	General Education Subject	2	2
plus			
	four of the following subjects		
27.133	Pedology	5	0
27.143	Biogeography	5	0
27.153	Climatology	5	0
27.176	Remote Sensing Applications	0	4
27.652	Geographic Information Systems	0	4
27.213	Soils and Landforms	4	0
27.713	Marketing Geography	0	5
27.743	Regional Population Analysis	5	0
27.753	Social Welfare and Urban Development	0	4
27.643	Sample Surveys and Questionnaire Design	4	0
and either			
15.053	Economic Development†	3	0
and			
15.073	Natural and Environmental Resource Economics	0	3
or			
25.510	Geology for Geomorphologists and Pedologists	2	4

or one of

43.142	Environmental Botany	6	0
45.152	Population and Community Ecology	6	0
		20/24	22/25

†Appropriate subjects may be substituted with the permission of the Head of School.
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

27.180	Field Project	0	8
27.190	Assessment of Human and Physical Resources*	4	0
27.504	Project	16	0
27.514	Practical Applications	0	3
27.524	Advanced Spatial Analysis*	0	4
27.534	Advanced Environmental Analysis	0	4
		20	19

*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.

Geography in Other Faculties

Courses in Geography are available on a full-time basis in the Faculties of Arts and Science, and in combined courses with Engineering 3730 and with Law 4770.

Graduate Study

Graduate Programs in Arid Lands Management

General

The University has considerable experience of research and teaching relating to the management of arid environments, gained over many years by several of its schools. This experience is being mobilized in the provision of graduate programs based at the University campus in Kensington, Sydney, but includes significant field studies using the resources at Fowlers Gap Arid Zone Research Station in western New South Wales.

The programs include the following areas of study:

- Hydrogeology
- Land Evaluation
- Terrain Management
- Soil Conservation
- Range Management
- Management of Pastoral Enterprises

For most of the above study areas, programs are available leading to the award of:

Master of Applied Science in Arid Land Management by Course Work **Course 8025**
 Graduate Diploma in Arid Lands Management **Course 5025**

Hydrogeology

These programs involve training in groundwater investigations, including geophysical investigations, and the assessment, development and utilization of groundwater resources. They are suited to geologists, engineers, agricultural scientists, planners and resource managers.

Land Evaluation and Terrain Management

These programs are designed to provide graduate training in the evaluation of land management and in the prediction of the environmental impact of land use. They include the two sectors of land evaluation and terrain management, with a close relationship reflected in overlapping core programs. Terrain management also embraces geopollution management, with reference to groundwater and hydrological processes. Terrain evaluation is envisaged as serving a wide range of land management, including agricultural and biological management.

Soil Conservation

These programs are designed to provide graduate training in soil conservation for land management in arid zones. They are appropriate for personnel engaged in or preparing for positions in conservation or reclamation projects, agricultural advisory services, land-use planning, administration of pastoral lands, or research into problems of arid land management.

Range Management

These programs are designed to provide graduate training in the assessment and management of rangelands, and are also relevant to animal production and soil conservation, national parks and wildlife management, and land evaluation. They are appropriate for personnel engaged in or preparing for positions in project management, pastoral advisory services, and rangeland research or administration.

Management of Pastoral Enterprises

These programs are designed to provide graduate training in the production and management of grazing sheep and beef cattle, the production of pasture, range management, and in the economic management of pastoral enterprises.

8024 Graduate Program in Land and Geographic Information Systems

Master of Applied Science MAppSc

The Masters degree program in Land and Geographic Information Systems 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 Honours degree of appropriate standard in Geography, Geology, Surveying, or a relevant environmental science.

Course requirements. Candidates are required to complete a course totalling at least 36 credits (1 credit equals 1 hour per week for one session), made up of compulsory subjects, elective subjects and a project or research project. The degree will normally comprise one year of full-time study (two sessions of 18 credits) or two years of part-time study (four sessions of 9 credits each).

Candidates who are not exempted from any of the compulsory subjects and who opt for the Research Project (18 credits) will achieve the required 36 credits without any elective subjects.

Compulsory Subjects	Credits
27.672G Geographic Information Systems	
29.608G Cadastral Systems	3
55.823G Files and Data Base Systems	3
29.604G Land Information Systems	3
27.043G Remote Sensing Applications	3
29.532G Computer-Assisted Mapping	3
Elective Subjects	
27.644G Computer Mapping and Data Display	3
29.217G Computer Graphics	2*
6.580G Image Analysis in Remote Sensing	3
55.817G Information Storage and Retrieval Systems	6
55.815G Economics of Information Systems	3

*Additional tutorials and assignments will increase subject to 3 credits

Project	Credits
27.950G Project	9
27.951G Research Project	18

Compulsory subjects not offered in a particular year, and other elective subjects than those listed, may be substituted by equivalent subjects approved by the Head of School.

8025 Arid Lands Management Graduate Course

Master of Applied Science MAppSc

Hydrogeology

Prerequisite: Four-year degree of appropriate standard in geology or in a relevant science.

Compulsory Subject
25.915G Project in Hydrogeology or
25.916G Research Project in Hydrogeology

Recommended Core Subjects

- 8.842G Groundwater Hydrology
- 8.860G Investigation of Groundwater Resources 1
- 8.861G Investigation of Groundwater Resources 2
- 25.325 Engineering and Environmental Geology
- 25.702G Hydrogeology
- 25.711G Arid Zone Engineering Geology*

Candidates must also include additional subjects selected from core subjects in other programs in Water Resources, or from the listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the School of Applied Geology and the Heads of the other Schools concerned, to complete a program equivalent to an average of 20 hours per week for two sessions of full-time study.

Optional Subjects

- 8.701G Economic Decision Making in Civil Engineering
- 8.703G Optimization Techniques in Civil Engineering
- 8.833G Free Surface Flow
- 8.878G Flood Design II
- 8.879G Flood Design III
- 8.843G Groundwater Hydraulics
- 8.847G Water Resources Policy
- 8.848G Water Resources System Design
- 8.849G Irrigation
- 8.850G Drainage of Agricultural Land
- 27.043G Remote Sensing Applications
- 27.171G Directed Problems in Remote Sensing
- 27.174G Remote Sensing Instrumentation and Satellite Programs
- 27.9226 Applied Geomorphology
- 27.914G Terrain Evaluation
- 27.910G Geomorphology of Arid Lands
- 27.911G Soil Erosion and Conservation
- 27.913G Soil Studies for Arid Lands Management
- 29.601G Remote Sensing Principles and Procedures
- 29.604G Land Information Systems

*Includes a field exercise of at least three days duration at Fowlers Gap Research Station.

Land Evaluation

Prerequisite: Four-year degree of appropriate standard in physical geography, or in a relevant environmental, biological or agricultural science.

Compulsory Subjects†

- 27.910G Geomorphology of Arid Lands
- 27.913G Soil Studies for Arid Lands Management
- 27.914G Terrain Evaluation
- 27.950G Project or
- 27.951G Research Project

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the School of Geography and Heads of the other Schools concerned, to complete a program equivalent to an average of 20 hours per week for two sessions of full-time study.

Optional Subjects

- 9.205G Range Management‡
- 25.711G Arid Zone Engineering Geology*
- 27.043G Remote Sensing Applications
- 27.171G Directed Problems in Remote Sensing
- 27.174G Remote Sensing Instrumentation and Satellite Programs
- 27.911G Soil Erosion and Conservation
- 29.601G Remote Sensing Principles and Procedures
- 29.604G Land Information Systems
- 45.900G Ecological Studies in Arid Lands Management

†Compulsory subjects jointly include one week of field work, probably at Fowlers Gap Research Station.

‡Includes up to one week of field work, probably at Fowlers Gap Research Station.

*Includes a field exercise of at least three days duration at Fowlers Gap Research Station.

Terrain Management

Prerequisite: Four-year degree of appropriate standard in geology or physical geography, or in a relevant environmental, biological or agricultural science.

Compulsory Subjects†

- 25.702G Hydrogeology
- 25.707G Geopollution Management
- 25.711G Arid Zone Engineering Geology*
- 25.712G Project in Terrain Management or
- 25.713G Research Project in Terrain Management
- 27.910G Geomorphology of Arid Lands
- 27.914G Terrain Evaluation

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the School of Applied Geology and Heads of the other Schools concerned, to complete a program equivalent to an average of 20 hours per week for two sessions of full-time study.

Optional Subjects

- 8.875G Hydrological Processes
- 27.043G Remote Sensing Applications
- 27.171G Directed Problems in Remote Sensing
- 27.174G Remote Sensing Instrumentation and Satellite Programs
- 27.911G Soil Erosion and Conservation
- 27.913G Soil Studies for Arid Lands Management
- 29.601G Remote Sensing Principles and Procedures
- 29.604G Land Information Systems

†Compulsory subjects jointly include one week of field work, probably at Fowlers Gap Research Station.

*Includes a field exercise of at least three days duration at Fowlers Gap Research Station.

Soil Conservation

Prerequisite: Four-year degree of appropriate standard in physical geography or agricultural science, or in a relevant earth science or biological science.

Compulsory Subjects†

- 27.910G Geomorphology of Arid Lands
- 27.911G Soil Erosion and Conservation
- 27.913G Soil Studies for Arid Lands Management
- 27.950G Project or
- 27.951G Research Project

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the School of Geography and Heads of the other Schools concerned, to complete a program equivalent to an average of 20 hours per week for two sessions of full-time study.

Optional Subjects

- 8.864G Arid Zone Surface Water Hydrology§
- 8.865G Arid Zone Water Resources Management
- 9.205G Range Management‡
- 25.711G Arid Zone Engineering Geology*
- 27.043G Remote Sensing Applications
- 27.171G Directed Problems in Remote Sensing
- 27.174G Remote Sensing Instrumentation and Satellite Programs
- 27.914G Terrain Evaluation
- 29.601G Remote Sensing Principles and Procedures
- 29.604G Land Information Systems
- 45.900G Ecological Studies in Arid Lands Management

§Co-requisites 8.837G Hydrological Processes
8.838G Flood Design

†Compulsory subjects jointly include one week of field work, probably at Fowlers Gap Research Station.

‡Includes up to one week of field work at Fowlers Gap Research Station.

*Includes a field exercise of at least three days duration at Fowlers Gap Research Station.

5025

Arid Lands Management Graduate Diploma Course

Graduate Diploma GradDip

Hydrogeology

Prerequisite: Degree in engineering or geology or in a relevant science.

Recommended Core Subjects

As for 8025 MAppSc degree Hydrogeology strand (see earlier this section).

Candidates must also include additional subjects selected from core subjects in other programs in Water Resources, or from the listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the Department of Applied Geology and Heads of the other Schools concerned, to complete a program equivalent to an average of 18 hours per week for two sessions of full-time study.

Optional Subjects

As for 8025 MAppSc degree Hydrogeology strand (see earlier this section).

Land Evaluation

Prerequisite: Degree in physical geography or geology, or in a relevant environmental, biological or agricultural science.

Compulsory Subjects

- 27.910G Geomorphology of Arid Lands
- 27.913G Soil Studies for Arid Lands Management
- 27.914G Terrain Evaluation
- 27.950G Project

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the School of Geography and Heads of the other Schools concerned, to complete a program equivalent to an average of 18 hours per week for two sessions of full-time study.

Optional Subjects

- 9.205G Range Management‡
- 25.711G Arid Zone Engineering Geology*
- 27.043G Remote Sensing Applications
- 27.171G Directed Problems in Remote Sensing
- 27.174G Remote Sensing Instrumentation and Satellite Programs
- 27.911G Soil Erosion and Conservation
- 29.601G Remote Sensing Principles and Procedures
- 29.604G Land Information Systems
- 45.900G Ecological Studies in Arid Lands Management

†Compulsory subjects jointly include one week of field work, probably at Fowlers Gap Research Station.

‡Includes up to one week of field work at Fowlers Gap Research Station.

*Includes a field exercise of at least three days duration at Fowlers Gap Research Station.

Terrain Management

Prerequisite: Degree in geology or physical geography, or in a relevant environmental, biological or agricultural science.

Compulsory Subjects†

- 25.711G Arid Zone Engineering Geology*
- 25.712G Project in Terrain Management
- 27.910G Geomorphology of Arid Lands
- 27.914G Terrain Evaluation

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the Department of Applied Geology and Heads of the other Schools concerned, to complete a program equivalent to an average of 18 hours per week for two sessions of full-time study.

Optional Subjects

- 8.875G Hydrological Processes
- 25.702G Hydrogeology
- 25.707G Geopollution Management
- 27.043G Remote Sensing Applications
- 27.171G Directed Problems in Remote Sensing
- 27.174G Remote Sensing Instrumentation and Satellite Programs
- 27.911G Soil Erosion and Conservation
- 27.913G Soil Studies for Arid Lands Management
- 29.601G Remote Sensing Principles and Procedures
- 29.604G Land Information Systems

†Compulsory subjects jointly include one week of field work, probably at Fowlers Gap Research Station.

*Includes a field exercise of at least three days duration at Fowlers Gap Research Station.

Soil Conservation

Prerequisite: Degree in physical geography or agricultural science, or in a relevant earth science or biological science.

Compulsory Subjects†

- 27.910G Geomorphology of Arid Lands
- 27.911G Soil Erosion and Conservation
- 27.913G Soil Studies for Arid Lands Management
- 27.950G Project

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the School of Geography and Heads of the other Schools concerned, to complete a program equivalent to an average of 18 hours per week for two sessions of full-time study.

Optional Subjects

- 8.865G Arid Zone Water Resources Management
- 9.205G Range Management‡
- 25.711G Arid Zone Engineering Geology*
- 27.043G Remote Sensing Applications
- 27.171G Directed Problems in Remote Sensing
- 27.174G Remote Sensing Instrumentation and Satellite Programs
- 27.914G Terrain Evaluation
- 29.601G Remote Sensing Principles and Procedures
- 29.604G Land Information System
- 45.900G Ecological Studies in Arid Lands Management

†Compulsory subjects jointly include one week of field work, probably at Fowlers Gap Research Station.

‡Includes up to one week of field work at Fowlers Gap Research Station.

*Includes a field exercise of at least three days duration at Fowlers Gap Research Station.

Range Management

Prerequisite: Degree in agricultural science, or in a relevant biological or earth science.

Compulsory Subject

- 9.205G Range Management‡
- 9.206G Project in Range Management

Recommended Subject**

- 45.900G Ecological Studies in Arid Lands Management

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the Department of Wool Science and Heads of the other Schools concerned, to complete a program equivalent to an average of 18 hours per week for two sessions of full-time study.

Optional Subjects

- 9.105G Livestock Production
- 9.113 Livestock Production 2
- 9.202 Pastoral Agronomy
- 9.421 Animal Nutrition
- 27.043G Remote Sensing Applications
- 27.171G Directed Problems in Remote Sensing
- 27.174G Remote Sensing Instrumentation and Satellite Programs
- 27.910G Geomorphology of Arid Lands
- 27.911G Soil Erosion and Conservation
- 27.913G Soil Studies for Arid Lands Management
- 27.914G Terrain Evaluation
- 29.601G Remote Sensing Principles and Procedures
- 29.604G Land Information Systems
- 43.121 Plant Physiology
- 43.142 Ecology and Environmental Botany
- 45.122 Animal Behaviour

**This subject may be omitted with permission of the Head of the School of Wool and Animal Science.

‡Includes up to one week of field work at Fowlers Gap Research Station.

Management of Pastoral Enterprises

Prerequisite: Degree in veterinary or agricultural science, or in a relevant biological science.

Recommended Subjects

- 9.105G Livestock Production
- 9.205G Range Management‡

Candidates must also include additional subjects selected from the following listed optional subjects, or from other relevant subjects offered within the University, as approved by the Head of the Department of Wool Science and Heads of the other Schools concerned, to complete a program equivalent to an average of 18 hours per week for two sessions of full-time study.

Optional Subjects

- 9.001 Project in Management of Pastoral Enterprises
- 9.113 Livestock Production 3
- 9.131 Animal Health 1
- 9.132 Animal Health 2
- 9.202 Pastoral Agronomy
- 9.301 Agricultural Economics and Management 1
- 9.302 Agricultural Economics and Management 2
- 9.421 Animal Nutrition
- 9.503 Wool Science 3
- 9.504G Wool Science

9.802	Genetics 2
9.803G	Animal Breeding
9.811	Biostatistics 1
9.812	Biostatistics 2
9.813G	Quantitative Methods
9.901	Rural Extension
45.122	Animal Behaviour
45.900G	Ecological Studies in Arid Lands Management

‡Includes up to one week of field work at Fowlers Gap Research Station

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 at least 36 credits, made up of compulsory subjects, elective subjects and a project or research project. Compulsory subjects not offered in a particular year may be substituted by an equivalent subject, approved by the appropriate Head of School. The degree will normally comprise one year of full-time study (two sessions of 18 credits) or two years of part-time study (four sessions of 9 credits each).

Candidates who are not exempted from any of the compulsory subjects and who opt for the Research Project (18 credits), will achieve the required 36 credits without any elective subjects.

Compulsory Subjects	Credits
27.043G Remote Sensing Applications	3
29.600G Principles of Remote Sensing	3
29.602G Remote Sensing Procedures	3
29.605G Ground Investigations for Remote Sensing	3
97.580G Image Analysis in Remote Sensing	3
97.581G Microwave Remote Sensing	3

Project

46.101G Project in Remote Sensing or	9
46.102G Research Project in Remote Sensing	18

Elective Subjects

Candidates are required to include additional subjects selected from the following listed elective subjects, or from other relevant

subjects offered within the University, as approved by the appropriate Head of School, to complete a program totalling 36 credits.

	Credits
6.468G Computer Display Systems and Interactive Instrumentation	3
6.611 Computing 1	4
25.816G Remote Sensing in Applied Geology	2
27.644G Computer Mapping and Data Display	3
27.672G Geographic Information Systems	3
27.911G Soil Erosion and Conservation	6
27.914G Terrain Evaluation	6
29.213G Physical Meteorology	3
29.604G Land Information Systems	3

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 a minimum of 30 credits or equivalent to 15 hours per week for two sessions of full-time study, made up of compulsory subjects (15 credits) and elective subjects (15 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
29.600G Principles of Remote Sensing	3
29.605G Ground Investigations for Remote Sensing	3
27.174G Remote Sensing Instrumentation and Satellite Programs	3
27.043G Remote Sensing Applications	3
97.580G Image Analysis in Remote Sensing	3

Elective Subjects

From the following (or as approved by the relevant Faculty):

6.468G Computer Display Systems and Interactive Instrumentation	3
8.875G Hydrological Processes	3
8.849G Irrigation	3

8.861G	Investigation of Ground Water Resources 2	3
8.864G	Arid Zone Hydrology	3
8.865G	Arid Zone Water Resources Management	3
25.704G	Environmental Geology	3
25.801G	Geology in Exploration 1	4
25.816G	Remote Sensing (in Applied Geology)	2
25.821G	Geology in Exploration 2	2
27.171G	Directed Problems in Remote Sensing	3
27.644G	Computer Mapping and Data Display	3
27.672G	Geographic Information Systems	3
27.914G	Terrain Evaluation	3
29.211G	Introduction to Geodesy	3
29.213G	Physical Meteorology	3
29.532G	Computer Assisted Mapping	3
29.604G	Land Information Systems	3
97.581G	Microwave Remote Sensing	3

Graduate Program 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 minimum of 40 credits (1 credit = 1 hour per week per one session):

- Core subjects Research Project (10 credits)
- Project (10 or 20 credits)
- Electives (10 or 20 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
27.202G Environmental Planning and Evaluation	3
36.945G The Organization of Town Planning	3
46.203G Medical Aspects	2
46.204G Legislative Aspects	2

Project

46.200G Research Project in Environmental Studies	20
or	
46.201G Project in Environmental Studies	10

Elective Subjects*

Earth Science — Engineering

8.021	Environmental Aspects of Civil Engineering	3
8.847G	Water Resources Policy	3
25.704G	Environmental Geology	3
25.707G	Geopollution Management	3
25.710G	Coastal Environmental Geology	3
27.043G	Remote Sensing Applications	3
27.133	Pedology	5
27.171G	Directed Problems in Remote Sensing	3
27.174G	Remote Sensing Instrumentation and Satellite Programs	3
27.183	Geomorphology	5
27.902G	Meteorological and Hydrological Principles	3

Chemistry — Biology*

	Credits
2.043A Environmental Chemistry	6
2.251G Toxicology, Occupational and Public Health	6
9.424G Minerals and Their Effects on Grazing Animals	2
27.143 Biogeography	5
27.153 Climatology	5
42.212G Principles of Biochemistry	3
43.142 Ecology and Environmental Botany	6
48.063G Industrial Water and Wastewater Engineering	3
48.386G Unit Operations in Waste Management	3
48.391G Atmospheric Pollution Control	3
48.392G Practical Aspects of Air Pollution Measurement and Control	3

Social-Economic-Planning*

8.402G	Transport, Environment, Community	6
8.403G	Theory of Land Use/Transport Interaction	3
27.923G	Population, Health and Environment	2
30.935G	Organization Behaviour A	3
30.958G	Organizational Communications	3
30.960G	Technology and Organizations	3
36.311	Environmental Psychology	4
37.3015	Environmental Impact Assessment 1	2
37.3016	Environmental Impact Assessment 2	2
37.1606	Land Systems	3
37.1707	Land Management	2
37.9105	Landscape Planning 1	4
37.9206	Landscape Planning 2	4
39.908G	Community Noise Control	2
85.716G	Public Policy	3
85.721G	Economics of Natural Resources	2

*Other subjects may be added on approval of Course Co-ordinator.

Subject Descriptions

Undergraduate Study

For Information Key refer to page 8

27.010 Land Studies

S1 L2T2

Concepts, significance and problems of land. Land as territory and land as resource in Australia. Constraints imposed by the physical environment on human occupancy and settlement patterns, the variety of conflicts that result and management strategies. Practical work involves study of the ways in which the attributes and characteristics of land are displayed on maps, air photos and satellite imagery, and introduces these as basic information sources and research tools in applied geography.

27.020 Locational Processes

S2 L2T2

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.

27.030 Environmental Processes

S2 L2T2

Essential and continuing links between components of the physical environment. Movement of energy and matter in the physical environment, including consideration of Earth's energy balance, the hydrological cycle, nutrient cycles in vegetation and soil, imbalances leading to land degradation and instability, alternatives to and movement of materials.

27.040 Data Processing Systems

F T2

Measurement, processing and display of spatial data. Basic knowledge and skills for using the University's computing system effectively; the use of computer software packages in geographic enquiry; exploratory data analysis and graphic information processing; and the presentation of data in tables, graphs and diagrams.

27.050 Geographical Data Analysis

F L2T2

Prerequisite: 27.030. *Excluded:* 27.162, 27.632, 27.813, 27.884.

Inferential statistics and hypothesis testing in the analysis of spatial data. Methods of analysing categorical data, identifying spatial correlation and associations, and multivariate methods applicable to topics in physical and economic geography.

27.100 Field Project 1

S2 T3

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.

27.133 Pedology

S2 L2T3

Prerequisites: 27.010 and 27.030 or any two units from 2.111, 2.121, 2.131, 2.141, and 27.818, 27.828 or 25.012 or 25.022.

Methodology of pedogenic studies and the application of these studies to the understanding of soil-landform relationships. Soil physical and chemical properties and their interrelationships, emphasizing clay-mineral structure and behaviour, soil solution chemistry, soil water movement and the application of these properties to elements of soil mechanics. Soil properties in natural, rural and urban landscapes, including assessment of soil fertility, swelling characteristics, dispersibility, erodibility and aggregate stability. Laboratory analysis of soil physical and chemical characteristics with emphasis on properties associated with land capability assessment. Statistical analysis of soil data and its application to mapping. The use of soil micromorphological and mineralogical studies in pedology.

27.143 Biogeography

S1 L2T3

Prerequisites: 27.030 or 27.828 or 17.031 and 17.041 or 27.111 or 27.172.

Distribution of taxa. Floras of the Southern Hemisphere with particular reference to Australia. Endemic, discontinuous and relict taxa. Dispersal and migration of species. Origin, evolution and geological history of Angiosperms. The development of the Australian biogeographic element. Study of the recent past to understand present distributions of taxa. The role of man and climatic change on Australian vegetation. Detection of pattern and association and their causes. Classification, ordination and mapping of vegetation. Ecology of selected Australian vegetation types. Management of vegetation in different climate regimes.

27.153 Climatology

S1 L2T3

Prerequisites: 1.001 or 27.030 or 27.828 or 25.110 and 25.120 or 17.031 and 17.041.

Physical bases for understanding microclimate. Processes of energy exchange at the earth's surface, and the atmospheric and terrestrial surface controls of the heat and mass budgets. Atmospheric diffusion. Wind profiles and atmospheric turbulence as affected by stability and surface properties. Determinants of the local and site-specific climatic environment, particularly topographic, surface cover and substrate conditions. Urban climate and climate in relation to human comfort and health. Building constructional design aspects of climate and applications of climatology in urban and regional planning. Climatic aspects of the development and regional planning. Climatic aspects of the development and utilization of solar and wind energy sources.

27.175 Introduction to Remote Sensing S1 L2T2

Prerequisite: Successful completion of a Year 1 program in Applied Science, Science or Arts (or equivalent) as approved by the Head of School.

Principles and technical aspects of remote sensing. Forms of available imagery, their utility and facilities for interpretation. Basic air-photo interpretation techniques relevant to environmental assessment. Introduction to principles of the electromagnetic spectrum, photometry and radiometry. Sensor types, image formation and end products associated with selected satellite programs, including Landsat. Land-cover and land-use interpretation procedures in visual image analysis. Basic procedures in machine-assisted image enhancement.

27.176 Remote Sensing Applications S2 L2T2

Prerequisite: 27.175 or 27.1711, 29.514 or 29.511 and 29.631. *Excluded:* 27.1712

Spectral characteristics of natural phenomena and image formation. Ground truthing, collection and calibration. Introduction to computer classification procedures. Multitemporal sampling procedures, image to image registration and map to image registration. Major applications of remote sensing in the investigation of renewable and non-renewable resources to include: soils, geology, hydrology, vegetation, agriculture, rangelands, urban analysis, regional planning, transportation and route location and hazard monitoring.

27.180 Field Project S2T8

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.

27.183 Geomorphology S2 L2T3

Prerequisites: 25.110 and 25.120 or 27.010 and 27.030 or 27.828. *Excluded:* 27.860.

Hillslope materials, processes and form; models of slope and landscape evolution. Fluvial geomorphology including water movement and sediment transport in river channels, hydraulic geometry, channel patterns, river types, flood plain formation, alluvial fans, river channel changes. Erosional and depositional landforms in coastal, arid, humid and glacial environments. Field work in fluvial and hillslope geomorphology, and laboratories on field measurements of geomorphic processes, sediment analyses and airphotograph interpretation.

27.190 Assessment of Human and Physical Resources S1 L4T4

Assessments of human and physical resources and environments. Specialised study in the following areas: landforms, soils, vegetation, climate and water, resource planning and decision making, human resources, geographical thought and perspectives. Since the units offered in any one year may be affected by the availability of staff, students should obtain information from the School.

27.193 Environment Impact Assessment S1 L2T2

Prerequisites: 27.030 or 27.818 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.

27.200 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.

27.213 Soils and Landforms S1 L2T2

Prerequisite: 27.133 or 27.183 or 27.828

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. Litho- and chrono-stratigraphic use of soils in residual aeolian, fluvial and coastal deposits.

27.223 Environmental Change S1 L2T2

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.

27.300 Field Project 3 S1/S2 T3

A five days field project normally undertaken during a recess, designed to support teaching in Year 3 (Level II) 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.

27.431 Computer Cartography S1 L2T2

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.

27.432 Computer Mapping and Data Display S1 L1T3

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.

27.500 Mathematical Methods for Spatial Analysis S1 L2T2

Prerequisite: 10.021B and 10.021C (or 10.001 or 10.011) and 27.040 or 13.200

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.

27.503 Project Design and Formulation S2 L1T3

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.

27.504 Project S1 T16

Prerequisite: 27.503

Implementation of the research proposal in Applied Geography prepared for 27.503 Project Design and Formulation under the direction of a supervisor; preparation of a project report.

27.510 Project in Spatial Analysis S2 L1T3

Prerequisite: 27.500.

Supervised application of quantitative 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.

27.514 Practical Applications in Geography S2 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.

27.520 Regional Theory S1 L2T2

Prerequisite: 27.020.

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.

27.524 Advanced Spatial Analysis S2 L2T2

Selected topics in economic and physical geography chosen to illustrate developments at the frontiers of research in spatial analysis.

27.534 Advanced Environmental Analysis S2 L2T2

Selected topics in the study of human and physical environments, chosen to illustrate contemporary frontiers of research and development in environmental studies.

27.633 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.

27.643 Sample Surveys and Questionnaire Design S1 L2T2

Explanation and prediction as distinct research objectives; designing research to achieve reliability and validity; case studies in research design; questionnaire design and implementation; scaling methods; interviewing techniques; sampling problems; directions in Qualitative Research.

27.652 Geographic Information Systems S2 L2T2

Prerequisites: 10.021B and 10.021C, or 10.001 or 10.011 or 27.432.

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.

27.672 Transport and Land Use S1 L2T2

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.

27.713 Marketing Geography S2 L2T3

Prerequisite: 28.042. *Note:* 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.

27.743 Regional Population Analysis**S1 L2T2**

The primary emphasis is on regional population estimation and forecasting with reference to Australian conditions and the use of Australian data. The population forecasting is handled within the framework of demographic theory and component analysis; migration analysis is given particular attention; multi-region population models; hybrid methods of small area population forecasting; use of population profiles for planning the provision of services.

27.753 Social Welfare and Urban Development**S1 L2T2**

Prerequisite: 27.829. *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.

Servicing Subjects

These are additional subjects taught within courses offered by other Faculties.

For further information regarding the following subjects see the Faculty of Architecture, Arts, Commerce, Engineering and Combined Sciences Handbooks.

27.813 Geographic Methods**S2 L2T2**

Prerequisites: 27.010 and 27.030, or 27.818 and 27.819. *Excluded:* 27.050, 27.813.

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.

27.818 Australian Environment and Human Response**S1 L2T2**

Prerequisite: Nil. *Excluded:* 27.010, 27.030, 27.801, 27.295, 27.111, 26.424.

Characteristics of the Australian environment viewed in global context. Topics include: the structure, function and origin of the lithosphere, hydrosphere and biosphere; the plate tectonic model and major landforms; atmospheric circulation, energy and radiation balances; the hydrological cycle; floods and droughts; characteristics and distribution of soils and vegetation; analysis of ecosystems. A one day field trip is compulsory. Students will incur some personal expenses in connection with this subject.

27.819 Technology and Regional Change**S2 L2T2**

Prerequisite: Nil. *Excluded:* 27.802.

The impact of technological change on the spatial organization of human activities and regional development and disparities.

The implications of technological change on population distribution and growth, resource utilization, and settlement patterns are examined at different scales emphasizing the social consequences at the community and regional level. International and intra-national spatial variations in the context of development and modernization theories. Examples are taken from Third World and modernized countries, with particular reference to Australian case studies.

27.824 Spatial Population Analysis**S2 L2T2**

Prerequisite: 27.829. *Excluded:* 27.834.

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.

27.825 Urban Activity Systems**S1 L2T2**

Prerequisite: 27.829. *Excluded:* 27.835, 27.812.

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.

27.826 Urban and Regional Development**S2 L2T2**

Prerequisite: 27.829. *Excluded:* 27.836, 27.812.

Theories of urban and regional change leading to assessment of the role of planning. Emphasis on resource allocation, conflict resolution and evaluation techniques including cost-benefit analysis and environmental impact assessment. Examples are taken principally from the fields of recreation and tourism.

27.828 Australian Natural Environments**S2 L2T2**

Prerequisite: 27.818 or 27.030. *Excluded:* 27.111, 27.811, 27.183.

Characteristics, origin and development of environments in Australia in terms of their tectonic history, lithology, landforms, climate, vegetation and soils. Analysis of natural physiographic regions and their modification by man. A two day field trip is compulsory. Students will incur some expenses in connection with this subject.

27.829 Australian Social Environments**S1 L2T2**

Prerequisite: 27.819. *Excluded:* 27.010, 27.030, 27.812.

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.

27.844 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 27.884.

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.

27.862 Australian Environment and Natural Resources

S1 L2T2

Prerequisite: 27.030 or 27.818 or 27.829. *Excluded:* 27.872.

Continental and regional patterns of land, water and energy resources in Australia and its territorial waters, and natural factors affecting their development, including climate, soils and terrain; problems of limited surface and underground water resources and of conflicting demands, exemplified through particular basin studies; comparable reviews of energy, minerals and forest resources, human resources and development.

27.883 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.

27.884 Advanced Geographic Methods

S1 L2T2

Prerequisites: 27.813. *Excluded:* 27.050, 27.880.

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.

description, classification and assessment of earth resources and environmental conditions. Different types of remote sensing data and imagery, their attributes, acquisition and uses. Relevance of remote-sensing data and imagery to a range of applications, including assessment of conditions of terrain, soils and surface materials; multitemporal monitoring and inventory of rangelands, croplands and forests; rural and urban land use assessment; surveillance of surface water resources and sedimentation; appraisal of changes in the coastal zone. Use of remote sensing in environmental management and in environmental impact assessment.

27.171G 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.

27.174G Remote Sensing Instrumentation and Satellite Programs

S1 L2T1 C3

Aircraft and satellite platforms; sensor types; image formation and end products including panchromatic, colour, colour IR and thermal IR photographic products, microwave imagery and computer tape products. The organization, acquisition, processing and analysis of imagery obtained from the following satellite programs: Landsat, Skylab, Heat Capacity Mapper Mission, Geodynamics Experimental Ocean Satellite, NOAA-9, Nimbus Coastal Zone Color Scanner, Seasat, Space Shuttle, Spot and Soyuz-Salyut.

27.202G Environmental Planning and Evaluation

C3

Lectures and seminars on environmentalism and political economy, environmental information, impact assessment, and economic evaluation.

27.644G Computer Mapping and Data Display

C3

Introduction to automated cartography and thematic mapping; theoretical and practical problems in displaying and mapping data by computer; review and application of selected computer mapping packages. INFO is used for database management, and ARC-INFO and GIMMS for cartographic manipulation and output.

27.672G Geographic Information Systems

C3

Study of selected geographic information systems; problems of data capture and display, data storage and manipulation, system design and development; cartographic displays and computer mapping. INFO is used for database management, and ARC-INFO and MAP for spatial data manipulation and display.

27.902G Meteorological and Hydrological Principles

S2 L3 C3

1. Meteorology: Heat and water balances of earth-atmosphere system. Global pressure, wind and climatic patterns. Atmospheric stability, temperature inversions, aerological diagrams. Synoptic and local and wind systems, dispersal of atmospheric pol-

Graduate Study

27.043G Remote Sensing Applications

S1 L1T2 C3

The application of remotely-sensed data and information in the

lutants under various conditions of stability and wind. Precipitation and precipitation fallout. Weather forecasting with particular reference to forecasting pollution potential. **2. Hydrology:** Catchment morphology. Precipitation: streamflow relationships; frequency analyses in hydrology. Drought and low flow analyses. Channel morphology and stream velocity characteristics, tidal estuaries, ocean currents. Dispersal of pollutants in flowing water.

27.910G Geomorphology of Arid Lands S2 L2T4 C6

Physiographic, geologic and climatic determinants of arid landforms and landforming processes. Rock weathering and weathering products under arid environments. Desert hillslopes and hillslope processes. Geomorphic aspects of runoff on desert hillslopes and the initiation of channel networks; characteristics of desert drainage nets. Geomorphic aspects of desert stream-floods; forms of desert channels and floodplains. Desert playa regimes and the associated features of desert lake basins. Transport of sand and dust by wind and related aeolian landforms and surfaces. Inheritance in desert landscapes and geomorphic evidence of climatic change. Geomorphic aspects of accelerated wind and water erosion in deserts. Exercises in the photo-interpretation of desert landforms and in related geomorphic mapping.

27.911G Soil Erosion and Conservation S1 or S2 L2T4 C6

Climatic, vegetational, geomorphic and pedologic controls of erosion. Physical processes of sediment transport and deposition. Conservational measures for the prevention of erosion including constructional and management practices. Methods of assessing soil loss risk and erosion hazard evaluation.

27.912G Arid Zone Climatology S1 L2T4 C6

Definitions of aridity based on climatic data and their relevance at different scales from hydrologic and biologic considerations. Measures of precipitation effectiveness. Meteorological controls of aridity at global and regional scales, and distinctive features of arid climates over the world. Characteristics and physical controls of the radiation, water and heat budgets as commonly found within arid environments. Climate as a fact in resource utilization considered in terms of plant growth and development, animal ecology, insects and diseases, soil erosion, and human adjustments to arid conditions, including problems of comfort, health, buildings design and energy use. *Laboratory and field work* is directed towards. **1.** instrumentation and measurements of climatic variables of special interest in arid environments, particularly those important to the radiation, water, and heat budgets; and **2.** statistical and other quantitative methods for summarization and interpretation of single and combined climatic elements to provide relevant information required for sound management of arid lands.

27.913G Soil Studies for Arid Lands Management S1 or S2 L2T4 C6

Soil forming processes in arid regions. Physical, mineralogical 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 alkalization. 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 27.133 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.

27.914G Terrain Evaluation S1 L2T4 C6

Principles and techniques for natural resource surveys and land evaluation including: land systems, terrain patterns, land capability and economic aspects of evaluation; examination of mapping, taxonomic and descriptive units; the problem of map scale and accuracy; styles of presentation for practitioners and other uses. Application of principles in selected other contexts.

27.922G Applied Geomorphology S2 L1½T½ C3

Landform expression of lithology and structure, Hillslope, drainage basin and channel forms and processes. Landform evolution, short-term and long-term geomorphic changes. Geomorphological background to soil erosion, stream channel, floodplain and coastal engineering problems. Geomorphological approach to terrain evaluation. Exercises in airphoto and map analysis of fluvial landforms or terrain types. Field excursion on fluvial landform or terrain assessment, as required.

27.923G 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.

27.950G Project S2 T9 C9

A practical application or investigation 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.

27.951G Research Project F T9 C18

As for 27.950G Project, but involving more substantial research over a longer period. Tutorial hours are equivalent contact hours,

but may also involve fieldwork out of session.

Remote Sensing

46.101G Project in Remote Sensing C9

A minor study of some aspects of remote sensing as it relates to investigations within a particular discipline or subject area offered by Schools within the Faculty of Applied Science.

46.102G Research Project in Remote Sensing C18

An investigation of a problem in remote sensing 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.

Environmental Studies

46.200G Research Project in Environmental Studies C20

Research investigation on an approved topic, conducted either individually or as part of a team.

46.201G Project in Environmental Studies C10

As for 46.200G but involving a smaller research task.

46.203G Medical Aspects C2

Aspects of medicine bearing upon physiological consequences of pollutants. Synergism and antagonisms, photosynthesis and phytotoxicity, metabolic mechanisms; morbidity and mortality surveys; exposure indices. Particular pollutants aldehydes, nitro-olefins, carbon monoxide, sulphur dioxide, oxides of nitrogen, hydrocarbons, ozone and oxidants, particulates, carcinogens.

46.204G Legislative Aspects C2

Resources in law for the preservation of satisfactory environments. Local government, town planning, environmental, common law. History of Australian legislation — consequences in border regions. Types of legislation and machinery measures and actions thereunder. Problems of administration of available law. American experience. Economic and sociological factors.

**School of
Materials Science and Engineering**

School of Materials Science and Engineering

Head of School

Associate 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 materials manufacturing industry in this country will have to be developed and restructured, and this can be expected to also 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 both ceramic engineering and in metallurgical engineering

as well as providing postgraduate specialists 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.

The School comprises three departments; ceramic engineering and metallurgical engineering which offer the above-mentioned undergraduate courses, and materials engineering which is responsible for materials servicing activities and for the development of a new degree materials and management.

Ceramic Engineering and Ceramics

The ceramic industry produces an 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 many 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 stu-

dents 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 two broad categories. Some go initially into activities associated directly with production, ie 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. In either case, graduates with organizing ability frequently move into management if they have an interest in this side of the industry.

In Australia, a number of government research organizations are active in ceramic research, eg the Australian Nuclear Science and Technology Organisation, and the Divisions of Materials Science and Building Research of CSIRO. Investigation 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) and the Royal Australian Chemical Institute.

Metallurgical Engineering

The metallurgical profession has developed in importance in keeping with the growth of the 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 the opportunities for a career in management are excellent, since it is a tradition in this industry that management should be in the hand of technical people. If the 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 the 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.

These courses meet the formal educational requirements for admission to the professional institutes, such as the Australasian Institute of Mining and Metallurgy and the Institution of Metals and Materials Australasia.

Staff

School of Materials Science and Engineering

Associate Professor and Head of School

David John Young, BSc PhD *Melb.*, FRACI, MAMerlChe

Professor of Materials Science

Vacant

Professor of Physical Metallurgy

Vacant

Associate Professor.

David John Haviland Corderoy, BSc N.S.W., PhD *Sheff.*, CEng, FIM-MA, MWeld(Lond), MIEAust, MAusIMM

Senior Lecturers

Sydney Blairs, BSc PhD *Manc.*, FIMMA

Bruce Harris, BSc *Syd.*, MSc N.S.W. AMAusIMM

Peter Krauklis, BSc PhD N.S.W. CEng., MIMMA

Peter George McDougall, BSc PhD N.S.W., ASTC, CEng, MIMMA

Michael Bernard McGirr, BSc *Syd.*, PhD N.S.W.

Saviatoslav Antonovich Prokopovich, MSc N.S.W., ASTC, CEng, MIEAust

Keith Robin Lee Thompson, BSc *Wales*, PhD N.S.W., CEng., MIMMA

John Maurice Wheatley, MA PhD *Camb.*, CEng, FIMMA, FAusWI, MWeld (*Lond.*)

Lecturers

Alan Gordon Crosky, BSc PhD N.S.W., MIMMA

Charles Christopher Sorrel BS *Missouri*, MS *Penn.*, PhD N.S.W.

Pantcho Tomas, MSc PhD N.S.W.

Honorary Visiting Professors

Anthony Vernon Bradshaw, BSc *Lond.*, CEng, ARSM FTS, FIMM, MAusIMM

Eric Robert McCartney, BSc *Syd.*, PhD N.S.W., FICeram, MIEAust, ARACI

Honorary Associate

Max Hatherly, MSc PhD N.S.W., ASTC, FTS, CEng, FIM

Professional Officers

Bernard James Baggeley, MSc PhD N.S.W., DipCer N.Stffs Poly

Frederick Henry Scott, BSc N.S.W., MAIP

John Walton Sharp, BSc(Tech) 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
1.001	Physics 1	6	6
2.121	Chemistry 1A	6	0
2.131	Chemistry 1B	0	6
4.003	Introduction to Computing	0	2
5.0011	Engineering Mechanics 1	0	4
5.0012	Introductory Engineering Design and Materials Science	2	0
5.0302	Engineering Drawing and Descriptive Geometry	4	0
10.001	Mathematics 1	6	6
		24	24

Year 2

		Hours per week	
		S1	S2
2.102A	Physical Chemistry	6	0
2.102C	Inorganic Chemistry and Structure	0	6
4.202	Ceramic Process Principles 1	2	0
4.212	Phase Equilibria in Ceramics	3	0
4.232	Ceramic Engineering 1	0	3
4.712	Materials Engineering 1A	3½	0
4.722	Materials Engineering 1B	0	3½
4.732	Mechanical Properties of Materials	4	0
4.742	Physics of Materials	0	3
4.752	Thermodynamics of Materials 1	0	3
10.031	Mathematics	2	2
	General Education Subject	2	2
		22½	22½

Year 3

4.213	Chemical Ceramics	4	7
4.233	Ceramic Process Principles 2	3½	3½
4.713	X-Ray Diffraction & Electron Microscopy	4	0
4.753	Thermodynamics of Materials 2	3½	0
7.7341	Mineral Process Engineering	2	0
4.823	Numerical Methods	1½	1½
10.301	Statistics SA	2	2
25.523	Mineralogy	2	2
48.163	Instrumentation and Process Control 1	0	3
48.304	Fuel Engineering for Ceramic Engineers	1	1
	General Education Subject	0	4
		23	23

Year 4

4.054	Materials Seminar	2	2
4.214	Electrical Ceramics	0	3
4.224	Physical Ceramics	5	5
4.234	Ceramic Engineering	2	3
4.294	Project (Ceramic Engineering)	6*	6
4.704	Design with Brittle Materials	3	0
48.047	Chemical Engineering 3D Unit 1 Management	0	2
48.165	Laboratory Automation Science	4	0
	General Education Subject	2	2
		24	24

*Project includes 42 hours of laboratory work during the mid year recess.

3030

Ceramics — Part-time Course

Bachelor of Science (Technology) BSc(Tech)

Stages 1 and 2*

		Hours per week	
		S1	S2
1.001	Physics 1	6	6
2.121	Chemistry 1A	6	0
2.131	Chemistry 1B	0	6
4.003	Introduction to Computing	0	2
5.0011	Engineering Mechanics 1	0	4
5.0012	Introductory Engineering Design and Materials Science	2	0
5.0302	Engineering Drawing and Descriptive Geometry	4	0
10.001	Mathematics 1	6	6

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

Stage 3

		Hours per week	
		S1	S2
2.102A	Physical Chemistry	6	0
2.102	Inorganic Chemistry and Structure	0	6
4.202	Ceramic Process Principles 1	2	0
4.232	Ceramic Engineering 1	0	3
10.031	Mathematics	2	2
		10	11

Stage 4

4.212	Phase Equilibria in Ceramics	3	0
4.712	Materials Engineering 1A	3½	0
4.722	Materials Engineering 1B	0	3½
4.732	Mechanical Properties of Materials	4	0
4.742	Physics of Materials	0	3
4.752	Thermodynamics of Materials 1	0	3
	General Education Subject	2	2
		12½	11½

Stage 5

4.233	Ceramic Process Principles 2	3½	3½
4.713	X-Ray Diffraction and Electron Microscopy	4	0
4.753	Thermodynamics of Materials 2	3½	0
10.301	Statistics SA	2	2
48.163	Instrumentation and Process Control 1	0	3
	General Education Subject	0	2
		13	12½

Stage 6

4.054	Materials Seminar	2	2
4.213	Chemical Ceramics	6	5
4.823	Numerical Methods	1½	1½
7.7341	Mineral Process Engineering	2	0
25.523	Mineralogy	2	2
48.304	Fuel Engineering for Ceramic Engineers	1	1
		12½	13½

Metallurgical Engineering

A four-year full-time course in metallurgical engineering leading to the award of the BMetE degree 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

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. In Year 2 two major strands of study in Physical Metallurgy and Metallurgical Engineering are introduced and these are supported by chemistry, mathematics and chemical metallurgy subjects. The two major strands are developed further in Years 3 and 4, but with the emphasis shifting from physical metallurgy to metallurgical engineering. 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
1.001	Physics 1	6	6
2.121	Chemistry 1A	6	0
2.131	Chemistry 1B	0	6
4.003	Introduction to Computing	0	2
5.0011	Engineering Mechanics 1	0	4
5.0012	Introductory Engineering Design and Materials Science	2	0
5.0302	Engineering Drawing and Descriptive Geometry	4	0
10.001	Mathematics 1	6	6
		24	24

Year 2

2.102A	Physical Chemistry	6	0
4.412A	Physical Metallurgy 1A	6	0
4.422B	Physical Metallurgy 1B	0	2
4.432	Physical Metallurgy 1C	0	4
4.642	Metallurgical Engineering 1D	0	2
4.712	Materials Engineering 1A	3½	0
4.722	Materials Engineering 1B	0	3½
4.732	Mechanical Properties of Materials	4	0
4.742	Physics of Materials	0	3
7.725	Chemical and Extraction Metallurgy 1	0	3
10.031	Mathematics	2	2
	General Education Subject	2	2
		23½	21½

Year 3		Hours per week	
		S1	S2
4.413	Physical Metallurgy 2A	2½	0
4.433C	Physical Metallurgy 2C	4	0
4.443	Physical Metallurgy 2D	0	4
4.453	Physical Metallurgy 2E	0	2½
4.613A	Metallurgical Engineering 2A	3	0
4.623B	Metallurgical Engineering 2B	0	3½
4.633	Metallurgical Engineering 2C	3½	3½
4.643	Metallurgical Engineering 2D	0	3
4.713	X-ray Diffraction and Electron Microscopy	4	0
6.854	Electrical Power Engineering	0	3
7.7341	Mineral Process Engineering	2	0
7.735	Chemical and Extraction Metallurgy 2	3½	0
	General Education Subject	0	4
		22½	23½

Year 4			
4.024	Metallurgy Project	6 **	3
4.044	Professional Electives	5	5
4.054	Materials Seminar	2	2
4.414	Physical Metallurgy 3A	2	0
4.424	Physical Metallurgy 3B	2	0
4.434	Physical Metallurgy 3C	0	3
4.614	Metallurgical Engineering 3A	2	0
4.624B	Metallurgical Engineering 3B	3	0
4.634	Metallurgical Engineering 3C	3	0
4.644	Metallurgical Engineering 3D	0	4
4.654	Metallurgical Engineering 3E	0	4
	General Education	0	4
		25	25

**Project includes 84 hours of laboratory work during the mid year recess.

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 days 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 metallurgy course and involves the same major strands of study in Physical Metallurgy and Metallurgical Engineering. 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
1.001	Physics 1	6	6
10.001	Mathematics 1	6	6
		12	12
Stage 2			
2.121	Chemistry 1A	6	0
2.131	Chemistry 1B	0	6
4.003	Introduction to Computing*	0	2
5.0011	Engineering Mechanics 1	4	0
5.0012	Introductory Engineering Design and Materials Science	2	0
5.0302	Engineering Drawing and Descriptive Geometry	0	4
		12	12

*There are no evening lectures in this subject.

Stage 3			
2.102A	Physical Chemistry	6	0
4.422B	Physical Metallurgy 1B	0	2
4.712	Materials Engineering 1A	3½	0
4.742	Physics of Materials	0	3
7.725	Chemical and Extractive Metallurgy 1	0	3
10.031	Mathematics	2	2
	General Education Subject	2	2
		13½	12

Stage 4			
1.9222	Electronics	3	0
4.412A	Physical Metallurgy 1A	6	0
4.432	Physical Metallurgy 1C	0	4
4.642	Metallurgical Engineering 1D	0	2
4.722	Materials Engineering 1B	0	3½
4.732	Mechanical Properties of Materials	4	0
	General Education Subject	0	4
		13	13½

Stage 5			
4.413	Physical Metallurgy 2A	2½	0
4.443	Physical Metallurgy 2D	0	4
4.453	Physical Metallurgy 2E	0	2½
4.613A	Metallurgical Engineering 2A	3	0
4.633	Metallurgical Engineering 2C	3½	3½
4.643	Metallurgical Engineering 2D	0	3
4.713	X-ray Diffraction and Electron Microscopy	4	0
		13	13

Stage 6			
4.034	Industrial Metallurgy Project	4	2
4.054	Materials Seminar	2	2
4.433C	Physical Metallurgy 2C	4	0
4.624B	Metallurgical Engineering 3B	3	0
4.644	Metallurgical Engineering 3D	0	4
4.654	Metallurgical Engineering 3E	0	4
6.854	Electrical Power Engineering	0	3
		13	15

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, Master of Engineering or Doctor of Philosophy in metallurgy or ceramic engineering or who are intereted in programs involving formal course work and research leading to the award of Graduate Diploma in 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.

5035 Graduate Diploma in Materials Graduate Diploma GradDip

The course is designed to provide specialist professional training in Materials at an advanced level for graduates in related courses in Science, Applied Science or Engineering and is aimed at extending the primary disciplines in this regard.

The current emphasis is on metallic and ceramic materials but it is anticipated that other specializations may be offered. Subject to consultation, other subjects may be drawn from graduate subjects available from other Schools by approval from the Heads of both Schools.

Entry Qualifications

Applicants for admission to the course must be graduates of this University or other approved university or have other qualifications deemed appropriate by the university. However, Faculty may require an applicant to take such other prerequisite or concurrent studies and/or examinations as it may prescribe. It is expected that the first degree or other qualification contain mathematics, physics and chemistry to an acceptable level but students without these qualifications may be admitted subject to the approval of the Head of School or required to undertake a qualifying program.

In cases in which qualifying programs or bridging courses are required these can be designed to suit the needs of the individual candidates.

Course Requirements

Candidates are required to complete a program of formal study (including a Project) totalling 20½ hours per week over two sessions on a full-time basis, or 10 hours per week over four sessions on a part-time basis. The full-time program will comprise a minimum of 12 hours per week drawn from the graduate subjects as listed below.

Students are assessed by written examination in graduate subjects and professional electives. Marks are assigned to each component of the course according to the proportion of time spent in each graduate subject and professional elective.

The subjects in the graduate program shall comply with the following compulsory and elective subjects in which the professional electives are drawn from the undergraduate group of subjects comprising subject 4.044 Professional Electives with extensions as appropriate to the graduate level.

Compulsory Subjects

		Hours per week	
		S1	S2
4.044	Professional Electives	5	5
4.201G	Graduate Seminar	2	2
4.241G	Graduate Materials Project	6	6
4.633	Metallurgical Engineering 2C	3½	3½
		16½	16½

Elective Graduate Subjects*

Plus not less than 4 hours per week of electives drawn from the following subjects:

4.211G	Metallurgical Practice		
4.221G	Advanced Metallurgical Techniques		
4.231G	Advanced Theoretical Metallurgy		
4.251G	Advanced Materials Technology		
		4	4
		20½	20½

*The program selected by each student must be approved by the Head of School. Not all electives are offered each session, nor is the full range available each year. Subject to consultation other graduate subjects may be drawn from other Schools by approval from the Heads of both Schools.

Subject Descriptions

Undergraduate Study

4.001 Introduction to Materials Engineering S1 or S2 L1

Forms part of 5.0012.

Metals, ceramics, polymers and composites, their structure, chemical, physical and mechanical properties, engineering applications and production, with particular reference to Australian industries.

4.003 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.

4.024 Metallurgy Project S1 S2 3

An experimental investigation of some aspects of metallurgy. Includes three weeks laboratory work during the mid-year recess.

4.034 Industrial Metallurgy Project S1 4 S2 2

An experimental investigation of some aspects of industrial metallurgy.

4.044 Professional Electives F5

A combination of the following electives giving a total of at least 140 hours over the whole year (28 weeks). The list of electives is:

	Hours
4.204 Ceramic Materials Selection	28
4.444 Advanced Crystallography of Phase Transformations	14
4.494 High Temperature Techniques	14
4.664 Surface Treatments and Wear	14
4.674 Mathematical Plasticity	14
4.684 Transport Phenomena in Metallurgical Processes	14
4.694 Air Pollution Control in the Metallurgical Industry	14
4.704 Design with Brittle Materials	42
7.7451 Advances in Pyrometallurgy	28
7.7452 Advances in Hydrometallurgy	28
7.748 Technical Decision Making	28

The program selected by each student must be approved by the Head of School. Not all electives are offered each session, nor is the full range available each year. Students are advised each year of the timetable of available electives.

4.054 Materials Seminar F L2

Lectures on the preparation and presentation of technical papers. Development of encoding and decoding communication skills in the various communication media. Chairpersonship.

Professional ethics and etiquette. Organization and direction of conferences. Traditional and on line retrieval of information. Each student is required to prepare and present a paper on a nominated subject.

4.202 Ceramic Process Principles 1 S1 L2

The nature of ceramics. The scope of ceramic industry. The origin, classification, physical properties and uses of clay minerals and other non-clay raw materials. Principal unit operations used in the ceramic industry. Drying and firing of ceramics, melt forming, hot forming and other forming procedures.

4.204 Ceramic Materials Selection S1 or S2 L2

Classification of ceramic materials. Structure-property relations. Mechanical properties; effects of grain size, porosity. Transformation toughening. Thermal and chemical toughening of glass. Glass ceramics. Nitrogen ceramics. Thermal properties; thermal stress resistance, refractories. Ferroelectric, piezoelectric components. Porcelain enamels.

4.212 Phase Equilibria in Ceramics S1 L2 T1

Phase equilibria and thermodynamic basis of the phase rule. The one component system, the importance of pressure, polymorphism of solids. The two component system: the binary eutectic, intermediate compounds, continuous and partial solid solution, liquid immiscibility. Experimental and thermodynamic methods of constructing phase diagrams. Ternary systems without solid solutions in ternary systems. Non-equilibrium in ceramic systems. Introduction to quaternary and multicomponent systems.

4.213 Chemical Ceramics S1 L3T3 S2 L2T3

Prerequisites: 2.102A and 2.102C

Structural principles: crystal chemistry, structure of glasses, defect solid state: phase equilibria and transformations; diffusion; solid state reactions. A systematic treatment of the chemistry of ceramic products.

Students are required to take part in a series of factory inspections.

4.214 Electrical Ceramics S2 L1 T2

Prerequisite: 4.742

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.

4.224 Physical Ceramics F L2T4

Prerequisites: 4.213

Application of the principles of physical chemistry and solid state physics to a study of the preparation and properties of ceramic materials and components. Mechanical, thermal, electrical and magnetic properties. Nucleation and spinodal decomposition. Solid electrolytes. Mechanisms of sintering and vitrification. Techniques for particle size and surface area determination and the identification of clay minerals.

4.231 Introduction to Ceramic Engineering S2 L2

The nature of ceramics. The scope of ceramic industry. The origin, classification, physical properties and uses of clay minerals and other non-clay raw materials. Principal unit operations used in the ceramic industry. Drying and firing of ceramics, melt forming, hot forming and other forming procedures.

4.232 Ceramic Engineering 1 S1 L3

The principles of operation, construction and fields of application of equipment used in the mining, preparation and fabrication of raw materials, and the drying and firing of ceramic products.

4.233 Ceramic Process Principles F L1T21/2

Review of raw materials and principal unit operations used in the ceramic industry. Plasticity in a clay-water system. Drying and firing calculations. Polymorphism. Firing and heat transfer considerations. Effect of porosity on fired 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. Testing methods and instrumentation in quality control.

Students are required to take part in a series of factory inspections.

4.234 Ceramic Engineering 2 F L2T2

Advanced treatment of fluid flow and heat transfer: non-Newtonian fluids and unsteady-state heat transfer. A detailed study of ceramic engineering unit operations: filtration, forming, drying and firing. Ceramic engineering design including design of dryers, kilns and glass tanks. Design of simple steel structures. Pollution control equipment.

Students are required to take part in a series of factory inspections.

4.294 Project (Ceramic Engineering) S1 T6 S2 T9

An experimental or technical investigation or design related to some aspect of ceramic engineering.

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

Co-requisite: 2.102A, 4.732.

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

Unit 2: Phase Equilibria Laboratory S1 T3

Elementary founding principles. Solidification processes in moulds. Metallography of non-ferrous alloys.

4.413 Physical Metallurgy 2A S1 L1 T1½

Prerequisite: 4.412A.

Metallography of non-ferrous alloys. Structure/property relationships in non-ferrous alloys. Hardening mechanisms. Metallography and properties of copper, aluminium, nickel, magnesium, lead, tin and titanium base alloys.

4.414 Physical Metallurgy 3A S1 L2

Prerequisite: 4.433C.

Studies of diffusional and martensitic phase transformations. Diffusional metastable transition phases, special reference to ageing of commercial alloys, Guinier-Preston zones, coherent and semi-coherent precipitates. Metastable solvus boundaries, reversion. General properties of martensitic transformations; relationship between stress and transformation, thermoelastic behaviour. Shape-memory alloys. Nucleation and kinetics of ferrous martensites. Morphology and strengthening characteristics of ferrous martensites, ausforming and maraging steels. Introduction to crystallographic theory of martensitic transformations. Introduction to coincident site theory, O lattice theory of interface structures; grain boundaries, recrystallization, inter-phase boundaries.

4.422B Physical Metallurgy 1B S2 L1T1

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

4.424 Physical Metallurgy 3B S1 L½T1½

Prerequisite: 4.713

Intensity of diffracted X-ray beams. Geometry of diffraction. Reciprocal lattice. Ewald sphere construction in thin foil transmission electron microscopy. Application to imaging of stacking faults, dislocations and precipitates.

4.432 Physical Metallurgy 1C S2 L1T3

Prerequisite: 4.412A

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

4.433C Physical Metallurgy 2C S1 L2½T1½

Prerequisite: 4.412A.

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

4.434 Physical Metallurgy 3C S2 L2T1

Prerequisite: 7.735.

Structure and properties. Application of the chemistry of the defect solid state to materials preparation and reactivity. Non stoichiometry and stoichiometry dependent physical and chem-

ical properties of metal compounds. Structure and properties of ionic and metallic melts.

4.443 Physical Metallurgy 2D

S2 L2T2

Prerequisite: 4.432.

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

4.444 Advanced Crystallography of Phase Transformations

S1 or S2 L1

Co- or prerequisite: 4.414.

Advanced crystallography of phase transformations. Martensite crystallographic theory applied to ferrous martensites, generalization of lattice invariant shear, dilatation. Application of coincident site theory. O lattice theory to generalized phase boundary structure. Crystallography of Widmanstätten precipitates.

4.453 Physical Metallurgy 2E

S2 L1T1½

Prerequisite: 4.432.

Alloy steels. Ternary equilibria involving iron and carbon. Metallography and properties of alloy steels. Effect of alloying elements on austenite formation and decomposition under equilibrium and non-equilibrium conditions. Heat treatment of alloy steels. Metallography and properties of alloy cast irons.

4.494 High Temperature Techniques

S1 or S2 L1

Experimental methods for the determination of thermophysical and thermochemical properties at elevated temperatures.

4.613A Metallurgical Engineering 2A

S1 L2T1

Prerequisite: 4.722.

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 BOF vessels and ladles. Slab cooling in hot strip mills. Interaction of free and submerged gas jets with melts. Accretion stability, back wall and tuyere erosion. Continuous casting. Solidification in metal and sand moulds. Solute transference between liquid metals and slags. Vacuum and magnesium desulphurization of steel melts. Lead softening. Cementation. Role of line and point defects on reactivity.

4.614 Metallurgical Engineering 3A

S1 L1T1

Prerequisite: 4.613A.

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 interfaces. Application to metal refining processes.

Vacuum degassing and refining processes.

4.623B Metallurgical Engineering 2B

S2 L3T½

Prerequisite: 2.102A.

Electrometallurgical engineering. Thermodynamics, kinetics and electrochemistry of aqueous solutions, potential-pH diagrams and other stability diagrams. Application to hydrometallurgy, corrosion, corrosion prevention and electrodeposition and electropolishing. Contacting of metallurgical phases, batch and continuous contacting. Application to design of leaching systems and reduction of metal oxides. 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. Electrodeposition, growth morphology, electropolishing.

4.624B Metallurgical Engineering 3B

S1 L3

Prerequisite: 4.732.

Mechanical and thermal processing. Mechanisms of deformation. Origin of rolling and annealing textures. Inhomogeneities of deformation. Texture control and controlled rolling. Application to transformer steel, HSLA steel, deep drawing 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.

4.633 Metallurgical Engineering 2C

F L2T1½

Prerequisites: 10.001 or 10.011.

Mathematical methods. 1. 10.301 Statistics SA (see Engineering Handbook) 2. Numerical methods. Finite difference and finite element techniques and their application to metallurgical phenomena involving diffusional transport, elasticity and plasticity.

4.634 Metallurgical Engineering 3C

S1 L2½T½

Prerequisite: 4.453.

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

4.642 Metallurgical Engineering 1D

S2 L1T1

Prerequisite: 4.732.

Metal forming. Introduction to metal forming operations. Factors affecting deformation and workability. Processes of forging, roll-

ing, extrusion, and wire drawing. Die materials and geometry. Deformation parameters and processing defects.

4.643 Metallurgical Engineering 2D S2 L2T1

Prerequisites: 4.412A, 4.732.

Fracture mechanisms. Classification of macroscopic and microscopic fracture mechanisms in metals. Initiation and propagation of ductile, brittle, fatigue, creep, stress-corrosion and corrosion-fatigue fracture. Effect of metallurgical defects and design deficiencies on origin and cause of fracture. Analysis of various models of fracture using metallographic and scanning transmission electron fractographic techniques. Studies of case histories of engineering service failures.

4.644 Metallurgical Engineering 3D S2 L2T2

Prerequisite: 4.453.

Welding engineering. Welding metallurgy, welding of structural steels, Q and T steels, stainless steels. Welding of aluminium alloys. Welding codes and standards. Welding processes, SMAW, GMAW, FCAW, SAW. Resistance welding, robotic welding. Electron-beam welding, laser welding. Non-destructive testing X-ray and gamma radiography, ultrasonic and eddy current testing.

4.654 Metallurgical Engineering 3E S2 L1T3

Prerequisites: 4.633, 4.643.

Engineering design. Engineering design codes of practice, experimental and theoretical stress analysis and fracture mechanics. Design codes and statutory regulations with emphasis on selection of materials for service conditions. Design approaches to fatigue and brittle fracture are treated in terms of contemporary rules for approaches to fatigue and dynamic loading and low temperature service. Stress analysis component is presented in terms of both experimental techniques and numerical analysis using finite element computer programs. Emphasis in laboratory classwork is on electrical resistance strain gauge techniques but other techniques are also applied. Quantitative design against fracture in terms of linear elastic fracture mechanics and elastic plastic fracture mechanics using COD and J integral approaches is presented with reference to case studies.

4.664 Surface Treatments and Wear S2 L1T1

Prerequisite: 4.623B.

Coatings for corrosion prevention, engineering and decorative purposes. Specifications for coating systems. Electrochemical and other metallic coatings. Non-metallic coatings. Selection, testing and evaluation of coatings. Classification of wear modes. Mechanisms of adhesive and abrasive wear. Selection, testing and evaluation of materials for wear mitigation. Wear-resistant materials, wrought and cast steels, cast iron, hard-facing and non-metallic materials.

4.674 Mathematical Plasticity S2 L1

Prerequisite: 4.633.

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.

4.684 Transport Phenomena in Metallurgical Processes S1 or S2 L1

Co- or prerequisite: 4.614.

Control of many metallurgical processes and design of suitable plant depend on an appreciation of factors affecting rate of reaction. In many cases, especially when conditions are far from equilibrium, transport of heat and/or mass is rate limiting.

Deals with application of transport processes (fluidised flow, heat and mass transfer) to a number of typical processes. Illustration from: iron-making, steelmaking, combustion, fluidized bed processing, leaching, solvent extraction, vacuum processing.

4.704 Design With Brittle Materials S1 or S2 L1½ T1½

Pre-requisites 4.732 or 8.6110

Materials with stiffness and resistance to wear, chemical attack and high temperature. Effects of composition and ceramic microstructure on mechanical properties. Strength and fracture theories; brittle fracture. Effect of time under load. Design principles; effect of thermomechanical stress. Design for loaded components. Selection of materials. Inspection and non-destructive testing and evaluation. Standards.

4.712 Materials Engineering 1A S1 L1T2½

Fluids. Applications of principles of fluid flow to primary and secondary metallurgical practice. Course examples are drawn from metallurgical engineering practice in the broadest sense. Corrosion in marine heat exchangers. Energy conservation in the selection of fluid meters for blast furnaces. Float-out of non-metallic inclusions in steel melts. Erosion and emptying rates of BOF vessels. Metal tapping from furnaces. Ladle-to-ladle vacuum degassing. Corrosion in the liquid metal coolant circuit of a fast breeder reactor. Sinter strands. Blast furnace hanging. Gas entrainment in falling metal streams. Metallurgical applications of fluidized beds. Particulate removal from process off-gases.

4.713 X-Ray Diffraction and Electron Microscopy S1 L2T2

Prerequisite: 4.412A or 4.212

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

4.722 Materials Engineering 1B S2 L1T2½

Prerequisite: 4.712.

Heat Applications of principles of steady and unsteady state heat transfer to primary and secondary metallurgical practice. Course examples are drawn from metallurgical engineering practice in broadest sense: Heat treatment of metals. Water-side corrosion in heat exchangers. Continuous casting. Aluminium smelting, electroslog refining, liquid metal-cooled nuclear

reactors. Refining zinc in the Imperial Smelting Furnace. Gas cooling system for arc furnace fume collection. Economic thickness of kiln walls.

4.732 Mechanical Properties of Materials

S1 L2T2

Prerequisite: 5.0011. *Co-requisite:* 4.412A.

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.

4.742 Physics of Materials

S2 L2T1

Pre-requisite: 1.001 or 1.011.

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

4.752 Thermodynamics of Materials 1

S2 L2 T1

Prerequisite: 2.102A

Fundamental principles of the thermodynamics of closed and open systems. Phase equilibria, the stability and composition of co-existing 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, analytic and diagrammatic representation of thermo-dynamic properties. Mass and energy balances. Application of thermodynamics to materials properties and preparation.

4.753 Thermodynamics of Materials 2

S1 L2 T1½

Prerequisite: 4.752

Thermodynamics functions of mixing, excess and integral mixing functions. Thermodynamic stability and models of solutions, standard states. Long-range order in solutions, interstitial solution. Calculation of phase diagrams. Thermodynamics of interfaces and surfaces. Statistical thermodynamics of solutions. Thermodynamics of irreversible processes. Computer programs for calculation of thermodynamic functions of mixing. Experimental methods in thermodynamics. Application of thermodynamics in material behaviour and reactivity and in industry.

4.694 Air Pollution control in the Metallurgical Industry

S1 or S2 L½T½

Case studies of emission survey, measurements and compliance program planning in the primary and secondary metallurgical industries.

4.823 Numerical Methods

F L1T½

Prerequisite: 10.031.

Consists of Unit 2 — Numerical Methods of 4.633 Metallurgical Engineering 2C.

4.913 Materials Science

F L2T1

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

4.934 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.

4.942 Materials for Mining Engineers

F L2T1

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.

4.964 Materials Science and Engineering for Electrical Engineers

S2 L3T1

Prerequisite: 1.982 Solid State Physics.

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

Graduate Study

For Information Key refer to page 7.

4.201G Graduate Materials Seminar **F L1T1**

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.

4.211G Metallurgical Practice **S1 or S2**

Studies relating to one or more specialised areas such as founding, welding, corrosion.

4.221G Advanced Metallurgical Techniques **S1 or S2**

Lectures and laboratory work in such areas as metallography, electron microscopy, stress analysis, fracture mechanics, mechanical testing and electrochemical techniques.

4.231G Advanced Theoretical Metallurgy **S1 or S2**

Topics drawn from physical, chemical and mechanical metallurgy.

4.241G Graduate Materials Project **F6**

An experimental, technical investigation or design project, including a written thesis.

4.251G Advanced Materials Technology **S1 or S2**

Principles of materials selection, selection of materials based on engineering design criteria, materials, specifications and principles and methods of non-destructive testing.

School of Mines

School of Mines

Head of School

Professor G. Hocking

Executive Assistant to Head of School

Dr. C. R. Ward

Administrative Assistant

Miss L. A. Bruce

The School of Mines, which was formed in 1986, consists of three Departments corresponding to the three main professions on which the mining and minerals industry of Australia depends. These are the Departments of Applied Geology; Mining Engineering; Mineral Processing and Extractive Metallurgy.

Prior to the formation of the School of Mines, Applied Geology and Mining Engineering were separate Schools and Mineral Processing and Extractive Metallurgy (sometimes 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 Mineral 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 Mineral 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 mineral 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 of the Departments 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

Professor J. Roberts

Administrative Officer

Miss L. A. Bruce

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 Mineral Processing and Extractive Metallurgy

Head of Department

Associate Professor R.G. Robins

Mineral Engineering comprises those professional activities required for the extraction of valuable components from mined

ore, and their conversion into refined metals and similar products used in the manufacturing industries. Graduates from the Mineral Engineering degree course are capable of the professional activities of research and development, design and commissioning of processes and plants, and operation and supervision of production plants in the mineral industry.

The mineral industry is diverse in scope, scale and location. It produces refined metals, construction materials, coal and coke, and a wide variety of other products such as chemicals, ceramics, abrasives and paints. Every mineral deposit has some unique characteristics that influence the extraction processes. Also each deposit is limited in quantity, consequently new ones must be continually investigated and developed. There is, therefore, a progressive challenge to mineral engineers to improve extraction methods and develop new techniques.

Department of Mining Engineering

Head of School

Professor F. F. Roxborough

Administrative Assistant

Vacant

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.

General Education Electives

For details of changes in the General Education requirements refer to the table earlier in this section.

Staff

School of Mines

Professor of Engineering, Geology and Head of School of Mines

Grant Hocking B.Tech C.E. S.A.I.T. MSc *N'de(U.K.)*, PhD DIC *London*, FGS, MAIME, MSRM

Executive Assistant to Head of School

Dr. C. R. Ward

Administrative Assistant

Miss L. A. Bruce

Department of Applied Geology

Professor and Head of Department

John Roberts, BSc *N.E.*, PhD *W. Aust.*

Professor of Geology

Gerald James Spurgeon Govett, DSc *Wales*, PhD DIC *London*, CEng, FIMM

Professor of Engineering Geology

Grant Hocking, B.Tech C.E. S.A.I.T., MSc *N'de(U.K.)*, PhD DIC *London*, FGS, MAIME, MSRM

Associate Professor

Philip Richard Evans, BA *Oxf.*, PhD *Brist.*, MAIG

Senior Lecturers

Alberto Albani, DrGeolSc *Florence*, MSc PhD *N.S.W.*
Chin Yoon Chork, BSc *Can.*, PhD *New Br.*, CEng, MIMM
Alistair Chisholm Dunlop, BSc *N.E.*, PhD *London*, DIC, MIMM
Bastiaan Jan Hensen, MSc *Ley.*, PhD *A.N.U.*
Michael Barry Katz, BS *Mich.T.U.*, MSc *McG.*, PhD *Tor.*
Michael John Knight, BSc PhD *MEib.*
Greg McNally, BSc *Syd.*, BA *N.E.*, MAppSc *N.S.W.*
Noel Merrick, BSc MSc *Syd.*, DipDP *N.S.W.I.T.*
William Alexander Mine-Home, BSc *Leic.*, MSc *London*, PhD *Alta.*, FGS
Gerrit Neff, BSc *London*, PhD *Well.*, FGS
Ittikhar Rasul Qureshi, MSc *Panji.*, PhD *Glas.*, FGS
Peter Cyril Rickwood, BSc *London*, PhD *Cape T.*, CChem, MRIC
Geoffrey Robert Taylor, MSc *Birm.*, PhD *N.E.*, FGS, MIMM, AMAusIMM
Colin Rex Ward, BSc PhD *N.S.W.*, MAusIMM, MAIG
Robert James Whitely, MSc *Syd.*, PhD *N.S.W.*

Lecturer

Paul Gordon Lennox, BSc *Tas.*, PhD *Monash*

Tutor

Malcolm David Buck, MSc *Waik.*

Honorary Associates

Frederick Charles Loughnan, BSc *Syd.*, PhD DSc *N.S.W.*

Stephen Scott Webster, MSc *Syd.*, MSEG, MASEG, MEAEG

Administrative Assistant

Lynne Anne Bruce

Project Scientist

Frederick Ivor Roberts, BSc *N.S.W.*, PhD *W'gong.*, AMAusIMM

Professional Officers

Zaynab Fidahsayn Muhammad Aly, MSc *Lond.*

Peter Richard Atherden, BSc *N.S.W.*, MSc *Macq.*

Mark Francis Reddy, BSc *N.S.W.*

Department of Mineral Processing and Extractive Metallurgy

Associate Professor and Head of Department

Robert George Robins, MSc PhD *N.S.W.*, MAmerChE, ARACI, AMAusIMM

Professor of Chemical and Extractive Metallurgy

Vacant

Associate Professor

Alan Philip Prosser, BSc PhD *DIC Lond.*, ARCS, ARACI, AMAusIMM

Senior Lecturer

David Ronald Young, BSc(Eng) PhD *Lond.*, ARSM, AMAusIMM

Lecturers

Peter Nigel Holtham, BSc *Leeds*, MSc *Manc.*, AMAusIMM

Tam Tran, BSc PhD *N.S.W.*, MAmerChE, ARACI, MAIME

Honorary Associate

Bernhard John Frederick Ralph, BSc *Tas.*, PhD *Liv.*, FRACI, FFTS

Department of Mining Engineering

Professor and Head of Department of Mining Engineering

Frank Ferdinand Roxborough, BSc PhD *Durh.*, CEng, FIE Aust, FIMinE, FIMM, MAusIMM

Professor of Mining Engineering

Leon John Thomas, BSc PhD *Birm.*, CEng, FIEAust, FIMinE, MAusIMM

Associate Professor

Edward George Thomas, BE PhD *Qld.*, MAusIMM, MAIME MCIMM

Senior Lecturers

Amal Krishna Bhattacharyya, BSc *Glas.*, MSc *Durh.*,

PhD *N'cle(U.K.)*, CEng, PEng, MIMinE, MCIMM, MAIME, MAusIMM

Gour Chand Sen, MSc *Wales*, PhD *Durh* CEng, FIEExpE, FIMinE, MAusIMM

Venkata Satyanarayana Vutukuri, BSc(Eng) *Bar.*, MS *Wis.*, MMGI, AIME, AMAusIMM

John Ormiston Watson BSc(Eng) *Nottm.* PhD *S'hampton*

Lecturers

Christopher Raymond Daly, BE MSc(Acoustics) *N.S.W.*, AIME

Drago Panich, BE *N.S.W.*, MSc *N'cle(U.K.)*

Administrative Assistant

Vacant

Professional Officers

Paul Carter Hagan, BE *N.S.W.*

Joseph Arthur Shonhardt, BSc(Tech) MSc *N.S.W.*, AIM, AMAusIMM

Centre for Groundwater Management and Hydrogeology

(in association with the Faculty of Engineering)

Director

Michael John Knight, BSc PhD *Melb.*, FGS, MIE Aust

Deputy Director

Colin Raymond Dudgeon, BE ME PhD *N.S.W.*

Senior Staff Member

Keith Kingsford Watson, BE ME PhD *N.S.W.*, DSc, FIE Aust

Senior Lecturers

William Alexander Milne-Horne, BSc *Leic.*, MSc *Lond.*, PhD *Alta.*, FGS

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

Professional Officers

Robert Gregor McLaughlan, BSc Grad Dip MAppSc *N.S.W.*

Anna Eade, BSc *N.S.W.* DipComProg

Administrative Assistant

Beverley Ann Colin

Centre for Waste Management

(in association with the Faculty of Engineering)

Director

Vacant

Deputy Director

Michael John Knight, BSc PhD *Melb.*, FGS, MIE Aust

Lecturer

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

Aust

Course Outlines

Undergraduate Study

Department of Applied Geology

The degree course in Applied Geology is of four years' duration and leads to a BSc degree at Pass or Honours level. It provides a comprehensive education in all aspects of earth science, with emphasis on the skills and applications required for professional practice of geology in the mineral industry, construction and development, or related areas. Graduates are prepared by the course to enter any branch of the geological profession, and to change their area 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 one or more other science subjects is essential. Students will take programs designed to bring them up to a satisfactory standard of physics and chemistry in year 1. Students who have reached a satisfactory standard in HSC geology may be offered an alternative program in Year 1.

A three-year full-time course in Geology, and courses that combine a single major in Geology with Physics, Chemistry, Mathematics, or Botany and Zoology, and courses that combine Geology with Geophysics and Geography are available to students in the Faculty of Science. Provision is also made for part-time study in the first year of Geology within that Faculty. Selected students in the Faculty of Science may study for an Honours degree in Geology.

Master of Applied Science degree courses in Engineering Geology, Hydrogeology, Environmental Geology, Mineral Exploration, Exploration Geochemistry and Exploration Geophysics are offered on a part-time or a full-time basis. The courses are designed to provide specialized training in practical applications to these fields.

General Education Electives

For details of changes in the General Education requirements refer to the table earlier in this chapter.

3000

Applied Geology — Full-time

Bachelor of Science BSc

Year 1

		Hours per week	
		S1	S2
1.001	Physics 1	6	6
OR			
1.021	Introductory Physics	6	6
2.121	Chemistry 1A*	6	0
2.131	Chemistry 1B	0	6
10.001	Mathematics 1 or		

10.011	Higher Mathematics or		
10.021B	General Mathematics 1B and	6	0
10.021C	General Mathematics 1C	0	6
25.110	Earth Materials and Processes**	6	0
25.120	Earth Environments and Dynamics**	0	6
		<u>24</u>	<u>24</u>

*Students without the specified prerequisite for 2.121 will be required to take either a Chemistry Bridging Course or 2.111, Introductory Chemistry before enrolling in this subject.

**Up to 2 days of field tutorials in 25.110, Earth Materials and Processes and up to 4 days in 25.120, Earth Environments and Dynamics are essential parts of these subjects. Attendance is compulsory.

Year 2

25.211	Earth Materials 1**	6	0
25.212	Earth Environments 1**	6	0
25.221	Earth Materials 2***	0	6
25.223	Earth Physics*	0	6
25.2261	Mathematical Geology 1	0	3
	General Education Elective	2	2
		<u>14</u>	<u>17</u>

*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.

Students take Ancillary Subjects equivalent to 2 units from Table 1 of the Combined Sciences Handbook.

		Hpw	
		S1	S2
Year 3			
25.311	Earth Materials 3	6	0
25.321	Earth Materials 4*	0	6
25.312	Earth Environments 2**	6	0
25.333	Exploration Geophysics	3	2
25.3162	Mathematical Geology 2	3	0
25.314	Mineral and Energy Resources 1***	6	0
25.324	Mineral and Energy Resources 2*	0	6
25.325	Engineering and Environmental Geology***	0	6
25.3261	Geochemical Analytical Techniques	0	2
25.3271	Structural Geology*	0	2
	General Education Elective	2	2
		<u>26</u>	<u>26</u>

*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

		S1 \$		S2
		A	B	
25.410	Resource Geology*	12	4	
25.420	Field Project			
25.4101	Topics in Advanced Geology			24
			6	
		<u>12</u>	<u>10</u>	<u>24</u>

and either

Hours per week

A. Mineral Resources strand, consisting of

	S1\$	
	A	B
7.013 Principles of Mining	2	2
7.044 Mining Economics	4	4
25.4141 Mineral Exploration	5	
25.4142 Geological Sampling and Analytical Methods**		4
25.4143 Research Project		5
	<hr/> 11	<hr/> 15

or

**B. Sedimentary Basin Resources strand,
consisting of**

	S1\$	
	A	B
25.4121 Advanced Sedimentology	7	7
25.4122 Seismic Stratigraphy and Log Analysis		4
25.4123 Geology of Selected Oil and Gas or Coal Fields	4	
25.4124 Palynology or Foraminiferal Micropalaeontology		4
	<hr/> 11	<hr/> 15

or

**C. Engineering and Environmental Geology
strand, consisting of**

	S1\$	
	A	B
25.4151 Hydrogeology	3	3
25.4152 Engineering Geology	3	3
25.4153 Environmental Geology	3	3
25.4154 Engineering Geology Project	2	6
	<hr/> 11	<hr/> 15

S1\$

or

D. Geophysics strand, consisting of**

	A	B
25.4122 Seismic Stratigraphy and Log Analysis		4
25.9311 Gravity and Magnetic Methods	3	3
25.9312 Seismic Methods	3	3
25.9313 Electrical Methods	3	3
25.9315 Regional Geophysics		2
and either		
25.4141 Mineral Exploration	5	
or		
25.4123 Geology of Selected Oil and Gas or Coal Fields	4	
	<hr/> 13/14	<hr/> 15

\$Session 1 is divided into 2 segments of 7 weeks each. Hours listed under A apply to weeks 1-7; those under B apply to weeks 8-14.

* Field work of up to 7 days is a compulsory part of this subject.

**Field work of up 3 days is a compulsory part of the subject of the strand.

Department of Mineral Processing and Extractive Metallurgy

The Department offers an undergraduate course of four years duration leading to the award of a BE degree at pass or honours level. This course meets the formal requirements for admission to the professional mining and metallurgical institutions.

A double degree in Chemical Engineering and Mineral Engineering, Bachelor of Engineering/Bachelor of Science degree is available. Students may be awarded honours BE/BSc double degree for distinguished performance over five years of study. Refer to School of Chemical Engineering.

The Mineral Engineering course is based on a broad spectrum of mathematics, physics, chemistry, geology, mineralogy and chemical engineering, and specializes in mineral processing, extractive metallurgy and process plant design.

A Master of Applied Science degree course in Mineral Engineering is also offered.

3126

Mineral Engineering — Full-time Course

Bachelor of Engineering BE

Year 1		Hours per week	
		S1	S2
1.001	Physics 1	6	6
2.121	Chemistry 1A and	6	0
2.131	Chemistry 1B	0	6
5.0011	Engineering Mechanics 1	4	0
5.0012	Introduction to Engineering Design and Materials	2	0
5.0302	Engineering Drawing and Descriptive Geometry	0	4
7.610	Introduction to Mining and Mineral Engineering	0	2
10.011	Higher Mathematics 1 or		
10.001	Mathematics 1	6	6
		<u>24</u>	<u>24</u>

Year 2

	S1	S2
2.102A Physical Chemistry	6	0
7.621 Mineral Engineering Science 1	0	3
7.622 Mineral Engineering 1	3	3
7.623 Mineral Engineering Laboratory 1	0	3
10.031 Mathematics	2	2
10.301 Statistics SA	2	2
25.520 Geology for Mining Engineers 1	2	2

		Hours per week	
48.021	Chemical Engineering 1A		
	Unit 1 Heat Transfer 1	0	2
	Unit 2 Computations	1	1
	Unit 3 Dimensions and Dimensional Analysis	1	0
48.301	Fuel Engineering (for mining engineers)	3	3
	General Education Subject	2	2
		<u>22</u>	<u>23</u>

Year 3

4.972	Materials for Mining Engineers	2	2
6.854	Electrical Power Engineering	0	3
7.113	Mining Methods	2	2
7.631	Mineral Engineering Science 2	5	0
7.632	Mineral Engineering 2	3	3
7.633	Mineral Engineering Laboratory 2	3	3
10.032	Mathematics	2	2
25.523	Mineralogy	2	2

48.031	Chemical Engineering 2A		
	Unit 1 Mass Transfer Theory	2	0
	Unit 2 Heat Transfer 2 (Theory)	1	0
48.136	Reactor Design	1	2
48.163	Instrumentation and Process Control 1	0	3
	General Education Subject	2	2
		<u>25</u>	<u>24</u>

Year 4

7.214	Mine Economics and Planning	4	4
7.642	Mineral Engineering 3	6	6
7.643	Mineral Engineering Projects and Laboratory	6	9
48.041	Chemical Engineering 3A		
	Unit 2 Simultaneous Heat and Mass Transfer	1	0
	Unit 4 Transport Phenomena	1	0
48.042	Chemical Engineering 3B		
	Unit 2 Optimization	1	0
	Professional Electives*	3	3
	General Education	2	2
		<u>24</u>	<u>24</u>

*Professional Electives: Appropriate subjects to the total of six session hours may be nominated. A list of some such subjects is available from the Head of School.

3129

Chemical Engineering/Mineral Engineering — Full-time Course

Bachelor of Engineering/Bachelor of Science BE/BSc

Refer to School of Chemical Engineering and Industrial Chemistry section.

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 as that for 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
1.001	Physics 1	6	6
2.951	Chemistry 1 (ME)	6	0
5.0011	Engineering Mechanics 1	4	0
5.0721	Computing	0	3
7.011	Stress Analysis in Mining 1	0	3
7.021	Mining, Minerals and the Environment*	0	3
7.031	Descriptive Engineering	2	0
7.041	Technical Communication	0	3
10.001	Mathematics 1	6	6
		24	24

*Visits to mines and related undertakings are a requirement of this subject.

Year 2		Hours per week	
		S1	S2
1.9222	Electronics	3	0
4.942	Materials for Mining Engineers	3	3
6.854	Electrical Power Engineering	0	3
7.012	Stress Analysis in Mining 2	3	0
7.132	Fluid Mechanics and Thermodynamics	2	2
7.142	Mine Development*	2	0
7.172	Microcomputers (Mining)	2	0
10.022	Engineering Mathematics 2	4	4
10.301	Statistics SA	2	2
25.520	Geology for Mining Engineers**	2	2
29.441	Surveying for Engineers	0	6
29.491	Survey Camp	0	0
	General Education Subject	2	2
		25	24

*Visits to mines and related undertakings are a requirement of this subject.

**Includes two compulsory field tutorials.

Year 3		Hours per week	
		S1	S2
7.113	Mining Methods	2	2
7.1231	Geomechanics A	3	0
7.1232	Geomechanics B	0	2
7.133	Mine Transport	0	3
7.153	Power Supply in Mines	2	0
7.163	Excavation Engineering	2	2
7.173	Computer Applications in Mining	1	1
7.183	Mine Ventilation and Drainage	2	2
7.213	Mine Surveying	2	0
7.223	Mine Feasibility Studies	0	1
7.433	Mining Laboratory	2	2
7.7342	Minerals Engineering Processes	3	3
25.530	Geology for Mining Engineers 2*	4	4
	General Education Subject	2	2
		25	24

*A geology field excursion is held in Session 2.

Year 4		Hours per week	
		S1	S2
7.114	Geotechnical Engineering	2	2
7.174	Mining Legislation	0	2
7.214	Mine Economics and Planning	4	2
7.224	Operational Management	2	2
7.304	Mine Safety Engineering	2	2
7.414	Minerals Industry Project	5	5
7.424	Industrial and Research Seminars	1	1
	General Education Subject	2	2

together with an approved group of three advanced subjects selected from the following

7.104	Underground Coal Mining*	2	2
7.144	Surface and Offshore Mining	2	2
7.184	Underground Metalliferous Mining*	2	2
7.194	Tunnel Engineering and Shaft Sinking	2	2
7.744	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.

Graduate Study

Department of Applied Geology

8020

Engineering Geology-Hydrogeology- Environmental Geology Course

Master of Applied Science MAppSc

The course consists of a Project (Group A) and six subjects chosen from Group B, at least one of which must be 25.702G Hydrogeology, 25.704G Environmental Geology, or 25.708G Engineering Geology.

The Project normally consists of field and laboratory work, and is related to the student's major interest. Students must consult the Professor of Engineering Geology for approval of the Project.

Group A		Hours per week	
		S1	S2
25.703G	Project (Engineering Geology Graduate Course)	0	18

Group B		Hours per week	
		S1	S2
25.702G	Hydrogeology	3	0
25.704G	Environmental Geology	3	0
25.705G	Engineering Geophysics	3	0
25.706G	Geological Basis of Geomechanics	3	0
25.707G	Geopollution Management	3	0
25.708G	Engineering Geology	3	0
25.710G	Coastal Environmental Geology	3	0
8.788	Site Investigations	3	0

8091

Mineral Exploration Graduate Course

Master of Applied Science MAppSc

The course is designed to give broad training in techniques of modern mineral exploration to geologists and mining engineers. Practical aspects are emphasized 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, 25.000G, 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)

25.800G	Seminar
25.801G	Geology in Exploration 1
25.802G	General Introduction to Exploration Geophysics
25.803G	Introduction to Exploration Geochemistry
28.804G	Introduction to Data Processing and Interpretation
25.805G	Resource Economics 1
and either	
25.807G	Exploration Geophysics
or	
25.808G	Exploration Project
or	
7.013*	Principles of Mining
and	
7.044*	Mining Economics

Seven days of field tutorials are an integral part of Unit A.

*These are one session subjects, ie weeks 1-14.

Unit B (Weeks 8-14 Session 1)

25.811G	Advanced Geology in Exploration
25.815G	Resource Economics 2
25.816G	Remote Sensing
25.817G	Mining Law and Exploration Management
25.840G	Seminar
7.001G	Exploration Drilling
and either	
7.013*	Principles of Mining
and	
7.044*	Mining Economics
or	
25.818G	Exploration Project

*These are one session subjects, ie weeks 1-14.

Unit C (Session 2)

25.819G	Field — Laboratory Project
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8092

Exploration Geophysics Graduate Course

Master of Applied Science MAppSc

This is a specialized course in the techniques of exploration geophysics relevant to the current needs of the exploration industry. Practical applications are emphasized, 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, 25.000G, 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)

- 25.800G Seminar
- 25.801G Geology in Exploration 1
- 25.802G General Introduction to Exploration Geophysics
- 25.803G Introduction to Exploration Geochemistry
- 25.804G Introduction to Data Processing and Interpretation
- 25.805G Resource Economics 1
- 25.807G Exploration Geophysics

Seven days field tutorials are an integral part of Unit A.

Unit B (Weeks 8-14 Session 1)

- 25.831G Geological Interpretation
- 25.832G Advanced Exploration Geophysics
- 25.840G Seminar

Unit C (Session 2)

- 25.839G Field — Laboratory Project

8093

Exploration Geochemistry Graduate Course

Master of Applied Science MAppSc

This is a specialist course in the techniques of exploration geochemistry covering general principles, specific field applications, laboratory techniques, and data display and interpretation. Practical applications are emphasized and the field-laboratory project is designed to investigate aspects of mineral 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, 25.000G, 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)

- 25.800G Seminar
- 25.801G Geology in Exploration 1

- 25.802G General Introduction to Exploration Geophysics
- 25.803G Introduction to Exploration Geochemistry
- 25.804G Introduction to Data Processing and Interpretation
- 25.805G Resource Economics 1
- and either
- 7.013* Principles of Mining
- and
- 7.044* Mining Economics
- or
- 25.808 Exploration Project

Seven days field tutorials are an integral part of Unit A.

*These are one session subjects, ie weeks 1-14.

Unit B (Weeks 8-14 Session 1)

- 25.831G Geological Interpretation
- 25.832G Advanced Exploration Geophysics
- 25.840G Seminar

Unit C (Session 2)

- 25.829G Field — Laboratory Project

Refer to Graduate Study section in the School of Geography for the following graduate courses:

- 5025 Graduate Diploma in Arid Land Management
- 8025 Master of Applied Science in Arid Land Management
 - Hydrogeology
 - Terrain Management
- 5026 Graduate Diploma in Remote Sensing
- 8026 Master of Applied Science in Remote Sensing
- 8045 Master of Environmental Studies

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. An M AppSc degree in Hydrogeology and Groundwater Management is planned for implementation in 1989.

8021

Hydrogeology and Groundwater Management Graduate Course Master of Applied Science MAppSc

Core Subjects

		Credits	Session
25.702G	Hydrogeology	3	1
8.880G	Groundwater Modelling	3	1
7.937G	Hydrogeochemistry	3	1
8.875G	Hydrological Processes	3	1

Co-requisite Subject (as required for 25.721G and 7.937G)
(satisfactory level required to be achieved)

25.717G	Computing for Groundwater Specialists
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Options

25.707G	Geopollution Management
25.716G	Groundwater Geophysics
25.718G	Remote Sensing of Groundwater Resources
8.843G	Groundwater Hydraulics
8.847G	Water Resources Policy*
8.849G	Irrigation*
8.850G	Drainage of Agricultural land*

Project

25.719G	Groundwater Research Project (C18)
25.720G	Groundwater Project (C12)

*Existing subject not offered each year

Centre for Waste Management

The Centre for Waste Management is a joint enterprise of the Faculties of Applied Science and Engineering, that co-ordinates and develops teaching and research in the multidisciplinary area of waste management. Waste management is concerned with the study of treating, controlling and disposing of industrial and domestic wastes as applied to the analysis of waste disposal technologies. Particular emphasis is placed on the safe treatment, disposal and resource recovery of solid and liquid wastes.

8085 Waste Management Graduate Course

Master of Applied Science MAppSc

Candidates are required to complete a course totalling at least 36 credits, made up of compulsory subjects, elective subjects and a project or a Research Project. The degree may be obtained internally on a full-time (normally 2 sessions of 18 credits) or part-time (normally 4 sessions of 9 credits) basis. An external course program is also offered (normally over 4 sessions). Selection of subjects for formal course must be approved by Director. A candidate must normally complete 18 credits of core subjects.

Core Subjects

		Credits	Session
8.872G	Management of Wastes	3	2
8.873G	Waste and Wastewater Analysis and Environmental Requirements	3	1
8.874G	Waste Management Science	3	1

25.715G	Sources of Waste and Landfill Disposal	3	1
48.067G	Treatment, Disposal and Resource Recovery of Solid and Liquid Wastes	3	2
48.388G(X)	Unit Operations in Wastewater Sludge and Solids Management	3	1

8.881G Hazardous Waste Management. Elective Subjects

7.152G	Mining Conservation
7.535X	Mine Fill Technology
48.391G(X)	Atmospheric Pollution Control (Theory)
48.392G(X)	Atmospheric Pollution Control (Practical Aspects)
8.857G	Sewage Treatment and Disposal
8.870G	Hydraulics and Design of Water and Wastewater Treatment Plants
25.702G	Hydrogeology
25.707G	Geopollution Management
25.704G	Environmental Geology
46.203G	Medical Aspects
46.204G	Legislative Aspects
46.512G	Project in Waste Management
46.513G	Research project in Waste Management
47.481G	Management of Dangerous Materials
47.120G	Human Behaviour and Safety Science
48.063G	Industrial Water and Wastewater Engineering

8.881G Hazardous Waste Management.

5070

Waste Management Graduate Diploma Course

Graduate Diploma GradDip

Candidates are required to complete a course totalling at least 30 credits made up of compulsory subjects, elective subjects and a 3 credit report. The diploma may be obtained full-time (normally 2 sessions of 15 credits) 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. A candidate must normally complete 18 credits of core subjects.

Core Subjects

		Credits	Session
8.872G	Management of Wastes	3	2
8.873G	Waste and Wastewater Analysis and Environmental Requirements	3	1
8.874G	Waste Management Science	3	1
25.715G	Sources of Waste and Landfill Disposal	3	1
48.067G	Treatment, Disposal and Resource Recovery of Solid and Liquid Wastes	3	2
48.388G	Unit Operations in Wastewater Sludge and Solids Management	3	1

Elective Subjects

7.152G	Mining Conservation
7.535X	Mine Fill Technology
48.391G(X)	Atmospheric Pollution Control (Theory)

48.392G(X)	Atmospheric Pollution Control (Practical Aspects)
8.857G	Sewage Treatment and Disposal
8.870G	Hydraulics and Design of Water and Wastewater Treatment Plants
25.702G	Hydrogeology
25.707G	Geopollution Management
25.704G	Environmental Geology
46.203G	Medical Aspects
46.204G	Legislative Aspects
46.511G	Report in Waste Management
47.481G	Management of Dangerous Materials
47.120G	Human Behaviour and Safety Science
48.063G	Industrial Water and Wastewater Engineering

Department of Mineral Processing and Extractive Metallurgy

8055 Mineral Engineering Graduate Course Master of Applied Science MAppSc

The course is under revision and will not be offered until 1990.

Department of Mining Engineering

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 back

ground undergraduate subjects, as directed by the Head of Department.

The program consists of formal study equivalent to nine to ten hours of lectures per week, depending on the subjects chosen, for two years on a part-time external basis. Not less than 20 per cent of the total program consists of a project on an approved topic covering a field or laboratory investigation of a mining geomechanics problem.

Three of the subjects, in addition to the project, form a compulsory core strand. These are augmented by a range of elective, optional subjects. A grouping of five options (including selections from undergraduate subjects, where appropriate) may 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.

Core Subjects	Hours per week	
	S1	S2
7.515X Rock Mechanics Measurements	3	3
7.525X Strata Control Engineering	3	0
8.776G Rock Mechanics	0	3

Project

7.455X Mining Geomechanics Project	4	4
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Optional Subjects

Group A

	Hours per week	
	S1	S2
7.535X Mine Fill Technology	2	2

	Hours per week	
	S1	S2
7.545X Advanced Rock Cutting Technology	2	2
7.555X Blasting Technology	2	2
7.565X Rock Slope Stability	2	2
7.575X Subsidence Engineering	2	2
7.585X Economics and Management of Geomechanics Projects	2	2

Group B

8.777G Numerical Methods in Geomechanics	0	3
25.702G Hydrogeology	0	3
25.706G Geological Basis of Geomechanics	3	0
25.708G Engineering Geology	3	0

The program is arranged as follows:

Year 1

The core subjects are taken, together with any approved combination consisting of *either* two options from Group A *or* one

option each from Group A and Group B. In certain cases optional subjects may be replaced by undergraduate subjects up to a total of 25 per cent of the total program, subject to the approval of the Head of Department.

Year 2

The project is carried out in Year 2, together with the remaining options or undergraduate subjects of the approved program.

Students may take three options from Group A or two options from Group A and one from Group B or one option from Group A and two Options from Group B.

5040

Mining and Mineral Engineering Graduate Diploma Course

Graduate Diploma GradDip

The Graduate Diploma course in Mining and Mineral Engineering is designed to provide professional training for graduates in Science, Applied Science or Engineering who wish to specialize in the fields of mining and mineral beneficiation. The course is concerned primarily with instruction in the scientific and engineering principles associated with the mining and beneficiation of minerals and coal.

The Graduate Diploma in Mining and Mineral Engineering (GradDip) will be awarded on the successful completion of one year full-time or two years part-time study. The course is a blend of lecture and laboratory work and allows the choice of elective specialization in either mining engineering or mineral processing and coal preparation.

It should be noted that some degree of specialization will be possible in the laboratory investigations.

When appropriate, certain sections of the course may be offered as a unit over a short period of time to permit mineral industry personnel to attend the advanced course in a particular area of that discipline.

Core Subjects

Hours per week

	S1	S2
7.515X Rock Mechanics Measurements	3	3
7.525X Strata Control Engineering	3	0
8.776G Rock Mechanics	0	3

Project

7.455X Mining Geomechanics Project	4	4
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Optional Subjects

Group A

Hours per week

	S1	S2
7.535X Mine Fill Technology	2	2
7.545X Advanced Rock Cutting Technology	2	2
7.555X Blasting Technology	2	2
7.565X Rock Slope Stability	2	2
7.575X Subsidence Engineering	2	2
7.585X Economics and Management of Geomechanics Projects	2	2

Group B

8.777G Numerical Methods in Geomechanics	0	3
25.702G Hydrogeology	0	3
25.706G Geological Basis of Geomechanics	3	0
25.708G Engineering Geology	3	0

The program is arranged as follows:

Year 1

The core subjects are taken, together with any approved combination consisting of *either* two options from Group A or one option each from Group A and Group B. In certain cases optional subjects may be replaced by undergraduate subjects up to a total of 25 per cent of the total program, subject to the approval of the Head of Department.

Year 2

The project is carried out in Year 2, together with the remaining options or undergraduate subjects of the approved program.

Students may take three options from Group A or two options from Group A and one from Group B or one option from Group A and two Options from Group B.

Subject Descriptions

Undergraduate Study

Departments of Mining Engineering and Mineral Processing and Extractive Metallurgy

Mining Engineering and Mineral Processing and Extractive Metallurgy are Departments within the School of Mines.

7.011 Stress Analysis in Mining 1 S2 L1T2

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.

7.012 Stress Analysis in Mining 2 S1 L1T2

Prerequisite: 7.011

Statics in mining systems. Bending moments, shear force and torsion. Combined stresses, calculation of principal stresses and strains. Brittle behaviour and anisotropy. Time-dependent properties and creep. Computer methods of stress analysis.

7.013 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.

7.021 Mining, Minerals and Environment S2 L2T1

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.

7.031 Descriptive Engineering S1 L1T1

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.

7.041 Technical Communication S2 L1T2

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.

7.044 Mining Economics S1 L2T2

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.

7.104 Underground Coal Mining F L1T1

Prerequisites: 7.113, and 7.114, 7.1231, 7.1183.

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.

7.113 Mining Methods F L2

Prerequisite: 7.142.

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.

7.114 Geotechnical Engineering F L1T1

Prerequisites: 7.1231, 7.1232.

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 struc-

tures. 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.

7.1231 Geomechanics A

S1 L1½T1½

Prerequisite: 10.001. *Co-requisite:* 7.433.

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.

7.1232 Geomechanics B

S2 L1T1

Prerequisite: 10.001. *Co-requisite:* 7.433.

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.

7.132 Fluid Mechanics and Thermodynamics

F L1T1

Prerequisites: 1.001, 5.0011, 7.011, 10.001. *Co-requisite:* 10.022.

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.

7.133 Mine Transport

S2 L2T1

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.

7.142 Mine Development

S1 L2

Prerequisite: 7.021.

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.

7.144 Surface and Offshore Mining

F L1T1

Prerequisite: 7.113.

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.

7.153 Power Supply in Mines

S1 L1T1

Prerequisite: 1.9222, 6.854, 7.031, 7.132.

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.

7.163 Excavation Engineering

F L1

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 assessing rock cuttability. The design of cutting arrays for machine mining.

7.172 Microcomputers in Mining**S1 L1T1**

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.

7.173 Computer Applications in Mining**F L1**

Prerequisite: 7.172.

Simulation of mining problems. Application of selected programs to exploration, operations, economics and design.

7.174 Mining Legislation**S2 L2**

An appreciation of the laws relating to mining practice and to safety and health in mines.

7.183 Mine Ventilation and Drainage**F L1T1**

Prerequisites: 7.132, 7.142. *Co-requisite:* 7.433.

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 affecting 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.

7.184 Underground Metalliferous Mining**F L1T1**

Prerequisite: 7.113

Production, development and resource scheduling. Main development, stope development. Cyclic and continuous production systems — stope, 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.

7.194 Tunnel Engineering and Shaft Sinking**F L1T1**

Not available to students who have completed 7.164.

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.

7.213 Mine Surveying**S1 L1T1**

Prerequisite: 29.441.

Map projections and the Integrated Survey Grid. Statutory and other requirements relating to mine surveys and plans. Codes of practice. Limits of error. Dip, fault and other three-dimensional problems. Borehole surveys. Correlation of mine surveys with the Integrated Survey Grid. Correlation of underground and surface surveys. Shaft plumbing. Gyrotheodolite. Shaft depth and verticality surveys. Subsidence surveys. Specialised equipment and techniques.

7.214 Mine Economics and Planning**S1 L2T2 S2 L1T1**

Prerequisite: 7.113, 7.223

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. Project control, contracts. Insurance. Operating cost systems, discounted cash flow techniques applied to mine expansion and system modification. Replacement of mine plant.

7.223 Mine Feasibility Studies**S2L1**

Elements of mineral project cash flow. Application of numerical discounted cash flow techniques to economic analysis of mineral projects. Parameter sensitivity calculations.

7.224 Operational Management**F L1T1**

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.

7.234 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.

7.304 Mine Safety Engineering**F L1T1**

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 measure-

ment, hearing hazards and control. Mine lighting. Poisons and general toxic hazards. Radiation hazards. Loss control, accidents, accident investigations, safety programs. Safety and health legislation.

7.414 Minerals Industry Project F T5

Candidates are required to submit a dissertation 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.

7.424 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.

7.433 Mining Laboratory F T2

Co-requisites: 7.1231, 7.1232.

A program of laboratory experiments for Year 3 students requiring the submission of appropriate laboratory reports related to the syllabus areas of the co-requisite subjects.

7.610 Introduction to Mining and Mineral Engineering S1 L2

Mineral deposits, metallic, non-metallic and fuels. Elements of prospecting and exploration. Basic mining techniques. Mining phases: development, exploitation, and withdrawal. Mining and the environment. Mining services. Relevance of basic science and engineering subjects to mining design and operations. The unit operations of mineral processing and extractive metallurgy, related to end use of product and its market value. Safe disposal of waste material.

7.621 Mineral Engineering Science 1 S2 L2T1

Application of the principles of stoichiometry and thermodynamics to mineral processing and extractive metallurgy. Review of the laws of thermodynamics, material and energy accounting, the thermodynamic data sources, chemical and phase equilibria in pyrometallurgical systems, computer methods, theory of metal solutions, slags, fused salts and mattes. Application to combustion of fuels, roasting, chlorination, reduction of oxides, smelting of sulphides and refining of metals.

7.622 Mineral Engineering 1 F3

Unit 1 Physical Operations in Mineral Processing

Basic theory and applications to unit design of the physical operations in mineral beneficiation, breakage and comminution, screening, classification, flotation, gravity concentration, minor separation processes and de-watering. Integration of equip-

ment into complete flowsheets, case studies of operating plants to illustrate the factors that influence the flowsheet design.

Unit 2 Process Design for Mineral Extraction

Mineral extraction processes in terms of mechanisms and achievements. Overall extraction schemes. Quantitative analysis and computation in the solution of mineral engineering problems involving fluid flow, heat transfer, statistics, and mineralogy. End uses of minerals, the technical aspects of the market requirements and how these influence mineral processing and extractive metallurgy.

7.623 Mineral Engineering Laboratory 1 S2 T3

Laboratory exercises relevant to both mineral and metallurgical processing covering: experimental design, the gathering and interpretation of data used for the assessment of ores and minerals in order to determine the processes most suitable for their beneficiation and subsequent refinement or utilization.

7.631 Mineral Engineering Science 2 S1 L5

Unit 1 Physical and Chemical Characterisation of Mineral Particles

Physico-chemical and electrical characteristics of surfaces. Surface phenomena in flotation. Fluid particle dynamics and the characteristics of ores and ore pulps in relation to the handling of these materials. Fine particle statistics in mineral beneficiation.

Unit 2 Aqueous Thermodynamics and Hydrometallurgical Processes

Application of principles of aqueous thermodynamics, electrochemistry, chemical and electrochemical kinetics, to hydrometallurgical processes: leaching of minerals and concentrates, solution purification, precipitation, and other separation processes, ion-exchange and liquid-liquid extraction.

Unit 3 Elements of Geomechanics

Elements of geomechanics in relation to the classification, testing, handling and disposal of rocks and soils.

7.632 Mineral Engineering 2 F L3

Unit 1 Plant Performance

Plant performance monitoring and the analysis, computation and reporting of operating data. Analysis and evaluation of mineral processing operations and extractive processes.

Unit 2 Process Design 1

Integrated design of mineral processing and extraction circuits. The application of reaction engineering principles to the design and evaluation of mineral and metallurgical reactors and processes with consideration of unsteady state processes. Identification of the information required to select and design processes, dealing with deficiencies in information. Development of communication skills through the collection and presentation of technical information.

7.633 Mineral Engineering Laboratory 2**F T3**

Exercises in mineral processing and extractive metallurgy designed to develop investigational skills for: obtaining quantitative relations for process phenomena, testing the performance of a machine or reactor, simulating a process by a computer program. Instrumental analysis, quantitative measurements of the properties of minerals and particles, solutions and gases. Collection and interpretation of data from operating plants. Development of proficiency in technical report writing, and communication.

7.642 Mineral Engineering 3**F L3T3****Unit 1 Control and Simulation**

Problems in the automatic control and on-line analysis of mineral and metallurgical processes.

Unit 2 process Design 2

Methodologies and mineral engineering investigations, including statistical design of testwork, development of quantitative empirical relationships, sensitivity analysis, and development of theoretical relationships. Development of a systematic approach to technical decision-making, with industrial case studies.

Unit 3 Environmental Engineering

Origin and control of environmental hazards in mineral engineering. Disposal of waste materials.

7.643 Mineral Engineering Projects and Laboratory**S1 T6 S2 T9**

One major investigation based on a selected problem in mineral engineering. A second problem in process selection and design based on quantitative data for various options. A third project may be included as an exercise in selection and evaluation of information from the literature for a specific case study. Seminars.

7.714 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.

7.725 Chemical and Extractive Metallurgy 1**S2 L2T1**

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.

7.734 Mineral Process Engineering**S1 L2T1****7.7341 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.

7.7342 Minerals Engineering Processes**F L1T2**

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.

7.735 Chemical and Extractive Metallurgy 2**S1 L2T1½**

Metallurgical thermodynamics. Thermodynamic behaviour 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 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.

7.744 Mineral Process Technology**F L1T1**

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.

7.7451 Advances in Pyrometallurgy S1 or S2 L2

Advances in pyrometallurgy related to extraction and refining processes used for recovery of ferrous and non-ferrous metals.

7.7452 Advances in Hydrometallurgy S1 or S2 L1T1

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.

7.746 Mineral Process Chemistry

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 of 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.

7.748 Technical Decision Making S1 or S2 L1T1

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.

25.110 Earth Materials and Processes S1 L2T4

Stream 1

Constitution of the Earth. The Earth and the Solar System. The interior of the Earth: the crust and its chemical composition, gravity and isostasy. Minerals and rocks, economic mineral deposits. *Earth Processes.* The origin of igneous rocks; plutonism and volcanism. The geological cycle. Weathering processes, soil formation and landforms. The origin of sedimentary rocks; transportation, deposition, lithification. Arid, glacial and periglacial processes. Geological time. Metamorphism and metamorphic rocks. Structural geology, classification and origin of faults and folds. Quaternary stratigraphic sequences, neotectonics. *Field work* of up to two days is a compulsory part of the subject.

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.

25.120 Earth Environments and Dynamics S2 L2T4

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
and	
25.110	

*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).

Earth Environments. Introductory palaeontology, including the evolution of life, invertebrates and vertebrates. Principles of stratigraphy. The stratigraphy of New South Wales: Broken Hill, Lachlan Orogen, New England Fold Belt and Sydney Basin. Introductory stratigraphy of Australia from the Precambrian to the Recent. The mineralogical study of rocks; techniques and significance of mineralogy. Structural geology; stereographic and statistical treatment of structural data. *Earth Dynamics.* The evolution of ocean basins; sea-floor spreading and sea-level changes. Climates of the past. Geophysical methods of exploration; seismology and earthquake prediction. Plate tectonics and continental drift. *Field work* of up to four days is a compulsory part of the subject.

25.211 Earth Materials 1 S1 L2T4

Prerequisite: 25.120.

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 crystallization 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. *Field work* of five days is a compulsory part of the subject.

25.212 Earth Environments 1 S1 L3T3

Prerequisite: 25.120.

Sedimentology. Flow regimes and bedding forms, sedimentary structures. Modern and ancient sedimentary environments of deposition: alluvial, nearshore, shelf and deep sea, in both ter-

igenous 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 stratigraphic distribution of invertebrates, including Foraminifera, Brachiopoda, Mollusca, Arthropoda, Protochordata and Echinodermata. Introductory palaeobotany. Palaeoecology. Biogeography. Trace fossils. Reef building organisms and the evolution of reefs. *Field work* of up to five days is a compulsory part of the subject.

25.221 Earth Materials 2

S2 L3T3

Prerequisite: 25.211.

Sedimentary Petrology. The influence of transportation, deposition and diagenesis on the composition, texture and structure of detrital sedimentary rocks. The non-clastic sedimentary rocks including phosphates, evaporites, ferruginous and siliceous 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 structures in rocks. Techniques of stereographic projection of structural elements and analysis of simple fracture systems. Tectonics and tectonic analysis. *Field work* of up to four days is a compulsory part of the subject.

25.223 Earth Physics

S2 L2T4

Prerequisite: 25.110.

Global Geophysics. Principles of gravity, geomagnetism, palaeomagnetism, geothermy and seismology and their relation to shape, internal constitution, dynamic processes and major tectonic features of the earth. *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. *Field work* of two days is a compulsory part of the subject.

25.2261 Mathematical Geology 1

S2 L2T1

Prerequisite: 25.120.

Geological Statistics. Measurement scales in geology. Probability distributions and their properties; sampling and test of significance. Application of these techniques using geological data. *Geological Computing*. FORTRAN programming; text editing; control language for VAX and CYBER.

25.311 Earth Materials 3

S1 L2T4

Prerequisite: 25.221.

Mineralogy. Principles of X-ray powder diffractometry and the use of X-ray powder cameras and diffractometers. Elementary stereochemistry. Laboratory methods of mineral separation. 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.

25.312 Earth Environments 2

S1 L3T3

Prerequisite: 25.212 (note: it is desirable that students taking this unit have also taken 25.223).

Stratigraphy. Stratigraphic classification. Biological and physical methods of correlation. Introduction to radiogenic methods of age determination: ^{14}C , 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 Palaeozoic 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 biological classification. Processes and theories of evolution. The origin and early history of life. Functional morphology. Practical application of palaeontology. *Field Mapping*. Geological mapping in a complicated geological terrain. Geological report writing and cartography. *Field work* of up to seven days is a compulsory part of the subject.

25.314 Mineral and Energy Resources 1

S1 L3T3

Co-requisite: 25.221 or 25.311.

Metallic Resources. Classification and origin of the ore deposits, geochemical processes, research methods. Orthomagmatic, hydrothermal, porphyry, volcanic-sedimentary, Mississippi Valley type, chromium, iron, manganese 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 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.

25.3162 Mathematical Geology 2

S1 L2T1

Prerequisite: 25.2261.

Application of the mathematical techniques listed below to geological data processing and analysis. Analysis of variance. Introduction to matrix algebra. 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 SPSS, BMDP and other library programs.

25.321 Earth Materials 4

S2 L3T3

Prerequisite: 25.221.

Clay Mineralogy. The structure and properties of the clay min-

eral groups including the kaolinites, illites, 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. *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 metamorphism. 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.

25.324 Mineral and Energy Resources 2 S2 L3T3

Prerequisite: 25.212 or 25.5212.

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*. Occurrence 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 sedimentation 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.

25.325 Engineering and Environmental Geology S2 L4T2

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 law 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 practices. Measurements of grain size, grain shape and packing; analyses of measured data. Geological significance of sediment parameters. The shoreline processes. Littoral and longshore drifts and net sand movement. Coastal

engineering works. The estuarine environment. *Field work* of up to three days is a compulsory part of the subject.

25.3261 Geochemical Analytical Techniques S2 L1T1

Prerequisite: 25.311.

Sampling and sample preparation. Modern destructive methods of rock and mineral analysis. Non-destructive methods; X-ray fluorescence spectroscopy and electron probe microanalysers.

25.3271 Structural Geology S2 L1T1

Prerequisite: 25.221.

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.

25.333 Exploration Geophysics S1 L3 and S2 L1T1

Prerequisite: 25.120.

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.

25.410 Resource Geology S1 L3T6

Exploration Geochemistry. Principles and techniques of soil, drainage and rock geochemistry as applied to mineral exploration. *Mathematical Geology*. 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.

Remote Sensing. Principles of various remote sensing techniques including landsat and side-looking airborne radar. The 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. *Precambrian Geology*. Distribution, terminology, concepts, general features of the Archaean and Proterozoic. Archaean of Australia: Pilbara, Yilgarn. Proterozoic of Australia: Kimberleys, Broken Hill. Precambrian syntheses: tectonic, plate tectonics. Aspects of Precambrian mineralization. *Resource Economics*. Introduction to the role of earth resources in industrial society; availability of resources and consideration of grade, price, economic, technical and political factors. Distribution, production, consumption and trade in minerals. Supply adequacy and resource assessment. Review of Australian and New South Wales mineral industry. Economics of engineering geological works. *Report Writing*. Techniques of scientific report writing, especially preparation of theses and research articles. Methods of illustrating oral and written presentations. Guidelines to oral presentations. *Field work* of up to seven days is a compulsory part of the subject.

25.4101 Topics in Advanced Geology S1 L3

Topics in geology selected from a list of subjects available from the Head of Department.

25.4121 Advanced Sedimentology S1 T6

Detailed field and laboratory study of sedimentary textural and structural characteristics of a sedimentary sequence and determination therefrom of its palaeogeographic setting.

25.4122 Seismic Stratigraphy and Log Analysis S1 L1T1

Structural and stratigraphic interpretation of seismic records at both regional and prospect scales. The application of wire-line logs to stratigraphic analysis and formation evaluation and the integration of log and seismic data in sedimentary basin analysis.

25.4123 Geology of Selected Oil and Gas or Coal Fields S1 L1T1

Literature study and seminars on typical Australian and, in particular, overseas productive regions and fields.

25.4124 Palynology or Foraminiferal Micropalaeontology S1 L1T1

Laboratory based studies in the application of palynology to geological problems; or, use of foraminifera in dating, correlation and stratigraphical subdivision; also diagnostic techniques as applied to principal zonal species.

25.4141 Mineral Exploration S1 L1½ T1

The use of geology in mineral exploration and area selection involving the development of conceptual models, the organization of exploration programs, radiometric methods, exploration ground tenure in New South Wales and exploration drilling.

25.4142 Geological Sampling and Analytical Methods S1 L1T1

Methods of collection of samples in exploration geochemistry including waters, soils, drainage sediments and rocks. Methods in estimating and monitoring sampling and analytical errors. Determination of selected elements in soil and stream samples by atomic absorption, fluorometric, specific ion electrode and colorimetric methods.

25.4143 Research Project S1 L1T1½

An integrated study involving literature review and laboratory analysis of an appropriate mineralized environment.

25.4151 Hydrogeology S1 L1T2

Hydrogeological systems analysis. Ground water mapping techniques. Ground water resources evaluation. Hydraulics of anisotropic aquifers.

25.4152 Engineering Geology S1 L1T2

Analysis of fractured systems for engineering purposes. Fabric analysis of engineering soils. Slope stability. Advanced geological surveying techniques.

25.4153 Environmental Geology S1 L1T2

Geological factors in waste disposal — domestic, industrial and radioactive. Environmental parameters of coasts and beaches.

25.4154 Engineering Project S1 L1T3

A field and laboratory project in an aspect of engineering geology.

25.420 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.

25.510 Geology for Geomorphologists and Pedologists S1 L1T1; S2 L2T2

Prerequisites: 25.211, 25.221.

Clay Mineralogy. The structure and properties of the clay groups, including the kaolinites, illites, 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.

25.5112 Geology for Civil Engineers S1 L2T1

An introduction to mineralogy, petrology, structural geology, stratigraphy and geomorphology. Weathering of rocks and development of soils. The role of the geologist in civil engineering.

25.520 Geology for Mining Engineers 1 F L1T1

Outline of the main branches 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. *Note:* Total hours: 56. The subject is divided equally between lectures and laboratory work. Field Tutorial hours are additional.

25.5212 Sedimentology**S1 L1T1***Prerequisite:* 25.120. *Excluded:* 25.212.

As for *Sedimentology* in 25.212 Earth Environments 1. Available only to Course 3145.

25.523 Mineralogy**F L1T1**

Crystallography, crystalline state and crystal growth of minerals. Fundamentals of the atomic structure of minerals, with examples of Bravais lattices and introduction to space lattice group theory. Physical properties of crystals; cleavage, gliding, secondary twinning, elasticity. Elements of crystal optics in polarized light. Classification, descriptive mineralogy and occurrence of primary and secondary minerals with special emphasis on economic metallic and non-metallic minerals. Introduction to petrology. Mode of formation of minerals and ores in the igneous, sedimentary and metamorphic cycles. Examples of principal types of economic mineral deposits, their mode of formation, paragenesis, textures and intergrowths. Elements of fuel geology, construction and refractory materials. *Laboratory: Crystallography* — Examination of crystals and crystal models for symmetry. Stereographic projection of crystals. *Optical Mineralogy* — Examination of minerals and rocks in transmitted and incident light using the polarizing microscope. Determination of refractive indices of crystal fragments by the immersion method. *Descriptive and Determinative Mineralogy* — Macroscopic examination of common minerals with emphasis on economic minerals. Study of texture and intergrowths of common mineral parageneses including the principal rock types in which they occur.

25.530 Geology for Mining Engineers 2**F L2T2**

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; transmission of ground water 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.

25.5331 Physical Geology**for Petroleum Engineers 1****S1 L1T2**

Introduction to earth science, the constitution of the earth, rock composition, rock types and processes of formation and deformation, organic evolution, geological time, fluids in rocks, presentation of geological data.

25.5332 Physical Geology**for Petroleum Engineers 2****S2 L1T2**

Sedimentary petrology, sedimentary environments and facies, facies analysis, origins and formation of petroleum, exploration techniques, petroleum in Australia.

25.5302 Structural Geology**for Petroleum Engineers****S2 L1 T2***Prerequisite:* 25.301.

Origin and properties of both regional and local geological structures and petroleum traps. Delineation of structures and petroleum traps by geophysical methods.

25.5311 Aqueous Geochemistry**S1***Prerequisite:* 25.221.

As for *Aqueous Geochemistry* in 25.311 Earth Materials 3. Available only to Course 3145. **Note:** Tutorials comprise 10 hours total in Session 1 only.

25.5312 Geological Field Mapping**S1 L2***Prerequisite:* 25.5212. *Excluded:* 25.312.

As for *Field Mapping* in 25.312 Earth Environments 2. Available only to Course 3145.

25.5313 Stratigraphy**S1 L2***Prerequisite:* 25.5212. *Excluded:* 25.312.

As for *Stratigraphy*, in 25.312 Earth Environments 2.

25.542 Mining Geology Project**S2**

Note: Comprises 18 hours total in Session 2.

25.9311 Gravity and Magnetic Methods**S1 L2T1**

Prerequisites: 1.001 and 10.001. It is desirable that students taking this unit have a background in 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.

25.9312 Seismic Methods**S1 L2T1**

Prerequisites: 1.001 and 10.001. It is desirable that students taking this unit have a background in geology.

Seismic waves. Physical/engineering properties of geological materials. Ray theory in 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.

25.9313 Electrical Methods**S1 L2T1**

Prerequisites: 1.001 and 10.001. 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.

25.9315 Regional Geophysics**S1 T15**

Qualitative and quantitative appraisal of geophysical data for a selected area.

Servicing Subjects

These are subjects taught within courses offered by other faculties.

For further information regarding the following subjects see the Combined Sciences Handbook.

25.435 Geology Honours

25.621 Marine Geology 1

F L1T2

Prerequisites: 25.601 or both 25.110 and 25.120.

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, geomagnetism, 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.

25.622 Hydrological and Coastal Surveying

F L1T2

Prerequisites: Nil.

General principles of surveying, with particular reference to coastlines and off-shore techniques. Optical and electronic methods of distance measuring and position fixing. Methodology for short-term and long-term measurement of tides and flow currents. Bathymetric surveys in shallow and deep water conditions. Coastline morphologies and their relationship to the behaviour of water masses. Analysis of sedimentary systems in deltaic, estuarine and near-shore environments. Data collecting, processing and storage. Shallow-water investigations for bed-rock morphologies. *Field work* of five days is a compulsory part of the subject.

25.631 Marine Geology 2

F L1T2

Prerequisite: 25.621.

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 and structuring of basins in tensional, compressive and strike-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 exceeding two days is a compulsory part of the subject.

Prerequisite: Nil.

The physical nature of the estuarine environment: its characteristic topography, chemistry and layering of water masses; tidal behaviour. Characteristic sediments, stratigraphy of sediment bodies and distribution patterns of sediments and microfossils in estuaries. Inorganic and microbial diagenesis of estuarine sediments. Procedures for mapping, sampling and sample analysis. Mineral morphology. Statistical treatment of results. *Field work* of four days is a compulsory part of the subject.

25.6341 Marine Mineral Deposits and Oceanic Minerals

S1 L1T1

Oceanic minerals and mineral deposits: detrital, authigenic and epigenetic. Methods of exploration, assessment and exploitation, international law relating to the sea floor. 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.

25.6342 Exploration and Seismic Methods

S2 L2T1

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.

25.9314 Geological Applications

S1 L1T1

Prerequisite: 25.120.

A subject of ten weeks' duration. **Structural Geology:** Elements of structural geology, stereographic 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.

25.9321 Geophysical and Geological Applications

S2 L1T2

Prerequisite: 25.120. *Excluded:* 25.6342.

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.

Graduate Study

Departments of Mining Engineering and Mineral Processing and Extractive Metallurgy

Mining Engineering and Mineral Processing and Extractive Metallurgy are Departments within the School of Mines.

Generally these subjects are of three hours' duration per week or multiples of that time.

7.001G Exploratory Drilling

Drilling equipment and technology. Deep boring. Selection of drilling methods, drill hole surveys. Development and exploitation of mineral resources. Exercises on mine planning.

7.111G 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.

7.122G 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.

7.132G 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.

7.151G 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.

7.152G Mining Conservation

The reclamation of excavated land; integration with operational stages of mining. Mining cycles of alluvial, strip, and open cuts, land clearing, stabilizing the mined area, socio-economic aspects of mining, rehabilitation costs, government regulations. Examination and evaluation of a current operation.

7.153G 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.

7.154G 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.

7.311G Mineral Beneficiation

Prerequisite: 7.7341 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.

7.322G Mineral Beneficiation Technology

Prerequisite: 7.311G 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.

7.332G Mineral Engineering Laboratory

Prerequisite: 7.311G 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.

7.351G Mineral Beneficiation

Prerequisite: 7.7342 or 7.311G 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. Flow-sheet 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.

7.361G 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-, Surface- and 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.

7.362G 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.

7.363G Minerals Engineering Laboratory

S1 T3

A series of laboratory investigations relating to material covered in subjects 7.361G and 7.362G.

7.364G 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.

7.365G 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.

7.442G 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.

7.455X Mining Geomechanics Project

F 4

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.

7.515X Rock Mechanics Measurements

F 3

Field measurement of rock mass properties. Controlled post-failure strength and deformation properties of rock. Data collection and analysis. *In situ* stress measurement. Prediction of pre-mining rock stresses. Monitoring rock movement and stress change in underground and surface rock excavations. Seismic techniques in rock mechanics.

7.525X 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.

7.535X Mine Fill Technology

F 2

Fill properties and their assessment. Fill preparation, placement and dewatering. Field sampling and *in situ* testing. Mining methods employing fill. Pozzolanic fills. Dry fills and rock fills. Economic aspects of fill practice. Soil and rock mechanics aspects. Environmental aspects. Specific fill practice in mining coal and uranium.

7.545X Advanced Rock Cutting Technology

F 2

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.

7.555X Blasting Technology

F 2

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.

7.565X 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.

7.575X Subsidence Engineering

F 2

Trough subsidence resulting from the extraction of bedded mineral deposits. Parameters influencing subsidence. Subsidence-related phenomena causing damage to structures at or below the surface. Measurement and empirical prediction. Theories and modelling of subsidence. Control of subsidence.

7.585X Economics and Management of Geomechanics Projects

F 2

Principles of historical accounting. Cash flow determination and cost-benefit analysis of geomechanics projects. Time value of money, discounted cash flow and incremental analysis and the effects of leverage, inflation and cost of capital. The use of sensitivity and probability analysis and optimization of economic benefit by dynamic and linear programming.

7.917G Fire and Explosion

S1 or S2 L2

Chemistry and physics of combustion reactions; types of flames; deflagration and detonation; ignition; fire point; flammable limits. Industrial fuel-fired appliances; fire risks in buildings; fire fighting equipment; flame proofing; fire and explosive risks in chemical process industries; case studies. Use of appropriate standards and legislation. Fire research; insurance.

7.936G 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 $\ln E/pH$, 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.

7.937G 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.

Department of Applied Geology

25.702G Hydrogeology

S1 L1½T1½C3**

Occurrence of groundwater in sedimentary, igneous and metamorphic rocks; hydrogeology of extreme climatic zones, arid and tropical; aquifer types in porous and fractured rocks. Regional groundwater basins, case histories; Great Artesian Basin. Hydrogeological mapping and applications. Exploration for groundwater. Groundwater behaviour and aquifer characteristics; storage and release of water; transmission in permeable and low permeable materials. Groundwater flow; 2 & 3 dimensional, radial, steady and transient flow, pump test analyses, flownets, boundaries. Practical extraction technology (advanced and simple); well design, pumps and testing of wells. Drilling techniques and programs, well completion. Monitoring, data logging technology. Groundwater management, conjunctive use, administration and law.

25.703G Project (Engineering Geology Graduate Course)

S2

The project is a research investigation consisting of field and laboratory work in any of the disciplines. Engineering Geology, Hydrogeology, Environmental Geology.

25.704G Environmental Geology

S1 L1½T1½ C3

Geological hazards: seismic risk, landslides, subsidence, floods, erosion, volcanic eruptions, discrete and continuous hazards, event return time. Geological resources and their management: types of resources, use and potential environmental conflict, resource economics and policy formulation. Waste disposal and the mineral industry, reclamation and rehabilitation of land used for extractive purposes. Swamp drainage. Geology and urban planning: map preparation, multiple land use principle, aesthetic criteria for landscape evaluation. Environmental impact of dams, roads, explorative and extractive stages of mining, impact statement techniques, case studies. Communication of geological information to technical and non-technical people. Geological legislation for water resources and waste disposal.

25.705G Engineering Geophysics

S1 L2T1

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.

25.706G Geological Basis of Geomechanics

S1 L2T1

Geomechanical behaviour of soils. Stress-strain theories, elasticity and plasticity. Clay-water reactions and their relation to soil

behaviour. Laboratory and field investigation techniques, including CBR, Proctor, field penetrometer, triaxial compression. Engineering classification of soils and soil stabilization. Elasticity and strength properties of rocks, state of stress in virgin rock masses, residual tectonic stresses, stresses about rock openings and beneath point loads. Mechanical classification of rocks. Rock mechanics testing procedures.

25.707G Geopollution Management

S1 L1½ T1½ C3

Material properties and hydrodynamic factors influencing surface and subsurface flow of pollutants in rocks and soils. Water quality and the problems of standards. Risk analysis in relation to water quality, contaminant sources and safety. Use of field instruments for quality determination. Geological and technological factors in waste disposal for minimal environmental impact; domestic and industrial wastes, deep well injection. Salinity management, salt evaporative basin — groundwater relations. Management of radioactive wastes, waste disposal problems in limestone areas. Behaviour over time of wastes disposed in rocks and soils. Case studies of aquifer contamination and practical measures for preventing pollution. Groundwater treatment technology. Rational planning of waste disposal and water resources for industrial and domestic use.

25.707X Geopollution Management

S1 L1½T1½ 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.

25.708G Engineering Geology

S1 L2T1

Co-requisite: 25.706G.

Soil and rock slope stability analyses and stabilization methods: geological, geomorphic and engineering considerations. Construction materials exploration, evaluation and assessment of standards, concrete aggregate requirements, tests. Practical site investigation procedures: drill core logging, RQD, drilling programs. Engineering classifications of weathered rocks. Weathering and engineering works. Discontinuities in rock masses, analysis, influence on engineering properties. Soil fabric analysis; principles and application to engineering behaviour of soil masses. Engineering geology organization; contracts; critical path analysis and geological investigations; communication between geologists and engineers. *Field tutorials:* Several field tutorials are included.

25.710G Coastal Environmental Geology

S1 L1½T1½ C3

The shoreline processes; calculation of beach profiles and littoral drift. Longshore drift and net sand movement. Coastal protection: groins, beach nourishment. Foundations of coastal engineering works. The estuarine environment: sedimentation, chemical and biological processes in estuaries. Man's impact on

the water environment. Investigation techniques. Marine hydraulic works: sewage disposal, thermal pollution.

25.711G Arid Zone Engineering Geology

S1 L2T1 C3

Geological characteristics of arid zones. Weathering of rocks and soil development under arid conditions. Engineering properties of weathered rocks and soils. Hydrogeology of arid zones. Engineering geology of water storages and traffic routes. Construction materials. Planning engineering geology and hydrogeology investigations with inadequate data. Includes laboratory and field exercises.

25.712G Project in Terrain Management

S2 T9 C9**

A practical exercise to illustrate the application of engineering geology in terrain evaluation and management, to be carried out at Fowlers Gap Research Station. A report is required.

25.713G Research Project in Terrain Management

F T9 C18**

A substantial research project involving the application of engineering geology in terrain evaluation and management. Involves fieldwork at Fowlers Gap Research Station. A report is required.

25.714G Geology of Foundations

S1 L2T1

A detailed review of case histories of the geological factors influencing the foundations of dams, buildings, bridges, roads and airfields. The geology of large underground cavities. Methods of geological investigation.

25.715G Sources of Waste and 25.715X Landfill Disposal

S1, C3 L2T1; S1, external C3

Sources of solid and liquid wastes, design and operation of landfills, processes within landfills, re-use and planning of sites, transport of waste.

25.716G Groundwater Geophysics

S1 L1½ T1½ 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.

25.717G Computing for Groundwater Specialists

S1 L1½ T1½ C0

Introduction to FORTRAN programming, mainframe, microcomputer operation systems, databases, spreadsheets, statistical and graphical packages with applications relating to groundwater processes.

25.718G Remote Sensing of Groundwater Resources

S3 L1 T½ 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.

25.719G Groundwater Research Project

S2 C18

Research investigation consisting of one or more of; modelling, laboratory experiments, field work related to hydrogeology and groundwater management.

25.720G Groundwater Project

S2 C12

Study of similar content to 25.719G but at a smaller scale.

25.800G Seminar

S1* T2

A weekly seminar to present and discuss student papers on exploration topics: speakers from industry are invited to attend and present papers from time to time.

25.801G Geology in Exploration 1

S1* L4

The development of conceptual models in mineral exploration and formulation of exploration programs. Consideration of significant guides to ore including structure, lithology, alteration and gossans.

25.802G General Introduction to Exploration Geophysics

S1* L3

A basic introduction to the theory and practice of exploration geophysics, including treatment of applications and limitations of the main methods of seismic, electric, electro-magnetic, gravity, magnetic and radiometric methods to geological problems in hydrocarbon, coal, ground water, mineral and engineering exploration. Treatment includes fundamental aspects of the method and case histories illustrating applications areas. *Field tutorial survey camp*: An integrated, geological, geophysical and geochemical field tutorial survey camp of seven days' duration is an integral part of this subject.

25.803G Introduction to Exploration Geochemistry

S1* L3

Basic principles of exploration geochemistry and the role of exploration geochemistry in the generalized exploration sequence. Principles and problems of anomaly recognition. Examples of main applications.

25.804G Introduction to Data Processing and Interpretation

S1* L3

FORTRAN and computer programming; use of terminal facilities. Basic data storage and retrieval. Simple interpretative procedures for exploration data.

25.805G Resource Economics 1**S1* L1**

Interdependence of political, economic and technical factors in mineral resource supplies. Examination of the main factors in reserves and resources estimation.

25.807G Exploration Geophysics**S1* L6**

An introduction to the theory and practice of all geophysical methods in exploration for energy, minerals, groundwater and engineering applications. These will include seismic reflections, seismic refraction, electrical, electro-magnetic, magnetic, gravity and radiometric methods of exploration, including the planning and conduct of field surveys for general and particular applications, and the theory and practice of the interpretation of geophysical results in terms of geological problems, conditions and occurrences.

25.808G Exploration Project**S1* T6**

Interpretation of exploration case-history data designed to familiarize students with the type of information normally required by exploration companies.

25.811G Advanced Geology in Exploration**S1† L4**

Definition of the geological environment and search techniques for major categories of mineral deposits including porphyry coppers, carbonate- and shale-hosted lead-zinc ores, volcanogenic massive sulphide ores, vein and sandstone uranium. Geological aspects of reserve estimation. Exploration case histories.

25.815G Resource Economics 2**S1† L2**

Distribution, production, consumption and trade in minerals. Supply adequacy and resource assessments and projected requirements. Review of the Australian minerals industry in a global context.

25.816G Geological Remote Sensing**S1† L4**

The physics of various remote sensing techniques; interpretation of conventional aerial photography in exploration; Infra-red remote sensing techniques; side 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.

**Equivalent contact hours, but also including fieldwork out of session.

*Weeks 1-7 only.

†Weeks 8-14 only.

25.817G Mining Law and Exploration Management**S1† L1**

Mining law in Australia with special reference to land tenure and lease acquisition; organization and management of exploration programs.

25.818G Exploration Project**S1† T6**

Design and costing of exploration program by students. This may be based on simulated conditions or actual situations.

25.819G Field-Laboratory Project**S2**

An individual exploration project that requires the student to acquire field and laboratory data on geological, geochemical and geophysical aspects of an actual exploration problem. As far as possible the project should be designed in consultation with the exploration industry. A report is required.

25.821G Geology in Exploration 2**S1† L2**

Specialized search techniques for selected types of metallic ores, with appropriate case histories.

25.823G Advanced Exploration Geochemistry**S1† L2T6**

Detailed consideration of the main techniques with emphasis on soil, drainage and rock surveys. All applications and problems will be examined on the basis of case-histories of actual surveys. Special consideration is given to problems of applications under Australian conditions.

25.824G Advanced Data Processing and Interpretation**S1† L2T2**

Advanced concepts of data storage and retrieval; problems of display of geochemical data; multi-variate statistical data interpretation. Students are encouraged to supply their own data sets for processing.

25.827G Laboratory Methods**S1† L1T3**

Instruction in the main techniques of sample preparation and instrumental analysis appropriate to exploration geochemistry. Practical experience with AAS and XRF. Students are encouraged to supply their own samples.

25.828G Exploration Project**S1† T6**

Interpretation of exploration data from geochemical surveys; this may be based on data from actual surveys, or data generated by the students themselves.

25.829G Field-Laboratory Project**S2**

An individual research project designed to contribute to the solution of a practical exploration problem; as far as possible the project should be chosen in consultation with the exploration industry to ensure relevancy to current exploration problems. In general the project involves collection of field data and samples, chemical analysis of samples, and interpretation of the results. A report is required.

25.831G Geological Interpretation**S1† T2**

The geological interpretation of geophysical data and geophysical models in seismic, electrical, electromagnetic, gravity and magnetic methods, including selected case studies from petroleum, coal, mineral and engineering exploration.

25.832G Advanced Exploration Geophysics**S1† L16**

An extension and advanced treatment of the subject matter in 25.807G, in the theory and practice of field and interpretational procedures in all methods and aspects of exploration geophysics.

ics, including instrumentation, manual and electronic data processing and interpretation. Specific application areas for prominent geophysical exploration techniques in the solution of relevant geological problems are treated in detail in both field and theoretical aspects of the methods.

25.839G Field-Laboratory Project **S2**

Exploration geophysical project on one or more topics of relevance in energy, water, mineral or engineering exploration. Includes tutorial sessions and seminars on relevant topics of geophysical/geological/geochemical exploration.

25.840G Seminar **S1† T2**

A weekly joint seminar of Mineral Exploration, Exploration Geochemistry, and Exploration Geophysics students who present papers on aspects of their own particular specialization. Outside speakers from industry and government organizations are invited to participate in the seminars from time to time.

25.915G Project in Hydrogeology

Small project involving the analysis of hydrogeological data from Fowlers Gap.

25.916G Research Project in Hydrogeology

Research project on some aspect of the hydrogeology of an arid region.

†Weeks 8-14 only.

Servicing Subject Descriptions

Servicing Subject Descriptions

Undergraduate Study

Physics

Physics Level I Units

1.001 Physics 1

F L3T3

Prerequisites:

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

Co-requisite: 10.021C or 10.001 or 10.011.

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

Aims and nature of physics and the study of motion of particles under the influence of mechanical, electrical, magnetic and gravitational forces. Concepts of force, inertial mass, energy, momentum, charge, potential, fields. Application of the conservation principles to solution of problems involving charge, energy and momentum. Electrical circuit theory, application of Kirchhoff'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 polarization.

1.021 Introductory Physics 1

(For Health and Life Scientists)

F L3T3

Prerequisites: None. *Co-requisites:* 10.021A and 10.021B, 10.021B and 10.021C, or 10.001 or 10.011.

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

1.002 Mechanics, Waves and Optics

S1 L3T1

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

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

1.012 Electromagnetism and Thermal Physics

S2 L3T1

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

Electric field strength and potential, Gauss' law, Poisson's and Laplace's equations, capacitance, dielectrics and polarization, magnetism, electro-magnetic induction, Maxwell's equations, electromagnetic waves. Laws of thermodynamics, kinetic the-

ory, microscopic processes, entropy, solid state defects, Helmholtz and Gibbs functions, Maxwell's relations, phase diagrams, chemical and electrochemical potential.

1.022 Modern Physics

FL ½ T ½

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

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

1.032 Laboratory

F T3

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

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

1.062 Computer Applications in Experimental Science 2

S1 L2T3

Prerequisite: 1.061 *Excluded:* 1.042.

Interface between computer and experiment, programmed and interrupt interaction, direct and dual port memory access concepts, hardware, software and timing restraints. Real-world variables, transducers and conversion to binary representation, converters and counters, signals and noise. Data collection, reduction and storage as digital matrices. Numerical modelling, analysis and elementary control of a system.

1.9222 Electronics

S1 L1T2

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

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

1.9322 Introduction to Solids

S2 L2T1

Prerequisites: 1.001 or 1.011 or 1.021. *Excluded:* 1.022, 4.402, 4.412.

Introductory quantum mechanics and atomic physics; crystal structure; point and line defects, introductory band theory; conductors, semi-conductor and insulators; energy level diagrams.

Physics Level III Units

1.023 Statistical Mechanics and Solid State Physics

S1 L3T1

Prerequisites: 1.012, 1.022, 10.2112.

Canonical distribution, paramagnetism, Einstein solid, ideal gas,

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

1.0343 Advanced Optics

S2 L1½T½

Co-requisite: 1.002.

Fresnel and Fraunhofer diffraction, Fourier transforms, filtering, coherence length and time, stellar interferometers, laser theory, non-linear optics.

1.0533 Experimental Physics B1

S1 T4

Prerequisite: 1.032.

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

1.0543 Experimental Physics B2

S2 T4

Prerequisite: 1.032.

As for 1.0533 Experimental Physics B1.

1.1433 Biophysics

S1 L2T1

Prerequisites: 1.012, 1.022.

Thermodynamics in biology, electrochemical potentials, Donnan equilibrium, irreversible processes, diffusion and applications to biological systems. Membrane potentials. Nernst potential, Goldman and Nernst-Planck equation, generalized approach. Active transport. Membrane structure. The nerve impulse, activation and inactivation, Hodgkin and Huxley equations. Muscle, contractile process, thermodynamics. Ecological ensemble theory, global thermodynamics interaction of species, ecological associations.

1.1533 Biophysical Techniques

S2 L2T1

Prerequisites: 1.012, 1.022, 1.032.

Theory and application of physical techniques of relevance to the study of biological systems. Techniques considered may include optical and electron microscopy X-ray and neutron diffraction, magnetic resonance, lasers, light scattering, calorimetry, fluorescence, electrochemical techniques and electrophysiological methods and dielectric measurements.

1.3033 Mechanical Properties of Materials

S1 L1½T½

Co-requisite: 1.023. *Excluded:* 4.403.

Properties of materials in relation to their structure: atomic and molecular structure of solids; elasticity, inelasticity, long-range (rubber) elasticity, viscoelasticity; plasticity; brittle fracture; viscosity and surface tension of liquids; adhesion; friction and lubrication.

1.713 Advanced Laser and Optical Applications**F L1½T½***Co-requisite: 1.002. See also Table 1.*

Laser operation, characteristics, theory, design of such types as gas, ion, molecular, excimer and dye lasers. Filter design, multiple beam interference, etalon use, dielectric mirror design. Modulators, theory and application, electro and acousto optic phenomena. Detectors, types, basic theory and design. Solid state and vacuum tube systems. Non-linear optics, theory and applications. A design study and case history of a typical optical system. Materials processing fundamentals. Laser safety.

1.942 Introduction to Physics of Measurement**S1 L1½T1½***Prerequisites: 1.001 or 1.011. Excluded: 1.042.*

Resolution: accuracy and sensitivity of instruments, errors of observation; experimental design; transducers; thermometry; electrical noise; servo systems, mechanical design of apparatus; optical instruments optical fibres; photometry; calorimetry; analogue to digital conversion and digital instruments; measurement of very large and very small quantities.

Chemistry

2.103B Organic Chemistry**S1 L3T3***Prerequisite: 2.102B. Excluded 2.003B.*

Heterocyclic Chemistry: synthesis and reactions of the following heteroaromatic systems; pyridine, quinoline, isoquinoline, pyrimidine, pyrrole, furan, thiophene, indole, imidazole; examples of naturally occurring alkaloids where relevant. *Alicyclic Chemistry:* stereochemistry of alicyclic systems; classical and non-classical strain in cyclic systems; stereochemistry and conformation of monocyclic and polycyclic compounds; synthesis, reactions and rearrangement of monocyclic compounds including stereochemical selectivity; transannular reactions in medium rings; synthesis and reactions of fused and bridged polycyclic systems; examples of steroids and terpenes where relevant. *Structure Determination:* application of spectroscopic methods (eg nuclear magnetic resonance, mass spectroscopy) to determination of organic structures.

2.003J Fundamentals of Biological and Agricultural Chemistry**S1 L2T4***Prerequisites: 2.121 and 2.131, or 2.141. Excluded: 2.013L, 41.101.*

Aspects of the chemical and physical properties of materials important in biological systems. Methods of separation, of purification and estimation, and correlations of structure with reactivity. Methods of separation and identification, such as gel permeation, discussed as appropriate to each topic. Significance of isomerism in biological systems, optical and geometrical, absolute configuration. Amino acids, peptides and introduction to protein structure. Relevant properties, acid/base

properties, pK values, zwitterion, isoelectric points. Simple peptide synthesis. Treatment of carbohydrates, establishment of structures, reactivity. Chemistry of monosaccharides, disaccharides and polysaccharides. Methods of analysis, chemical and physicochemical. Fats, correlation of properties with saturated and unsaturated fatty acid composition. Structural chemistry of fatty acids. Reaction of unsaturated fatty acids, urea complexes. Detergents. Trace elements in biological systems. Chemistry of common heterocyclic systems with emphasis on molecules of biological importance.

2.030 Organic Chemistry**S1 L2T4***Prerequisite: 2.102B.*

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 discussing syntheses and reactions including degradation.

2.043L Chemistry and Enzymology of Foods**F L2T4***Prerequisite: 2.102B. Excluded: 2.003J, 2.043L.*

The chemistry of food constituents at an advanced level and the relationship between the chemistry and enzymology associated with the origin and handling of foodstuffs. Treatment of the stability of constituents, changes in colour and texture occurring during processing and storage. Methods of assessment, chemical and physical. General classification of constituents, role of free and combined water. Fixed oils and fats, rancidity of enzymic and autoxidative origin, antioxidants — natural and synthetic — theories on mechanisms of action, carbohydrates, reactivity, role in brewing processes, carbohydrate polymers, starch structure, enzymic susceptibility and mode of action, estimations, enzymic degradation and enzymic browning, reactions and stability of natural pigments, vitamins, preservatives.

2.102A Physical Chemistry**S1 or S2 L3T3***Prerequisites: 2.121 and 2.131, or 2.141, and 10.011 or 10.001 or 10.021B and 10.021C. Excluded 2.002A.*

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

2.102B Organic Chemistry**F or S2 L3T3***Prerequisite: 2.131 or 2.141. Excluded: 2.002B*

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

2.102C Inorganic Chemistry and Structure S1 or S2 L3T3

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

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

2.102D Chemical and Spectroscopic Analysis S1 or S2 L3T3

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

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

2.102E Organic and Inorganic Chemistry for Chemical Engineers S1 L4

Prerequisites: 2.121 and 2.131 or 2.141

Discussion of selected types of organic reactions (eg addition, substitution, elimination, free radical, rearrangement) to provide a broad cover of the chemistry of aliphatic hydrocarbons, halides, alcohols, ethers and amines. Addition reaction of aldehydes and ketones. Substitution reactions of acid derivatives. Chemistry of benzene and its derivatives with a brief extension to include naphthalene chemistry.

Survey of geometrical structures, energetics, bonding, reactions and reactivity, spectroscopic and magnetic properties of representative inorganic compounds, including selected main group compounds, compounds of selected transition metals and rare earth elements, and coordination complexes. Applications of inorganic chemistry.

2.111 Introductory Chemistry S1 L2T4

Prerequisite: Nil.

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

Classification of matter and the language of chemistry. The gas laws and the ideal gas equation, gas mixtures and partial pressure. The structure of atoms, cations and anions, chemical bonding, properties of ionic and covalent compounds. The periodic classification of elements, oxides, hydrides, halides and

selected elements. Acids, bases, salts, neutralization. Stoichiometry, the mole concept. Electron transfer reactions. Qualitative treatment of reversibility and chemical equilibrium, the pH scale. Introduction to the diversity of carbon compounds.

2.121 Chemistry 1A S1 or S2 L2T4

Prerequisites:

HSC Exam
Score Range
Required
67.100
1-50
1.100

2 unit Mathematics* or

3 unit Mathematics or

4 unit Mathematics

and

2 unit Science (Physics) or

2 unit Science (Chemistry) or

4 unit Science or

3 unit Science or

2.111

53.100

53.100

1-50

90-150

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

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

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

2.123E Environmental Chemistry S2 L3T3

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

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

2.131 Chemistry 1B S1 or S2 L2T4

Prerequisite: 2.121.

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

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

2.141 Chemistry 1M**F L2T4***Prerequisites:*

	<i>HSC Exam Score Range Required</i>
2 unit Mathematics*	67-100
3 unit Mathematics	1-50
4 unit Mathematics and	1-100
2 unit Science (Chemistry) or	60-100
4 unit Science or	1-50
3 unit Science or	90-150
2.111	

*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).

Note: As for **Note 2.121 Chemistry 1A**.

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

2.951 Chemistry 1ME**S1 L3T3**

Prerequisite: As for 2.121.

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

Mechanical and Industrial Engineering

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

	<i>HSC Score</i>
Either	
2 unit Science (Physics) or	53-100
4 unit Science (multistrand)	1-50
or	
2 unit Industrial Arts or	53-100
3 unit Industrial Arts	1-50

Excluded: 5.010, 5.0101, 5.0201.

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

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

5.0012 Introductory Engineering Design and Materials Science**S1 or S2 L2 T0**

Excluded: 5.0016, 5.010.

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

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

5.0300 Graphical Analysis and Communications**S2 L1T2**

Excluded: 5.0016, 5.030, 5.0302.

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

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

Excluded: 5.0016, 5.030.

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

5.0305 Manufacturing Technology**S2 L/T3**

Prerequisites: 5.0011, 5.0012. *Co-requisite:* 5.421. *Excluded:* 5.030.

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

5.122 Mechanical Engineering Design 2**F L1T2**

Prerequisites: 5.010, 5.030. *Co-requisites:* 5.0201, 5.061, 5.422, 5.620, 5.626.

Design of basic engineering elements and simple systems. Selection and specification of materials and manufacturing processes for engineering items. Communication by means of

engineering drawings (including tolerances) of manufacturing information for simple structures and assemblies. Application of standards and trade literature to design. Simple design-and-make project to meet a published specification and to demonstrate the product's performance.

5.3021 Engineering Mechanics 2A S1 or S2 L2T1

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

Kinetics of system of particles, plane steady mass flow. Plane kinematics and kinematics of rigid bodies, mass moment of inertia, differential equations of motion, work, energy, impulse and momentum. One degree of freedom vibrations, free, forced, undamped, damped, transmissibility.

5.3022 Engineering Mechanics 2B S1 or S2 L/T2

Prerequisites: 1.001 or 1.951, 5.3021, 10.001 or 10.011.

Transverse vibrations of beams. Whirling of shafts. Motion relative to a rotating and moving frame. Virtual work for static and dynamic systems. Kinematics and kinetics of simple mechanisms.

5.620 Fluid Mechanics 1 F L1T1

Prerequisites: 1.001 or 1.951, 5.010, 10.001 or 10.011. *Co-requisite:* 5.300. *Excluded:* 5.622.

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

5.626 Thermodynamics 1 FL1T1

Prerequisites: 1.001 or 1.951, 5.010, 10.001 or 10.011. *Excluded:* 5.622.

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

Electrical Engineering and Computer Science

6.611 Computing 1 S1 or S2 L3T3

Prerequisite: As for 10.001. *Co-requisite:* 10.001 or 10.001 or 10.011. *Excluded:* 6.600, 6.620.

Introduction to programming: design and correctness of algorithms and data structures; programming in a high-level algorithmic language which provides simple, high level program control and data structuring facilities. Problem solving: basic ideas of problem solving; introduction to abstract structures used for computing solutions to problems. Introduction to propositional logic, computing machinery, computer arithmetic, artificial intelligence, and operating systems.

6.621 Computing 2A S1 or S2 L3T2

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

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

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

6.854 Electrical Power Engineering S2 L1T2

Prerequisite: 1.001 or equivalent (1.9222 or 6.851 for students in Course 3140).

Extensive introduction to the theory and application of heavy current electrical engineering. Commences with the requisite circuit theory and then proceeds to consideration of the distribution of electrical power and the characteristics and selection of electrical machinery. DC power supplies, three-phase AC supply, voltage regulation, transformers, AC and DC machines and their rating; a project illustrating the application of electrical engineering to various aspects of industry. Consists of one 2-hour tutorial or laboratory sessions per week each commencing with a structured mini-lecture. Detailed lecture notes are provided.

6.856 Electronics for Measurement and Control S1 L2T1

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, feedback and filtering. Digital logic using integrated circuits. Noise. Techniques for A/D and D/A conversion, measurement system interfacing to microprocessors.

Civil Engineering

8.1130 Engineering Drawing**S1 L1T2**

Fundamental concepts of descriptive geometry, orthographic drawing, first and third angle drawing, isometric and perspective drawing, Australian standard engineering and drawing practice, application of descriptive geometry to common problems in civil engineering, graphic communications, introduction to computer graphics.

8.6110 Structures**S1 L1T2**

Theory of structures: Moduli of elasticity, simple stress and strain. Compound bars, temperature stresses. Thin shells. Stress at a point. Strain at a point. Principal stresses and strains. Relationship between load, shear force and bending moment. Moments of inertia, principal moments of inertia. Stresses due to axial force, bending moment, shear force, and torsion. Differential equations of simple beam theory. Deflection of beams. Statistically indeterminate beams. Strain energy. Deflections at a single load. Shock loads. Theory of centrally loaded column and eccentrically loaded columns.

8.6130 Properties of Materials**F L1T1**

Mechanical behaviour of materials. Response to static loading in tension, compression, shear and bending. Use of static test data in analysis and design; variability of material properties; factors of safety. Hardness tests. Creep in solid materials. Response to dynamic loading; fatigue; impact. Deterioration of engineering materials. Rheological classification of materials.

Mathematics

10.001 Mathematics 1**F L4T2***Prerequisite:*

2 unit Mathematics* or
3 unit Mathematics or
4 unit Mathematics
or
10.021B.

HSC Exam
Score Range
Required
67-100
1-50
1-100

Excluded: 10.011, 10.021B, 10.021C.

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

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

10.011 Higher Mathematics 1**F L4T2***Prerequisite:*

3 unit Mathematics
or
4 unit Mathematics

HSC Exam
Score Range
Required
120-150

1-100

Excluded: 10.001, 10.021B, 10.021C.

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

10.021B General Mathematics 1B**S1 L4T2***Prerequisite:*

2 unit Mathematics* or
3 unit Mathematics or
4 unit Mathematics
or
10.021A

HSC Exam
Score Range
Required
60-100
1-50
1-100

Excluded: 10.011, 10.001.

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

Functions (and their inverses), limits, asymptotes, continuity; differentiation and applications; integration, the definite integral and applications; inverse trigonometric functions; the logarithmic and exponential functions and applications; sequences and series; mathematical induction; the binomial theorem and applications; introduction to probability theory; introduction to 3-dimensional geometry; introduction to linear algebra.

10.021C General Mathematics 1C**S2 L4T2**

Prerequisite: 10.021B. *Excluded:* 10.001, 10.011.

Techniques for integration, improper integrals; Taylor's theorem; first order differential equations and applications; introduction to multivariable calculus; conics; finite sets; probability; vectors, matrices and linear equations.

10.022 Engineering Mathematics 2**F L2T2**

Prerequisite: 10.001.

Differential equations, use of Laplace transforms, solutions by series; partial differential equations and their solution for selected physical problems, use of Fourier series; introduction to numerical methods; matrices and their application to theory of linear equations, eigenvalues and their numerical evaluation; vector algebra and solid geometry; multiple integrals; introduction to vector field theory.

10.031 Mathematics

F L1T1

Prerequisite: 10.001 or 10.011 or 10.021C (CR).

Note A: A unit, together with 10.032, which is available to Faculty of Science students as one of a sequence of two units constituting a terminating service course in mathematics. As such it is mutually exclusive to any other Level II or Level III unit in Pure and/or Applied Mathematics and/or Theoretical Mechanics except that 10.412A may be taken with 10.031 and 10.032.

Note B: Mathematics 10.031 is included for students desiring to attempt only one Level II Mathematics unit. If other Level II units in Pure Mathematics or Applied Mathematics are taken, 10.031 Mathematics will not be counted.

Differential equations, use of Laplace transforms, solutions by series; partial differential equations and their solution for selected physical problems, use of Fourier series; multiple integrals, matrices and their application to theory of linear equations, eigenvalues; introduction to numerical methods.

10.032 Mathematics

F L1T1

Prerequisite: 10.031.

Note A: As for Note A in 10.031 Mathematics.

Note B: Mathematics 10.032 is included for students desiring to attempt only one Level III Mathematics unit. If other Level III units in Pure Mathematics, Applied Mathematics or Theoretical Mechanics are taken, 10.032 Mathematics will not be counted.

Vector calculus; special functions; convolution theorem and applications; complex variable theory; Fourier integrals; Laplace transforms with application to ordinary and partial differential equations.

10.1113 Pure Mathematics 2 — Multivariable Calculus

S1 or S2 L1½T1

Prerequisite: 10.001 or 10.011. *Excluded:* 10.1213.

Multiple integrals, partial differentiation. Analysis of real valued functions of one and several variables.

10.2111 Applied Mathematics 2 — Vector Calculus

S1 or S2 L1½T½

Prerequisite: 10.001. *Excluded:* 10.2211.

Properties of vectors and vector fields; divergence, gradient, curl of a vector; line, surface, and volume integrals. Gauss' and Stokes' theorems. Curvilinear co-ordinates.

10.2112 Applied Mathematics 2 — Mathematical Methods for Differential Equations

S1 or S2 L1½T½

Prerequisite: 10.001. *Excluded:* 10.2212.

Mathematical methods for ordinary and partial differential equations. Series solutions, numerical methods, separation of variables. Fourier series. Besser functions.

10.301 Statistics SA

F L1½T½

Prerequisite: 10.001 or 10.021C. *Excluded:* 10.331, 10.311A, 10.311B, 10.321A, 10.321B, 45.101.

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.

Accounting

14.501 Accounting and Financial Management 1A

S1 or S2 L2T2½

Prerequisite: Nil.

The basic concepts of financial model building and information systems, including the double-entry recording system, the accounting cycle, income measurement and financial reporting, and an introduction to basic elements of auditing.

14.511 Accounting and Financial Management 1B

S1 or S2 L2T2½

Prerequisite: 14.501.

Development of basic concepts introduced in 14.501 Accounting and Financial Management 1A, including corporate reporting, business finance, system design, elementary computer applications.

14.522 Accounting and Financial Management 2A

S1 or S2 L2T2½

Prerequisites: 14.511 plus

		HSC minimum mark required
2 unit Mathematics or		60
3 unit Mathematics	2 unit	60
	3 unit or	1
	3 unit	1
4 unit Mathematics	4 unit	1

The design, production and use of accounting and other quantitative information in the planning and control of organizations, with particular reference to manufacturing activities.

14.542 Accounting and Financial Management 2B S2 L2T2½

Prerequisite: 14.511 plus HSC results as for 14.522.

Critical examination of concepts and problems in income measurement, asset valuation and financial reporting for various forms of business undertaking with particular reference to corporate organizations, including associated aspects of auditing and taxation and methods of accounting for changing prices.

14.602 Computer Information Systems 1 S1 or S2 L2T1

Prerequisite: 15.411 or 15.401 or approved studies in computer science.

Information systems and the organization, 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.

14.606 Management Information Systems Design S2 L2T1

Prerequisite: 14.602. Excluded: 14.603.

Organizational impact, information systems design methodologies, requirements elicitation, logical and physical design, implementation procedures, principles of data management, data analysis, telecommunications networks, systems design in a distributed environment, commercial programming practice, systems development case studies using spreadsheet, file management and word processing software.

14.613 Business Finance 2A S1 or S2 LT3

Prerequisite: 14.511, 15.011 and 15.421.

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.

14.774 Legal Environment of Commerce S1 or S2 L2T1

Prerequisite:

	HSC minimum mark required
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 organization, employment, commercial arbitration, advertising, trade regulation, civil compensation, discrimination.

14.776 Legal Regulation of Commerce S1 or S2 L2T1

Prerequisite: 14.774.

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 monopolization) and consumer protection law (including misleading and deceptive advertising and other unfair practices). Consumer credit; product liability; protection of intellectual property.

Commerce and Economics

15.101E Microeconomics 1 S1 or S2 L2T1½

Prerequisite:

	HSC minimum mark required
2 unit English (General) or	60
2 unit English or	53
3 unit English	1

Economics as a social science, the central role of scarcity and opportunity cost. Australian industrial structure. Efficiency concepts. Relative prices and their change through time. Demand, revenue and elasticity. Theory of exchange. Property rights, externalities and distortions. Gains from specialization and international trade. Marginal productivity, input demand. The price taking firm, profit maximization in short and long run. Taxation, protection, stabilization of markets. Imperfect markets, competition policy. Investment decisions and economic growth.

15.102E Macroeconomics 1 S1 or S2 L2T1½

Prerequisite: 15.101E.

The economics of output, employment and inflation, including social accounting, consumption and investment functions, the Keynesian goods market model, supply and demand for money, interactions between the goods and money markets in equilibrium and disequilibrium situations, inflation and the balance of payments.

15.201E Microeconomics 2 S1 L2T2

For students first enrolling in 1989 —

Commerce prerequisite: 15.102E

Arts/Applied Science/Sciences prerequisites: 15.102E, 15.103M.

Co-requisite: 15.203M.

Excluded: 15.221E, 15.203E.

For students who first enrolled before 1989 —

Commerce prerequisite: 15.011.

Applied Science/Sciences prerequisites: 15.011 plus 15.401 or 15.411 or 10.001 or 10.011.

Arts prerequisite: 15.011. *Co-requisites:* 15.401 or 15.411 or 10.001 or 10.011.

Excluded: 15.012, 15.072.

Consumer behaviour. Theory of the firm, production theory. Competition, monopoly, oligopoly. Factor markets. General equilibrium analysis: efficiency and equity, welfare maximisation, gains from trade. Externalities, market distortions. Intertemporal economics, investment criteria.

15.302E Macroeconomics 3

S2 L2T2

For students first enrolling in 1989 —

Prerequisites: 15.201E, 15.202E and 15.203M.

Excluded: 15.322E

For students who first enrolled before 1989 —

Commerce prerequisite: 15.042 or 15.052.

Arts/Applied Science/Sciences prerequisite: 15.042 or 15.052.

Co-requisite: 15.412. *Excluded:* 15.013.

Macroeconomic theory and policy including an introduction to the theory of economic policy, the structure and dynamic characteristics of macro-models, fiscal policy, monetary theory and policy, inflation and unemployment. Rational expectations. Macroeconomic policy in Australia.

15.202E Macroeconomics 2

S2 L2T2

Commerce prerequisite: 15.102E.

Arts/Applied Science/Sciences prerequisites: 15.201E and 15.203M.

Excluded: 15.204E, 15.222E

For students who first enrolled before 1989 —

Commerce prerequisite: 15.011.

Art/Applied Science/Sciences prerequisites: 15.002 plus 15.401 or 15.411 or 10.001 or 10.011. *Co-requisite:* 15.421.

Excluded: 15.052, 15.062.

Extensions to the Keynesian model of income determination. Consumption and investment theories. Money demand and supply. Balance of payments and exchange rate analysis. Inflation and unemployment. Introduction to dynamic analysis. Labour markets. Growth and cycles.

15.203E Applied Microeconomics

SS L2T1½

Commerce prerequisite: 15.102E.

Arts/Applied Science/Sciences prerequisites: 15.102E and 15.103M or 15.104M.

Excluded: 15.201E, 15.221E.

For students who first enrolled before 1989 —

Commerce/Arts/Applied Science/Sciences prerequisite: 15.011.

Excluded: 15.012 and 15.002.

Structural change in the Australian economy. The effect of different market structures on firms and consumer welfare. The consequences of markets 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.

15.204E Applied Macroeconomics

SS L2T1½

Commerce prerequisite: 15.102E.

Arts/Applied Science/Sciences prerequisite: 15.102E and 15.103M or 15.104M.

Excluded: 15.202E, 15.222E.

For students who first enrolled before 1989 —

Commerce/Arts/Applied Science/Sciences prerequisite: 15.011.

Excluded: 15.052 and 15.042.

Economic growth and fluctuations in Australia. Inflation, unemployment and balance of payments issues. Fiscal, monetary, exchange rate and incomes policies. Changes in the structure of the Australian financial system and its links with the international monetary system. Effects of restrictions on capital markets.

15.205E Marxian Political Economy

S1 or S2 L2T1

Prerequisite: 15.102E.

For students who first enrolled before 1989 —

Commerce/Arts/Applied Science prerequisite: 15.011.

Varieties of political economy. Marx and the classics, the Marxian system. Marxian economics since Marx, Marx and socialist planning, Marxian analysis of current economic problems.

15.207E Natural and Environmental Resources Economics

S1 or S2 L2T1

Prerequisites: 15.201E or 15.221E or 15.203E.

For students who first enrolled before 1989 —

Prerequisite: 15.002 or 15.012 or 15.072.

Classification of renewable and non-renewable resources: reserves, resources and resource base; the concept and measurement of resource scarcity, costs, prices and rents; exhaustion of resources, ore quality, exploration, availability of substitutes; uncertainty of discovery, technical progress, market imperfections; renewable resources, sustainable yield concepts. Policy issues, with particular reference to Australia's role in the international economy.

15.241E Economics of Developing Countries

S1 L2T1

For students who first enrolled before 1989 —

Commerce/Arts/Applied Science prerequisite: 15.072 or 15.103 or 15.113.

Aspects of economic development in the less developed countries. Characteristics of these countries and the policies available to them, simplified models of under-development, phenomenon of structural change in the development process, role of industrialization in promoting structural change, international relationships of developing countries and strategies of development based on industry or agriculture.

15.243E Public Finance

S1 or S2 L2T1

For students who first enrolled before 1989 —

Commerce/Applied Science prerequisite: 15.002 or 15.012 or 15.072.

Arts prerequisites: 15.002 or 15.012 or 15.072 plus 15.421 or 15.403.

General aspects of public sector expenditure and its financing with special reference to Australia: role of government in the economy; principles and types of public expenditure; tax sharing and revenue systems; economic and welfare aspects of different types of taxes and social services systems; inflation and tax indexation; loan finance and the public debt; fiscal policy, the Budget and the economy.

15.247E Public Sector Economics S1 or S2 L2T1

For students who first enrolled before 1989 —

Commerce/Arts prerequisite: 15.002 or 15.012 or 15.072.

Applied Science prerequisite: 15.002 or 15.012 or 15.072 with the approval of the Head of the Department of Economics.

The theory of public economic activity in the short-run and the long-run. Government objectives and the social welfare function. Equity and efficiency in revenue raising. The theory of public sector pricing and its applications. Techniques of investment appraisal, cost-benefit analysis and related issues. The application of cost-benefit analysis to transport, urban and other problems.

15.301E Microeconomics 3 S1 L2T2

Prerequisites: 15.201E, 15.202E and 15.203M.

Exclusion: 15.321E.

For students who first enrolled before 1989 —

Commerce prerequisite: 15.002 or 15.012.

Arts/Applied Science/Sciences prerequisite: 15.002 or 15.012. Co-requisite: 15.412.

Excluded: 15.153.

Input-output analysis, applications to Australia. General equilibrium analysis: industry protection and taxation. Income distribution. Market failure, property rights and public goods. Introduction to analysis of uncertainty. Deregulation of industry. Public enterprise pricing and investment.

15.208E Industry Economics and Australian Industrial Policy S1 or S2 L2T1

Prerequisite: 15.201E or 15.221E or 15.203E.

For students who first enrolled before 1989 —

Commerce/Applied Science prerequisite: 15.002 or 15.012 or 15.072.

Arts prerequisites: 15.403 or 15.421 plus 15.072 or 15.012 or 15.002.

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).

15.211E Managerial Economics S1 L2T1½

Prerequisites: 15.101E and 15.102E.

The application of economic concepts and analysis to managerial decision making. The relevance of opportunity cost and marginal analysis. Introduction to linear programming as a tool for managerial decision making. Production and cost analysis and measurement, with applied examples. Market and demand analysis and forecasting with applied examples. Problems of

price setting. The role of non-price competition, such as advertising. The cost of capital and capital budgeting. An introduction to risk.

15.501 Introduction to Industrial Relations S2 L2T1

For students enrolled in Faculties other than Commerce and Arts. Designed to provide a practical introduction to important industrial relations concepts, issues and procedures. Includes: the origins, evolution and operation of the Australian system of industrial relations; the structure and role of trade unions and employer bodies; the function of industrial tribunals such as the Australian Conciliation and Arbitration Commission and the NSW Industrial Commission; wages structure and determination; employment, unemployment and retraining; the nature and causes of strikes and other forms of industrial conflict; the processes and procedures for conflict resolution.

Where appropriate to class composition, particular attention is paid to individual industries.

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

15.511 Industrial Relations 1A S1 or S2 L2T1½

Commerce/Arts prerequisite:

HSC minimum
mark required

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 organizations 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.

15.902 Management Strategy and Business Development S2 L2T1½

Commerce prerequisite: 15.901.

Applied Science/Arts/Sciences prerequisite:

HSC
minimum mark
required

2 unit English (General) or

60

2 unit English or

53

3 unit English

1

The strategy and structure of large scale business enterprise over the past century. An analysis of the process of growth from small family firms and partnerships to corporate enterprises and multi-national corporations. The external business environment

Case studies of managerial hierarchies, investment strategy and diversification of firms in transport, mass retailing and mass production.

Biological and Behavioural Sciences

17.031 Biology A

S1 L2T4

Prerequisite:

HSC Exam
Mark Range
Required
53-100
53-100
53-100
53-100
90-150
1-50

2 unit Science (Physics) or
2 unit Science (Chemistry) or
2 unit Science (Geology) or
2 unit Science (Biology) or
3 unit Science or
4 unit Science

Basic cell structure; membranes, organelles, prokaryotic and eukaryotic cells; cellular locomotion; basic biological molecules; enzymes; structure and metabolic roles, cellular compartmentalization and enzyme function; diffusion, osmosis and active transport; theory of inheritance, linkage, mutation, information transfer and protein synthesis.

Requirements for Practical Work

Equipment required for practical work is set out in the *Course Guide*, available during enrolment time at the First Year Registration Centre (Physics Building). Students must purchase this *prior* to the first week of session.

17.041 Biology B

S2 L2T4

Prerequisite: 17.031. *Excluded:* 17.021.

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.

Industrial Engineering

Industrial Engineering is a Department within the School of Mechanical and Industrial Engineering.

18.121 Production Management

F L2T1

Prerequisites: 10.031, 10.331.

Engineering economy: Economic objectives of the firm. Economic measure of performance: net present value, annual equivalent value and the DCF rate of return (including the incremental rate of return) and their application in the selection and replacement of processes and equipment. *The use of human and physical resources:* Methods engineering, ergonomics, motion and time study, financial incentives, applications to machine controlled processes, work sampling and data collection. Plant location, factory layout. *Production and quality control:* Control of jobbing, repetitive batch and continuous production. Manufacturing organizations, functions, inter-relationships and information flow. Sampling techniques in quality control, control charts. *Introduction to inventory control:* Analysis of some engineering planning decisions. *Introduction to operational research:* The formation and optimization of mathematical models of industrial processes. The development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queueing theory, inventory models, simulation.

18.1211 Production Management A

S1 L3

Prerequisites: 10.031, 10.331 or 10.021B, 10.021 C, 13.200.

Use of human and physical resources: Methods engineering, ergonomics, motion and time study, financial incentives, applications to machine controlled processes, work sampling and data collection. Plant location, factory layout. *Production and quality control:* Control of jobbing, repetitive batch and continuous production. Manufacturing organisations, functions, inter-relationships and information flow. Sampling techniques in quality control, control charts. *Introduction to inventory control:* Analysis of some engineering planning decisions.

18.1212 Production Management B

S2 L3

Prerequisites: 18.1211.

Engineering economy: Economic objectives of the firm. Economic measure of performance: net present value, annual equivalent value and the DCF rate of return (including the incremental rate of return) and their application in the selection and replacement of processes and equipment. *Introduction to operational research:* Formation and optimization of mathematical models of industrial processes. Development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queueing theory, inventory models, simulation.

18.131 Operations Research

Introduction to operational research: The formation and optimization of mathematical models of industrial processes. The development of decision rules. Some techniques of operational research and applications, eg mathematical programming, queueing theory, inventory models, simulation.

18.551 Operations Research**F L2T1***Prerequisites:* 5.0721, 10.022, 10.351. *Excluded:* 6.646.

The formulating and optimization of mathematical models. The development of decision rules. Some techniques of operations research such as mathematical programming, queueing theory, inventory models, replacement and reliability models; simulation. These techniques applied to situations drawn from industrial fields, eg production planning and inventory control. Practical problems of data collection, problem formulation and analysis.

Marketing**28.012 Marketing Systems****S1 L2T2***Prerequisite:* Nil.

Conceptual introduction to marketing from the systems viewpoint. Evolution and characteristics of marketing systems, buyer behaviour, marketing channel flows (equalizing supply and demand, communication, ownership, finance, physical distribution), marketing activities in the firm (planning and marketing program, co-ordination and control of marketing activities, problem solving, product planning, promotion and pricing, physical distribution management), resources allocation by competition, the expanding role of government, social performance of marketing and social efficiency of marketing.

28.052 Marketing Research**S2 L2T2***Prerequisite:* 15.421 or approved substitute.

Sources and types of marketing information. Design, conduct, analysis and reporting of market surveys and experiments. Technique of statistical inference.

28.073 Strategic Marketing**S1 L2T2***Prerequisites:* 28.012 and 28.052.

Conceptual framework relevant to the practice of marketing management for the further development of an integrative understanding of the market function. Important extensions and limitations of customer orientation and the emergence of a broader concept of marketing; stages of development of a marketing operation, the central role of innovation in opportunity management and the concept of control; importance of product life cycle concept to the formulation of marketing strategy; relationships between corporate and marketing strategy; marketing strategy, future analysis and scenario construction.

28.083 Managerial Marketing**S2 L2T2***Prerequisite:* 28.073.

Application of theoretical marketing concepts developed in 'Strategic Marketing' and quantitative techniques developed in 'Marketing Models'. Based on the planning, implementation and appraisal of a major field study.

Surveying**29.441 Surveying for Engineers****S1 or S2 L2T4**

Co-ordinate systems. Levelling. Theodolite and angular measurements. Distance measurements: steel band, electronic. Traversing. Tacheometry. Contour and detail surveys. Horizontal and vertical curves. Area and volume computations. Control, engineering and underground surveys. Outline of photogrammetry.

29.491 Survey Camp

A one-week field camp for students studying 29.441 Surveying for Engineers.

Town Planning**Core Subject****36.411 Town Planning****S1 L2T1***Architecture prerequisite:* 11.4308 and 100 credit points.

Introduction to the purpose, scope and application of planning. The urban planning process. Objectives and means of planning cities. Levels of planning and types of plans: state environmental policies, regional environmental plans, local environmental plans. Problems in planning: equitable distribution of resources. Environment and environmental impact statements. Planning law and administration. Future of cities.

Landscape Architecture

Students should contact the Head of School before enrolling in any of the following subjects.

37.1616 Land Systems**S2 L1T1***Prerequisite:* 37.5505.

An investigation of resources and their management in relation to a range of land use types with an emphasis on an ecological approach. Management of both natural and cultural landscapes within the context of marine, coastal, estuarine and terrestrial environments. Studies of specific examples and the effects of human impacts. Methods of conservation and rehabilitation considered. Field excursions.

37.9105 Landscape Planning 1**S1 L2T2***Prerequisite:* 37.1504.

Basic methods and techniques of resource data collection, analysis and valuation. History of landscape planning in Australia and overseas with reference to pioneering case studies. Projects include the use of maps, air photos and simple computer programs.

37.9206 Landscape Planning 2**S2 L2T2***Prerequisite:* 37.9105.

Classification of planning methods. Study of complex methods and techniques used in recent landscape planning models. Development of land use suitability models for recreation, residential, industrial, commercial, grazing, agriculture, forestry and conservation. Projects include the use of remote sensing techniques and advanced computer programs.

Biochemistry

41.101 Biochemistry**F L2.5T3.5***Prerequisites:* 17.041, 2.121 and 2.131, or 2.141. Excluded 2.003J.

The chemical properties of amino acids, peptides and proteins, carbohydrates, nucleic acids and lipids and the 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. Photosynthesis. Practical work to amplify the lectures.

Biotechnology

Biotechnology is a Department within the School of Applied Bioscience.

42.101 Introduction to Biotechnology**S2 L2T4***Prerequisites:* 2.121 and 2.131, or 2.141; 17.041; 10.011 or 10.001 or 10.021B and 10.021C.

An introduction to biotechnology as a multidisciplinary subject, dealing with the application of biochemical systems or their products in industry. Industrial uses include: production of single products (such as amino acids, vitamins, antibiotics etc), single cell protein, alternate fuels from renewable resources and fermented foods and beverages; biological waste treatment; aspects of pollution control, biodeterioration and biodegradation; and principles of enzyme technology. Concepts relevant to productivity in these systems, including: thermodynamic feasibility, techniques of environmental and genetic manipulation, choice of the appropriate biological catalyst(s) for a particular process, regulation of gene activity. The laboratory component emphasizes the manipulation of different classes of microorganisms and the use of biochemical products involved in a variety of biotechnological areas.

42.102A Biotechnology A**S1 L2T4***Prerequisites:* 41.101 and 42.101 or 44.101 (Pass Conceded (PC) or Terminating Pass (TP) awarded prior to Session 2, 1983, is not acceptable).

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 micro-organisms, laboratory-scale fermenter operation, microbial enzyme isolation, visits to industrial fermentation plants and industrial seminars.

42.102B Biotechnology B**S2 L2T4***Prerequisite:* 42.102A (Pass Conceded (PC) or Terminating Pass (TP) awarded prior to Session 2, 1983, is not acceptable).

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 optimization techniques. The economics of microbial processes are considered and comparison made with alternative modes of production or treatment. The economics of agro-industry 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.

4.102C Microbial Genetics**S1 L2T4***Prerequisites:* 41.101 or 44.101. Excluded: 43.102.

A detailed study of the mutational basis of microbial variation. Mutagens: mechanisms of mutagenesis; induction, enrichment, isolation and characterization of mutants; mechanisms of repair of mutational damage. Systems of gene transfer and recombination in fungi, bacteria and bacterial viruses; the use of these systems in constructing genetic maps, and as tools for probing aspects of microbial physiology and biochemistry. Genetic control of gene expression; the operon concept and its application to specific regulatory systems. Genetic code, collinearity between a gene and its product, genes within genes, suppression of mutations. Restriction and modification of DNA; genetic engineering — its implications and prospects. Genetics of nitrogen fixation.

42.103 Biotechnology (Honours)

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

42.114 Fermentation Processes

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 optimization and waste disposal. Demonstrations of the operation and control of fermenter systems and of microbial process simulation.

42.103 Biotechnology (Honours)

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

Biological Science

Plant Science**43.111 Flowering Plants****S1 L2T4**

Prerequisites: 17.031 and 17.041.

Plant cell structure, structure and functions of the major organs in angiosperms (flowers, roots, stems and leaves), secondary thickening and arborescence, transport systems in plants, seeds and germination. Variation in structure and function in relation to environment. Introduction to taxonomy and identification of major Australian plant families. A short field excursion is part of the subject.

43.112 Taxonomy and Systematics**S1 L2T4**

Prerequisite: 43.111.

The assessment, analysis and presentation of data for classifying organisms both at the specific and supra-specific level.

43.121 Environmental Physiology**S2 L2T4**

Prerequisites: 17.031, 17.041, 2.121 and 2.131, or 2.141.

How plants function in relation to the constraints imposed on them by soil and atmospheric environments. Includes: germination, growth and development, particularly photosynthesis, respiration, inorganic nutrition, water relations, transport processes and reproductive physiology. Important practical applications of various physiological mechanisms.

43.142 Environmental Botany**S1 L2T4**

Prerequisites: 17.031 and 17.041.

The soil and atmospheric environments in which plants live and a study of the interaction of plants with their environment. Energy

and mass transfer. Emphasis is placed on the role of environmental science in food production.

43.152 Plant Community Ecology**S2 L2T4**

Prerequisites: 43.111 and 17.012 or 27.111.

Recognition and delimitation of plant communities. Ecology of selected Australian vegetation types. Use of numerical methods and application of community concepts to palaeoecology. Field work is an integral part of this course.

Animal Science**45.101 Biometry****S2 L2T4**

Prerequisites: 17.031, 17.041. *Excluded:* 10.311A, 10.321A, 10.331.

Statistical methods and their application to biological data, including introduction to probability; the binomial, Poisson, normal distributions; student's *t*, χ^2 and variance ratio tests of significance based on the above distributions, the analysis of variance of orthogonal and some non-orthogonal designs; linear regression and correlation. Non-linear and multiple regression. Introductory factorial analysis. Introduction to experimental design. Non-parametric statistics, including tests based on χ^2 , the Kruskal-Wallis test, Fisher's exact probability test and rank correlation methods. Introduction to programming in BASIC.

45.121 Evolutionary Theory**S1 L3T3**

Prerequisites: 17.031, 17.041.

Current evolutionary theory, emphasizing the population level. Ecological genetics, evolutionary aspects of ecological niche theory, speciation, evolution of social behaviour, molecular evolution and general evolutionary genetics. Some background in genetics is desirable.

45.122 Animal Behaviour**S2 L2T4**

Prerequisites: 45.101, and 45.201 or 45.301.

An introduction to Ethology, the biological study of behaviour. Physiological, ecological, developmental and evolutionary aspects of behaviour are examined as important elements in the analysis of behaviour, particularly social behaviour. Both field and laboratory work are included.

45.152 Population and Community Ecology**S1 L2T4**

Prerequisites: 17.041 and 10.001 or 10.011 or both 10.021B and 10.021C.

Examination of the dynamics of one, two or more interacting populations. Systems analysis and simulation in ecology. Theoretical and mathematical analysis of the dynamics and stability of ecosystems. Topics in the optimal management of renewable resources. Unifying concepts in ecology.

45.201 Biology of Invertebrates**S2 L2T4**

Prerequisites: 17.031, 17.041.

A comparative study of the major invertebrate phyla with emphasis

on morphology, systematics and phylogeny. Practical work to illustrate the lecture course. Obligatory field camp.

45.301 Vertebrate Zoology S1 L3T3

Prerequisites: 17.031 and 17.021, or 17.041.

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.

45.302 Vertebrate Zoogeography and Evolution S2 L2T4

Prerequisite: 45.301.

A geographic approach to the current distribution, abundance and types of vertebrate species in the Australian region. Particular emphasis is placed on the basic principles of speciation, the history of the Australian continent, vertebrate adaptations and changes in the distribution and abundance of the Australian vertebrate fauna under the influence of humans. Field excursions as arranged.

45.422 Economic Zoology S2 L2T4

Prerequisite: 45.201 or 45.402.

A study of the biology, ecology and control of vertebrate and invertebrate animals which harm humans and their possessions. Human and domestic animal parasitology, pests on plants, diseases caused or spread by animals, chemicals, biological and physical control, and side effects.

Microbiology

44.101 Introductory Microbiology S1 L2T4

Prerequisites: 17.031 and 17.041.

The general nature, occurrence and importance of microorganisms. A systematic review of the major groups of microorganisms; the eucaryotic protista (micro-algae, protozoa and fungi); procaryotic protista (blue-green algae, "higher" bacteria, typical unicellular bacteria and small bacteria-like forms); plant, animal and bacterial viruses. The relationship between microorganisms and their environment, ecological considerations. Interactions between microorganisms and higher organisms.

44.121 Microbiology 1 S2 L2T4

Prerequisites: 44.101 and 41.101 or 2.003J.

The balanced structure of this unit makes it suitable for students majoring in microbiology and also for students who wish to enlarge their knowledge and skills in microbiology beyond those obtained in 44.101 Introductory Microbiology or equivalent units at other institutions.

The classification and function of bacteria. Differentiation of major families and genera of bacteria. Measurement models and theory of microbial growth. Comparative aspects of microbial growth. Bacterial nutrition and biosynthetic pathways. Microbial survival. Theory and practice of sterilization. Introduction to applied aspects of microbiology especially medical microbiology and the role of bacteria in ecosystems.

Political Science

54.1003 Australian Political Institutions S1 3CCH C6

J. Paul

Excluded: 54.1001, 54.1002 and 54.1006.

The nature and history of Australian political institutions in depth. The Australian constitution and federal structure and the role of the High Court in helping determine the nature of the power relationships in Australian politics. The political parties, their history, successes and failures, strengths and weaknesses both in and out of government. The formal institutions of government: parliament, cabinet, the bureaucracy and both Labor and Liberal prime ministers. Elections and voting in Australia and pressure groups.

54.1004 Government in the Modern World S2 3CCH C6

A. Chan, A.C. Palfreeman

Excluded: 54.1001.

The development, nature and forms of government in the modern world. Particular attention is paid to the major conceptual tools of political analysis with emphasis on a comparative approach to the study of government and case studies drawn from Australia and the industrialized and developing areas. An underlying theme is the management of conflict and the establishment of order in the various systems examined.

54.1005 A History of Political Thought S2 3CCH C6

C. Condren

Excluded: 54.1001.

An introduction to Western political theory through the study of four major texts taken from three distinctly different political civilisations. Each text is studied against its social and intellectual background and in the context of the political crises to which it was addressed. The main themes of the lectures concern the relationship between political theory and practice and that between language and political awareness.

The texts are Plato, *The Republic*; Machiavelli, *The Prince and Discourses*; Hobbes, *Leviathan*; Locke, *The Second Treatise of Government*.

54.2008 Public Policy Making**S2 3CCH C6**

E. Thompson

Prerequisite: 12 Level I credit points in Political Science.

The problems of administering government and the problems of decision making. Models of decision-making are discussed, as are problems in implementation. Areas of public policy in Australia, such as poverty and education.

54.1006 The Australian Political System**S1 3CCH C6**

R. Lucy

Excluded: 54.1001, 54.1002, 54.1003.

Basic concepts in political science such as power, influence and authority. Models of the Australian political system. The subsequent examination of the Australian political system is designed to illustrate these concepts and to test these models. The Australian political system is understood as the formal governmental institutions, political parties, and political culture. Australian political issues are studied to illustrate the Australian political culture.

54.1007 The Politics of Development**S2 3CCH C6**

R. Lim

Excluded: 54.1001.

The history of Australia's relations with Asia. Australia's place in the postwar network of US alliances and the impact of this on relations with regional countries, especially China. The development of ASEAN and Australia's relations with it, with particular emphasis on Indonesia. The economic relationship with Japan and China and proposals for an Asian Pacific community. The debate about aid policy.

54.1008 Politics of Soviet-Type Systems S1 3CCH C6

S. Fortescue

Excluded: 54.1001.

Examines political concepts and phenomena in Soviet-type systems, with the emphasis on Eastern Europe. Includes legitimacy and authority, economic reform and political pluralism, the party in communist systems, political participation, and others.

The approach is strongly comparative, with an effort being made to discern and explain differences within the Eastern bloc, and between that bloc and the Western and developing worlds.

Graduate Study

Chemistry

2.251G Toxicology, Occupational and Public Health

F L1T3

Important classes of toxic materials found in the environment; treatment of pesticide residues, industrial chemicals of various types, toxic gases, mould metabolites and bacterial toxins occurring in food, carcinogenic substances, toxic metals, etc. Effects of these substances on living organisms, particularly man. Practical work: pesticide residue analysis, blood and urine analysis, gas sampling and analysis, trace metal determination and experiments on the animal metabolism of toxic substances.

2.271G Chemistry and Analysis of Foods

F L1T3

Illustrates the bases and application of analytical techniques as applied to foods. Emphasis is placed on the design of methods, on the preparation of material for instrumental analysis and on the interpretation of data. Includes: proteins and flesh foods, carbohydrates and saccharine foods, fats and oils, dairy and fermentation products, vitamins, food additives — preservatives and colouring matters, pesticide residues, metal contaminants — food microscopy.

Electrical Engineering and Computer Science

6.070G Digital Image Processing Systems

C3

Excluded: 6.476G.

The fundamentals of digital image processing with topics selected from the following: Visual perception and the image model, transforms, enhancement, sharpening and smoothing, restoration, encoding, segmentation, reconstruction and images from projections and lomography, satellite imaging and imaging in remote sensing; image processing hardware and systems; picture processing; measurement and inspection.

97.580G Image Analysis In Remote Sensing

C3

Prerequisite: 10.361 or equivalent.

Techniques for extracting information from remotely sensed data with particular emphasis on satellite imagery. Topics taken from: nature and characteristics of earth resources and related satellites; satellite sensors and data formats; image enhancement techniques; image classification methods, including clustering,

classification and feature selection; image classification methodologies; new horizons in remote sensing image analysis.

97.581G Microwave Remote Sensing

C

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.

Civil Engineering

8.402G Transport, Environment, Community

F C

Effect of transport on public health, environment and communities. Analysis of unwanted effects of transport activity: accidents, noise, pollution, intrusion; causation, measurement, preventative and remedial action. Community reaction to transport activity; government, bureaucracy and public involvement in transport policy and environment impact statements.

8.403G Theory of Land Use/Transport Interaction

S1 C

Theoretical aspects of land use transport planning. Basic concepts, data collection methods, systems models and equations of state (function behavioural, optimizing). Introduction to land use-transport modelling (land use, generation, distribution, modal assignment, network assignment, evaluation). Planning methodologies (short-, medium-, long-term; action planning, strategic planning; local, urban, regional national).

8.413G Transport Economics

S2 C

Cost and price analysis for each of the transport modes (road, rail, air and sea). Welfare analysis and taxation theory with respect to transport. Economics of location, economics of land use models; regional trade model.

8.701G Economic Decision Making in Civil Engineering

SS C

Review of practical engineering decision-making problems and relevant techniques. Engineering economics, benefit/cost analysis, consideration of inflation and taxation in investment decisions, bidding, decision theory, microeconomic theory, objectives and criteria, multiple objective planning.

8.703G Optimization Techniques in Civil Engineering**SS C3**

Search, linear programming, non-linear programming, geometric programming, calculus of variations, maximum principle, applications.

8.776G Rock Mechanics**SS C3**

Description of rock mass and discontinuities, strength and failure criteria, classification systems. Data collection and presentation. Initial stresses and their measurements, methods of stress analysis, stresses around underground openings. Selection of design of tunnel support systems, steel sets, rock bolts and shotcrete. Design of large underground openings. Excavation. Methods of prediction. Blasting.

8.777G Numerical Methods in Geomechanics**SS C3**

Fundamentals of finite element and boundary element methods; application to practical geotechnical design and case studies; deformation and flow problems; linear and non-linear analysis; application to underground opening, stability of slopes, foundations, mining excavation; seepage and consolidation soil-structure interaction problems; earth pressures, retaining walls and buried pipes, thermal stress analysis.

8.833G Free Surface Flow**SS C3**

Theory of waterflow in open channels. Application of theory to design of hydraulic structures, spillways, control gates, energy dissipators, channel transitions. Use of hydraulic models.

8.842G Groundwater Hydrology**SS C3**

Confined and unconfined aquifers, analogue and digital models of aquifer systems, water movement in the unsaturated zone, recharge, groundwater quality, sea water intrusion.

8.843G Groundwater Hydraulics**SS C3**

Mechanics of flow in saturated porous materials, steady and unsteady flow to wells, leaky aquifers, partial penetration, multiple aquifer boundaries, delayed yield from storage, regional studies.

8.847G Water Resources Policy**SS C3**

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

8.848G Water Resource System Design**SS C3**

Principles of the optimal design and operation of multiple purpose, multiple component, water resource system; evaluation of cost and benefits in complex and simple systems.

8.849G Irrigation**SS C3**

Soils, soil-water relationships, plants, climate, crop requirements; water budgets, sources, quality, measurement; irrigation efficiency. Design of irrigation systems, appurtenant works, distribution.

8.850G Drainage of Agricultural Land**SS C3**

Characteristics of drainage systems, steady and unsteady state drainage formulae, conformal transformation solutions, soil characteristics field measurement of hydraulic conductivity and soil water pressure, significance of unsaturated zone, practical aspects.

8.857G Sewage Treatment and Disposal**SS C3****8.857X Sewage Treatment and Disposal (external) S2 C3**

Application of processes and process variations used to improve the quality of sewage effluent, and the disposal of the effluent. Re-use of effluents where applicable. Sludge treatment and disposal.

8.860G Investigation of Groundwater Resources 1**SS C3**

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

8.861G Investigation of Groundwater Resources 2**SS C3**

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

8.864G Arid Zone Hydrology**S1 L1½T1½ C3**

Co-requisites: 8.837G, 8.838G.

Arid zone rainfall characteristics, data collection and instrumentation, runoff processes, infiltration, transmission loss, recharge processes, flood characteristics and design; water yield, storage of water; evaporation and evaporation suppression; sediment transport and measurements.

8.865G Arid Zone Water Resources Management**SS L1½T1½ C3**

Water as a resource: demand for and supply of water; works and management to match demand with supply. Special features of the arid zone climate, water uses, quantification of demand quantities and qualities; measurement of flow rate, volume, quality. Engineering works: design, construction, operation and maintenance of work, including excavation tanks, dams, pipelines, pumps, windmills, engines and motors, troughs; costs; reliability; energy sources for pumping. Special practices: water spreading, irrigation including trickle irrigation; evaporation reduction, desalination.

8.870G Hydraulics and Design of Water and Wastewater Treatment Plants**S2 C3**

Co-requisites: 8.856G, 8.857G.

Application of hydraulic principles to flows within treatment plants. Selection and integration of unit processes required for

water and wastewater treatment, plant layout, plant design including hydraulic profiles, the influence of flow and load variability, instrumentation and control strategies.

8.872G Management of Wastes S2 L2T1 C3

8.872X Management of Wastes (external) S1 C3

Management and control strategies in waste management, legal requirements, local and overseas legislation, case studies of waste management.

8.873G Waste and Wastewater Analysis and Environmental Requirements S1 L1½T1½C3

8.873X Waste and Wastewater Analysis and Environmental Requirements (external) S1 C3

Principles of analytical methods used in chemical analysis of wastes and wastewaters, sampling schemes, statistical evaluation of data, environmental requirements to prevent pollution.

8.874G Waste Management Science S1 L2T1C3

8.874X Waste Management Science (external) S1 C3

Aspects of chemistry, biology and geology relevant to waste management, equilibrium and kinetic approaches, cell structure and metabolisms, formation and classification of rocks and soils.

8.875G Hydrological Processes S1 L2 T1 C3

Measurements and variations of meteorological processes. Conditions for precipitation. Definition, forms, types and measurement of precipitation.

The evaporation process. Plant water dynamics. Methods of estimating evaporation and transpiration at different space and time scales. Management of evaporation and transpiration.

The interception process. Significance in the water cycle and in the rainfall runoff process. Measurement and estimation of interception. Factors affecting infiltration. Description and importance of the process. Introduction to unsaturated flow theory. Philip, Green and Ampt, and Horton equations. Ponding and non-ponding infiltration. Effect of macropores, soil horizons etc.

General description of the runoff process. Horton runoff, saturated surface flow, throughflow, partial area runoff, variable source areas, occurrence of different processes. Effects of depression storage, topography and subsurface features such as macropores and soil horizons on the nature of processes and their space-time distribution. Catchment storage, channel transmission losses.

Groundwater recharge by percolation through vadose zone and by transmission loss from streams. Artificial recharge. Groundwater discharge through stream base flow and transpiration of phreatophytes.

Effects of land use on precipitation, interception, infiltration, evapotranspiration. Resulting effects on yield, flood runoff, water quality, surface salting and sediment production.

8.877G Flood Design 1 SS C3

Introduction to flood estimation, frequency analysis of hydrological data, design rainfall data, hydrograph analysis, storm rainfall-runoff relations, design flood estimation for small to medium sized catchments including the rational method, introduction to urban drainage design.

8.878G Flood Design 2 SS C3

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

8.879G Flood Design 3 SS C3

Flood frequency analysis, river flood routing, catchment characteristics, estimation of extreme floods, synthetic unit hydrographs, design hydrograph methods, application of runoff routing models.

8.880G Groundwater Modelling S1 L1½ T1½ C3

Types of groundwater models and their physical bases for porous and fractured rock aquifers. Modelling low permeability materials. Analogue, analytical and numerical model forms. Finite difference and finite element approaches to model development. Spreadsheet applications for groundwater modelling, boundary conditions, matrix structure, inverse methods for parameter estimation. Stochastic modelling and characterization of variability. Modelling multiphase, immiscible fluids, and regional groundwater flow. Applications of modelling to borefield management, saltwater intrusion, mine dewatering, geotechnical problems; settlement, slope stabilization. Use of standard model computer codes.

Surveying

29.101G Aspects of Electromagnetic Distance Measurement SS L2T1 C3

New developments in electronic distance measurements including multiple wavelength systems, interferometers, optical transponders. Component properties of instrumental errors. Techniques of instrumental calibration and establishment of calibration facilities. High precision measurement techniques.

29.102G Characteristics of Optical Surveying Instrumentation SS L2T1 C3

Sources of error in modern optical surveying instruments. Methods of testing and calibration. Observational techniques for reducing effects of errors. Developments in circle reading and level sensing systems. Design of instrument testing facilities.

29.103G Precise Engineering Surveys SS L2T1 C3

Techniques and instrumentation for precise surveys. Applications in industry and engineering; deformation and settlement surveys, surveys for large constructions, optical tooling, special measurement problems.

29.106G Special Topic in Surveying A C3

A special subject to be lectured on by visiting professors or other visiting staff.

29.107G Special Topic in Surveying B C3

A special subject taken by an individual student or a small group of students by private study in conjunction with tutorial sessions with the member(s) of staff in charge of the subject.

29.151G Adjustment of Control Surveys SS L2T1 C3

Choice and analysis of adjustment models in geodetic triangulation and control surveys. Detection of outliers. Design optimization and analysis of survey control networks. Methods of carrying out very large continental adjustments.

29.210G Satellite Surveying SS L2T1 C3

Concepts of satellite surveying: nomenclature, TRANSIT system, GPS for point and relative positioning, vertical control. Surveying with GPS: planning a survey, field and office procedures, case studies. Considerations for high-precision applications: aspects of satellite geodesy, modelling the observable, dual frequency observations, orbit determination, short-arc techniques.

29.211G Introduction to Geodesy S1 L2 T1 C3

Geodesy in the service of mankind. The earth's gravity field. The earth's motion in space. Co-ordinate and time systems used in geodesy. Horizontal and vertical control networks. Earth Satellite motion. Principles of satellite positioning. Gravimetric geodesy. Space geodetic methods. Variations of geodetic positions with time.

29.212G Doppler Positioning SS L2T1 C3

Description of the TRANSIT system of satellites. Principle of Doppler measurements. Geodetic position from Doppler. Doppler satellite receivers, computation of point position and translocation using on-board software. Broadcast and precise ephemerides. Mainframe software and multi-station computation. Interpretation of results.

29.213G Physical Meteorology S2 L2T1 C3

Electromagnetic wave propagation, geometrical optics approximation, emission and transfer of radiation. Structure of the earth's atmospheric envelope, surface layer and boundary layer meteorology, structure of the ionosphere, atmospheric turbulence, meteorological measurements. Interaction and propagation of electromagnetic radiation. Refraction, scattering, absorption, dispersion, reflection. Description, models and solutions of geodetic

refraction effects. Atmospheric effects on remote sensing (visible, infrared and microwaves). Remote sensing of atmospheric parameters.

29.530G Analytical Photogrammetry SS L2T1 C3

Fundamental relationships, image and object space. Interior orientation, deviations from collinearity, use of reseau. General orientation of one and two images by collinearity and coplanarity conditions. Calibration of metric and non-metric cameras. Principles of analytical plotters, software design. Special applications of photogrammetry.

29.531G Photogrammetric Block Adjustment SS L2T1 C3

Review of strip triangulation. Simultaneous block adjustments with independent models and bundles. Additional parameters. Solution of large systems of symmetric strongly diagonal linear equations. Computer programs. Control requirements and auxiliary control.

29.532G Computer-Assisted Mapping SS L2T1

Introduction to principles of computer-assisted mapping. Sources of data, ground survey maps, images. Collection and editing of feature coded digital terrain data, points, lines and areas. Digital elevation models, acquisition and interpolation, breaklines, contouring. Accuracy of heights from digital elevation models. Design of mapping programs based on computer-assisted techniques.

29.600G Principles of Remote Sensing S1 L2T1 C3

History and development. Definition and physics of basic electromagnetic radiation quantities. Basic energy matter relationship. Spectral signatures of surfaces. Atmospheric considerations and the reduction of atmospheric effects. Sensor concepts including film and electro-optical sensors. An introduction to data processing and enhancement, including image interpretation procedures.

29.602G Remote Sensing Procedures S2 L2T1 C3

Review of atmospheric correction procedures and application to multi-temporal Landsat MSS data. Review of image registration, enhancement and classification procedures with particular reference to multi-source remote sensing data sets. Analysis of techniques over a varied land use area. Land use change project and analysis using multi-source and multi-temporal remotely sensed imagery, including Landsat MSS, TM, SPOT and SAR.

29.603G Statutory Controls of Land Development SS L2T1 C3

Detailed examination of the subdivision and development process in N.S.W., with particular emphasis on the statutory procedures and controls at the local government level. The Local Government Appeals Tribunal and its major relevant decisions. Local Government and land development law. Case studies in land development.

29.604G Land Information Systems SS L2T1 C3

Land information as maps and records. Methods of data collection. Integrated surveys and coordinate systems. Legal boundaries. Land tenure. Identifiers. Computerization of land information. Data input methods. Data storage methods. Data processing and manipulation, including management, searching, existing data base languages, and interactive data editing. Data output, including computer graphics, line printer maps, and digital plotters. Application of Anc-Info LIS software.

29.605G Ground Investigations for Remote Sensing S1 L2T1 C3

The spectral, temporal and spatial characteristics of various surfaces, and the available sensors to effect maximum differentiation. Ground and image comparisons. Instruments available for field measurements. Field investigation procedures including positioning and sampling considerations.

29.608G Cadastral Systems SS L2T1 C3

The cadastral concept. Cadastral surveying and mapping, land registration, valuation of land, land tenure and land administration. Cadastres and land information systems (L.I.S.). Strategies for improving cadastral systems. Cadastral systems in developing countries; legal, technical, administrative, economic and social issues.

29.909G Project C9**29.918G Project Report C18****29.936G Thesis C36**

Industrial Relations and Organizational Behaviour

Due to uncertainties in staffing, it is not possible for the Faculty of Commerce to give an assurance that all subjects in Organizational Behaviour listed in the handbook will be offered in future years.

30.935G Organization Behaviour S1 L3

Relationships between individuals and organizations. Individual behaviour—personality, perception, motivation, learning, performance. Organizations as settings for individual behaviour—types of organization, work organizations. Interaction, groups and

work groups. Organizational influences on work behaviour. Structural factors and the design of work; reward systems. Organizational cultures and social influences. The development of individual-organization relationships: participation, socialization, careers; conflict, stress and adaptation; organizational effectiveness.

30.958G Organizational Communications S2 L3

Prerequisite: 30.935G or equivalent.

Communication is both an end and a means to an end for members of complex organizations. As an end, the pattern of inputting, processing and outputting of information is the net work of interdependent relationships that we come to call an organization. Thus communication is organizing. As a means to an end, communication suggests the ways that govern the interaction of organizational members exchanging messages in service of such outcomes as decision making, innovation, etc. Organizational communication therefore is the study of the flow of messages in an information network as well as the uses made of those messages by network participants for the overall attainment of organizational goals.

30.960G Technological Change and Organizational Participation S1 L3

Prerequisite: 30.942G or 14.956G or their equivalent.

The complex relationships between technological change and organizational participation in societies using advanced technology, with particular reference to Australia, California, Japan, Germany and the Nordic nations. Key issues include: the relationship between technological change and sociotechnical systems, skill formation, organizational learning, industrial relations, humanization of work, organizational equity, participation, and power.

Town Planning

Graduate Study**36.945G The Organization of Town Planning**

Aims, means and consequences of town planning in Australia. *Aims of planning:* organization 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.

Graduate School of the Built Environment

39.908G Community Noise Control

S1 L1T1 C2

Introduction; sound and sound propagation, sound power, sound pressure, decibels; sound perception, psychoacoustics loudness, annoyance, phons and dB(A); hearing conservation; acoustic measuring and analysing instruments — sound level meters, filters, analysers, recorders; sound sources; community noise assessment; the NSW Noise Control Act; practical exercises in sound recording, analysis and assessment; noise control — source noise reduction, use of barriers, enclosures, distance, sound absorbing materials; sound transmission through building elements; noise components of environmental impact statements.

Librarianship

55.815G Economics of Information Systems

S1

Use of surveys, user studies and market research to determine demand. Costing, financial planning, control and forecasting. Cost-benefit analysis. Economics of networks. Economic implications of new technologies.

55.817G Information Storage and Retrieval Systems

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 cueing tutorials. Choice criteria for on-line and batch systems. Testing, analysis and evaluation of systems. Advanced technologies for information storage and retrieval.

55.823G Files and Database Systems

S1

File structures, database management systems and file interrogation systems in a text processing or bibliographical environment. *Topics:* relations, their mapping and normalization; access methods; data organization; independence, integrity and security; CODASYL databases, relational databases and query languages.

Graduate Study

Conditions for the Award of Higher Degrees

Rules regulations and conditions for the award of first degrees are set out in the appropriate Faculty Handbooks.

First Degrees

For the list of undergraduate courses and degrees offered see **Faculty (Undergraduate Study)** in the Calendar.

The following is the list of higher degrees and graduate diplomas of the University, together with the publication in which the conditions for the award appear.

Higher Degrees

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 the Calendar.

Title	Abbreviation	Calendar/Handbook
Doctor of Science	DSc	Calendar
Doctor of Letters	DLitt	Calendar
Doctor of Laws	LLD	Calendar
Doctor of Medicine	MD	Calendar 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

Higher Degrees

**Higher Degrees
(continued)**

Title	Abbreviation	Calendar/Handbook
Master of Arts	MA	Arts University College
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)		
Master of Business Administration	MBA	AGSM
Master of Chemistry	MChem	Sciences*
Master of Cognitive Science	MCogSc	Arts
Master of Commerce (Honours)	MCom(Hons)	Commerce
Master of Commerce	MCom	Commerce
Master of Community Health	MCH	Medicine
Master of Construction Management	MConstMgt	Architecture
Master of Education	MEd	Professional Studies
Master of Educational Administration	MEdAdmin	Professional Studies
Master of Engineering	ME	Applied Science Engineering
<i>Master of Engineering without supervision</i>		Engineering University College
Master of Engineering Science	MEngSc	Engineering University College
Master of Environmental Studies	MEnvStudies	Applied Science
Master of Health Administration	MHA	Professional Studies
Master of Health Personnel Education	MHPed	Medicine
Master of Health Planning	MHP	Professional Studies
Master of Industrial Design	MID	Architecture
Master of Landscape Architecture	MLArch	Architecture
Master of Landscape Planning	MLP	Architecture
Master of Laws	LLM	Law
Master of Librarianship	MLib	Professional Studies
Master of Mathematics	MMath	Sciences*
Master of Management Economics	MMgtEc	University College
Master of Music	MMus	Arts
Master of Nursing Administration	MNA	Professional Studies
Master of Optometry	MOptom	Sciences*
Master of Paediatrics	MPaed	Medicine
Master of Physics	MPhysics	Sciences*
Master of Project Management	MPM	Architecture
Master of Psychology (Clinical)	MPsychol	Sciences§
Master of Psychology (Applied)	MPsychol	Sciences§
Master of Safety Science	MSafetySc	Engineering
Master of Science	MSc	Applied Science
<i>Master of Science without supervision</i>		Architecture Engineering Medicine University College Sciences*§
Master of Science (Acoustics)	MSc(Acoustics)	Architecture

Title	Abbreviation	Calendar/Handbook
Master of Science (Industrial Design)	MS(IndDes)	Architecture
Master of Science and Society	MScSoc	Arts
Master of Social Work	MSW	Professional Studies
Master of Statistics	MStats	Sciences*
Master of Surgery	MS	Medicine
Master of Surveying	MSurv	Engineering
Master of Surveying <i>without supervision</i>		
Master of Surveying Science	MSurvSc	Engineering
Master of Town Planning	MTP	Architecture
Master of Welfare Policy	MWP	Professional Studies

**Higher Degrees
(continued)**

Graduate Diploma	GradDip	Applied Science Architecture Engineering Sciences*§
	DipPaed	Medicine
	DipEd	Professional Studies
	DiplM-ArchivAdmin DiplM-Lib DipFDA	Sciences*

Graduate Diplomas

*Faculty of Science

*Faculty of Biological Sciences

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.

Higher Degrees

**Doctor of Philosophy
(PhD)**

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.

Qualifications

(2) In exceptional cases an applicant who submits evidence of such other academic and professional qualifications as may be approved by the Committee may be permitted to enrol for the degree.

(3) If the Committee is not satisfied with the qualifications submitted by an applicant the Committee may require the applicant to undergo such assessment or carry out such work as the Committee may prescribe, before permitting enrolment as a candidate for the degree.

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.

**Enrolment and
Progression**

(2) In every case, before permitting a candidate to enrol, the head of the school* in which the candidate intends to enrol shall be satisfied that adequate supervision and facilities are available.

(3) An approved candidate shall be enrolled in one of the following categories:

(a) full-time attendance at the University;

(b) part-time attendance at the University.

(4) A full-time candidate shall be fully engaged in advanced study and research except that the candidate may undertake not more than five hours per week or a total of 240 hours per year on work which is not related to the advanced study and research.

(5) Before permitting a part-time candidate to enrol, the Committee shall be satisfied that the candidate can devote at least 20 hours each week to advanced study and research for the degree which (subject to (8)) shall include regular attendance at the school* on an average of at least one day per week for 48 weeks each year.

(6) A candidate shall be required to undertake an original investigation on an approved topic. The candidate may also be required to undergo such assessment and perform such other work as may be prescribed by the Committee.

(7) The work shall be carried out under the direction of a supervisor appointed from the full-time academic members of the University staff.

(8) The work, other than field work, shall be carried out in a school* of the University except that the Committee:

(a) may permit a candidate to spend not more than eighteen months of the program in advanced study and research at another institution provided the work can be supervised in a manner satisfactory to the Committee;

(b) may permit a candidate to conduct the work at other places where special facilities not possessed by the University may be available provided the direction of the work remains wholly under the control of the supervisor;

(c) may permit a full-time candidate, who has been enrolled as a full-time candidate for at least six academic sessions, who has completed the research work and who is writing the thesis, to transfer to part-time candidature provided the candidate devotes at least 20 hours each week to work for the degree and maintains adequate contact with the supervisor.

(9) The progress of a candidate shall be reviewed annually by the Committee following a report by the candidate, the supervisor and the head of the school* in which the candidate is enrolled and as a result of such review the Committee may cancel enrolment or take such other action as it considers appropriate.

(10) No candidate shall be awarded the degree until the lapse of six academic sessions from the date of enrolment in the case of a full-time candidate or eight academic sessions in the case of a part-time candidate. In the case of a candidate who has had previous research experience the committee may approve remission of up to two sessions for a full-time candidate and four sessions for a part-time candidate.

(11) A full-time candidate for the degree shall present for examination not later than ten academic sessions from the date of enrolment. A part-time candidate for the degree shall present for examination not later than twelve academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

Thesis

4. (1) On completing the program of study a candidate shall submit a thesis embodying the results of the investigation.

(2) The candidate shall give in writing to the 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;

*Or department where a department is not within a school or schools or departments where the research is being undertaken in more than one school or department.

(e) it must consist of an account of the candidate's own research but in special cases work done conjointly with other persons may be accepted provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may not submit as the main content of the thesis any work or material which has previously been submitted for a university degree or other similar award but may submit any work previously published whether or not such work is related to the thesis.

(5) Four copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of theses for higher degrees.

(6) It shall be understood that the University retains the four copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

5. (1) There shall be not fewer than three examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least two of whom shall be external to the University.

Examination

(2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the thesis and shall recommend to the Committee that:

- (a) the candidate be awarded the degree without further examination; or
- (b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school*, or
- (c) the candidate be awarded the degree subject to a further examination on questions posed in the report, performance in this further examination being to the satisfaction of the Committee; or
- (d) the candidate be not awarded the degree but be permitted to resubmit the thesis in a revised form after a further period of study and/or research; or
- (e) the candidate be not awarded the degree and be not permitted to resubmit the thesis.

(3) If the performance at the further examination recommended under (2)(c) above is not to the satisfaction of the Committee, the Committee may permit the candidate to re-present the same thesis and submit to further examination as determined by the Committee within a period specified by it but not exceeding eighteen months.

(4) The Committee shall, after consideration of the examiners' reports and the results of any further examination, recommend whether or not the candidate may be awarded the degree. If it is decided that the candidate be not awarded the degree the Committee shall determine whether or not the candidate be permitted to resubmit the thesis after a further period of study and/or research.

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 Applied Science or Master of Environmental Studies by formal course work may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

Master of Applied Science (MAppSc) and Master of Environmental Studies (MEnvStudies)

2. (1) A candidate for the degree shall:

Qualifications

(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

*Or department where a department is not within a school.

(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 of tertiary institution at a level acceptable to the Committee and

(ii) have undertaken appropriate postgraduate studies of one 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 Academic Registrar at least two calendar months before the commencement of the session in which enrolment is to begin.

(2) A candidate for the degree shall be required to undertake such formal subjects 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 has demonstrated ability to undertake research by the submission of a thesis embodying the results of an original investigation.

Qualifications

2. (1) A candidate for the degree shall have been awarded an appropriate degree of Bachelor from the University of New South Wales or a qualification considered equivalent from another university or tertiary institution at a level acceptable to the Committee.

(2) 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 Academic Registrar at least one calendar month before the commencement of the session in which enrolment is to begin.

(2) In every case, before permitting a candidate to enrol, the head of the school* in which the candidate intends to enrol shall be satisfied that adequate supervision and facilities are available.

(3) An approved candidate shall be enrolled in one of the following categories:

*Or department where a department is not within a school.

- (a) full-time attendance at the University;
- (b) part-time attendance at the University;
- (c) external — not in regular attendance at the University and using research facilities external to the University.
- (4) A candidate shall be required to undertake an original investigation on an approved topic. The candidate may also be required to undergo such examination and perform such other work as may be prescribed by the Committee.
- (5) The work shall be carried out under the direction of a supervisor appointed from the full-time members of the University staff.
- (6) The progress of a candidate shall be reviewed annually by the Committee following a report by the candidate, the supervisor and the head of the school* in which the candidate is enrolled and as a result of such review the Committee may cancel enrolment or take such other action as it considers appropriate.
- (7) No candidate shall be granted the degree until the lapse of three academic sessions in the case of a full-time candidate or four academic sessions in the case of a part-time or external candidate from the date of enrolment. In the case of a candidate who has been awarded the degree of Bachelor with Honours or who has had previous research experience the Committee may approve remission of up to one session for a full-time candidate and two sessions for a part-time or external candidate.
- (8) A full-time candidate for the degree shall present for examination not later than six academic sessions from the date of enrolment. A part-time or external candidate for the degree shall present for examination not later than ten academic sessions from the date of enrolment. In special cases an extension of these times may be granted by the Committee.

Thesis

- 4. (1) On completing the program of study a candidate shall submit a thesis embodying the results of the original investigation.
- (2) The candidate shall give in writing two months notice of intention to submit the thesis.
- (3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.
- (4) The candidate may also submit any work previously published whether or not such work is related to the thesis.
- (5) Three copies of the thesis shall be presented in a form which complies with the requirements of the University for the preparation and submission of higher degree theses.
- (6) It shall be understood that the University retains the three copies of the thesis submitted for examination and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act, 1968, the University may issue the thesis in whole or in part, in photostat or microfilm or other copying medium.

Examination

- 5. (1) There shall be not fewer than two examiners of the thesis, appointed by the Academic Board on the recommendation of the Committee, at least one of whom shall be external to the University unless the Committee is satisfied that this is not practicable.
- (2) At the conclusion of the examination each examiner shall submit to the Committee a concise report on the merits of the thesis and shall recommend to the Committee that:
 - (a) the candidate be awarded the degree without further examination; or
 - (b) the candidate be awarded the degree without further examination subject to minor corrections as listed being made to the satisfaction of the head of the school*; or
 - (c) the candidate be awarded the degree subject to 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

*Or department where a department is not within a school.

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

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* 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 Academic Registrar two months notice of intention to submit the thesis.

(3) The thesis shall present an account of the candidate's own research. In special cases work done conjointly with other persons may be accepted, provided the Committee is satisfied about the extent of the candidate's part in the joint research.

(4) The candidate may also submit any work previously published whether or not 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* 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

*Or department where a department is not within a school.

(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.

6. A candidate shall pay such fees as may be determined from time to time by the Council.

Fees

See Master of Applied Science above.

Master of Environmental Studies (MEnvStudies)

See Master of Engineering above.

Master of Science (MSc)

See Master of Engineering *without supervision* above.

Master of Science (MSc) without supervision

Graduate Diploma

1. A Graduate Diploma may be awarded by the Council to a candidate who has satisfactorily completed a program of advanced study.

Graduate Diploma (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 prescribe, before permitting enrolment.

3. (1) An application to enrol as a candidate for the diploma shall be made on the prescribed form which shall be lodged with the Academic Registrar at least two calendar months before the commencement of the session in which enrolment is to begin.

Enrolment and Progression

(2) A candidate for the diploma shall be required to undertake such formal subjects and pass such assessment as prescribed.

(2) A candidate for the diploma shall be required to undertake such formal subjects and pass such assessment as prescribed.

(3) The progress of a candidate shall be reviewed at least once annually by the Committee and as a result of its review the Committee may cancel enrolment or take such other action as it considers appropriate.

(4) No candidate shall be awarded the diploma until the lapse of two academic sessions from the date of enrolment in the case of a full-time candidate or four sessions in the case of a part-time candidate. The maximum period of candidature shall be four academic sessions from the date of enrolment for a full-time candidate and six sessions for a part-time candidate. In special cases an extension of these times may be granted by the Committee.

Fees 4. A candidate shall pay such fees as may be determined from time to time by the Council.

Scholarships and Prizes

The scholarships and prizes listed below are available to students whose courses are listed in this handbook. Each faculty handbook contains in its Scholarships and Prizes section the scholarships and prizes available with that faculty. The General Information section of the Calendar contains a comprehensive list of scholarships and prizes offered throughout the University.

Scholarships

Undergraduate Scholarships

Listed below is an outline only of a number of scholarships available to students. Full information may be obtained from Room G20; located on the Ground Floor of the Chancellery.

Unless otherwise indicated in footnotes, applications for the following scholarships should be made to the Registrar by 14 January each year. Please note that not all of these awards are available every year.

Donor	Value	Year/s of Tenure	Conditions
General			
Bursary Endowment Board*	\$200 pa	Minimum period of approved degree/combined degree course	Merit in HSC and total family income not exceeding \$6000
Sam Cracknell Memorial	Up to \$3000 pa payable in fortnightly instalments.	1 year	Prior completion of at least 2 years of a degree or diploma course and enrolment in a full-time course during the year of application; academic merit; participation in sport both directly and administratively; and financial need.

*Apply to The Secretary, Bursary Endowment Board, PO Box 460, North Sydney 2060, immediately after sitting for HSC.

Undergraduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
General (continued)			
Girls Realm Guild	Up to \$1500 pa	1 year renewable for the duration of the course subject to satisfactory progress and continued demonstration of need	Available only to female students under 35 years of age who are permanent residents of Australia enrolling in any year of a full-time undergraduate course on the basis of academic merit and financial need
W.S. and L. B. Robinson**	Up to \$4200 pa	1 year renewable for the duration of the course subject to satisfactory progress	Available only to students who have completed their schooling in Broken Hill or whose parents reside in Broken Hill; for a course related to the mining industry. Includes courses in mining engineering, geology, electrical and mechanical engineering, metallurgical process engineering, chemical engineering and science.
Universities Credit Union	\$500 pa	1 year with the possibility of renewal	Prior completion of at least 1 year of any undergraduate degree course. Eligibility limited to members of the Universities Credit Union Ltd of more than one year's standing or members of the family of such members.

**Applications close 30 September each year.

Applied Science**Applied Bioscience****Food Science and Technology**

Coca-Cola Export Corporation	Up to \$1500 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		
Goodman Fielder	Up to \$500 pa	1 year renewable	Permanent residence in Australia. Eligible for admission to Year 2, 3 or 4 of course (three available).
Food Technology Association	\$600 pa		

Undergraduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
Applied Science (continued)			
Food Science and Technology			
Coca-Cola Export Corporation	Up to \$1500 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		
Goodman Fielder	Up to \$500 pa	1 year renewable	Permanent residence in Australia. Eligible for admission to Year 2, 3 or 4 of course (three available).
Food Technology Association	\$600 pa		

Chemical Engineering and Industrial Chemistry

Bridge Oil Ltd	Up to \$5000 pa	1 year renewable for the duration of the course subject to satisfactory progress	Permanent residence in Australia living in Queensland and must have completed the first two years of any accredited engineering program in that state
Dow Chemical (Australia)	Up to \$1000 pa		Permanent residence in Australia and eligibility for admission to Year 2 of the full-time degree course in Chemical Engineering
Goodman Fielder	Up to \$1000 pa		Permanent residence in Australia and eligibility for admission to Year 2 of the full-time degree course in Chemical Engineering or Industrial Chemistry
ICI Australia Operations Ltd	Up to \$1000 pa		Eligibility for admission to Year 4 of the full-time degree course in Chemical Engineering
Shell Refining (Australia) Pty Ltd	Up to \$1500 pa		Eligibility 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

Fibre Science and Technology**Textile Technology**

Bonds Industries Ltd	\$2477 pa	1 year renewable for the duration of the course, subject to satisfactory progress	Permanent residence in Australia and eligibility for admission to the full-time degree course in Textile Technology
Bradmill Textiles Ltd	Up to \$3000 pa		
Bruck (Australia) Limited	\$3821 or \$2477 pa		
Fibremakers Division of ICI Australia Operations Pty Ltd	\$3821 or \$2477 pa		
Reckitt's Toiletries International	Up to \$1500 pa		
Textile Council of Australia	\$3821 or \$2477 pa		
Webco	\$500 pa		

Undergraduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
Applied Science (continued)			
Wool and Animal Science			
National Australia Bank	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
Merck, Sharp and Dohme	Up to \$1000 pa		

Materials Science and Engineering

Materials

Australian Ceramic Society	Up to \$300 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 Brick Manufacturer's Association of New South Wales	Up to \$1000 pa		
Caroma Industries Ltd	Up to \$1000 pa		
Ceramco Limited	Up to \$1000 pa		
Ferro Corporation	Up to \$600 pa		
Fowlerware	Up to \$500 pa		
Monier Limited	Up to \$1000 pa		
North Sydney Brick and Tile Co Ltd	Up to \$1000 pa		
Plessey Australia Pty Ltd	Up to \$1000 pa		
Swan Resources Ltd	Up to \$1000 pa		
The Thomson Family	Up to \$1000 pa		
Zacuba Pty Ltd	Up to \$1500 pa		

Metallurgy

Sandvik Australia Pty Ltd	Up to \$1250 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 Metallurgy or Metallurgical Process Engineering
Sir Rupert Myers	Up to \$1500 pa		
Industrial Sponsors Program	Up to \$1500 pa		
			Eligibility for admission to Year 1 of the full-time degree course in Metallurgy or Metallurgical Process Engineering

Undergraduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
Applied Science (continued)			
Mines			
Applied Geology			
BP Coal Australia	Up to \$500 pa	1 year renewable for the duration of the course, subject to satisfactory progress	Permanent residence in Australia and enrolled in Year 4 of the Applied Geology or Mining Geology degree course (or equivalent program in the sciences) Eligibility for admission to Year 3 or Year 4 of the full-time degree course in Mining Engineering
Mining Engineering			
Stan Sawyer Memorial Scholarship to Coal Mining Students	Up to \$200 pa		
School of Mines			
Joint Coal Board Scholarship	\$500	1 year	Enrolled in Year 4 of Geology, Mineral Engineering or Mining Engineering course. Selection is based on academic merit.

Graduate Scholarships

Application forms and further information are available from the Student Enquiry Counter, located on the Ground Floor of the Chancellor's office 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.

Donor	Value	Year/s of Tenure	Conditions
General			
University Postgraduate Research Scholarships	Living allowance of \$7600 pa. Other allowances may also be paid.	1-2 years for a Masters and 3-4 years for a PhD degree	Applicants must be honours graduates (or equivalent). Applications to Dean of relevant Faculty.
Commonwealth Postgraduate Research Awards			Applicants must be honours graduates (or equivalent) or scholars who will graduate with honours in current academic year, and who are domiciled in Australia. Applications to the Academic Registrar by 31 October.
Commonwealth Postgraduate Course Awards	Living allowance of \$8882 pa. Other allowances may also be paid.	1-2 years; minimum duration of course	Applicants must be graduates or scholars who will graduate in current academic year, and who have not previously held a Commonwealth Post-graduate Award. Preference is given to applicants with employment experience. Applications to the Academic Registrar by 30 September.

*Available for reference in the University Library.

Graduate Scholarships (continued)

Door	Value	Year/s of Tenure	Conditions
General (continued)			
Australian American Educational Foundation Fulbright Award	Travel expenses and \$A2000 as establishment allowance.	1 year, renewable	Applicants must be graduates who are domiciled in Australia and wish to undertake research or study for a higher degree in America. Applications close 30 September with The Secretary, DEET, AAEF Travel Grants, PO Box 826, Woden ACT 2606.
Australian Federation of University Women	Amount varies, depending on award	Up to 1 year	Applicants must be female graduates who are members of the Australian Federation of University Women
Commonwealth Scholarship and Fellowship Plan	Varies for each country. Generally covers travel, living, tuition fees, books and equipment, approved medical expenses. Marriage allowance may be payable.	Usually 2 years, sometimes 3	Applicants must be graduates who are Australian citizens and who are not older than 35 years of age. Tenable in Commonwealth countries other than Australia. Applications close with the Academic Registrar in September or October each year.
The English-Speaking Union (NSW Branch)	\$5000	1 year	Applicants must be residents of NSW or ACT. Awarded to young graduates to further their studies outside Australia. Applications close mid-April with The Secretary, Ground Floor, Sydney School of Arts, 275c Pitt Street, Sydney NSW 2000.
Frank Knox Memorial Fellowships tenable at Harvard University	Stipend of US\$7000 pa plus tuition fees	1, sometimes 2 years	Applicants must be British subjects and Australian citizens, who are graduates or near graduates of an Australian university. Applications close with the Academic Registrar mid-October.
Robert Gordon Menzies Scholarship to Harvard	Up to \$US 15,000	1 year	Tenable at Harvard University. Applicants must be Australian citizens and graduates of an Australian tertiary institution. Applications close 31 December with the Registrar, A.N.U., GPO Box 4, Canberra ACT 2601.
Gowrie Scholarship Trust Fund	\$4000 pa. Under special circumstances this may be increased.	2 years	Applicants must be members of the Forces or children of members of the Forces who were on active service during the 1939-45 War. Applications close with the Academic Registrar by 31 October.
Harkness Fellowships of the Commonwealth Fund of New York	Living and travel allowances, tuition and research expenses, health insurance, book and equipment and other allowances for travel and study in the USA	12 to 21 months	Candidates must be Australian citizens and 1. Either members of the Commonwealth or a State Public Service or semi-government Authority. 2. Either staff or graduate students at an Australian university. 3. Individuals recommended for nomination by the Local Correspondents. The candidate will usually have an honours degree or equivalent, or an outstanding record of achievement, and be not more than 36 years of age. Applications close 29 August with the Academic Registrar. Forms available from Mr J Larkin, Bureau of Agriculture and Resource Economics, GPO Box 1563, Canberra ACT 2601.

Graduate Scholarships (continued)

Donor	Value	Year/s of Tenure	Conditions
General (continued)			
The Packer, Shell and Barclays Scholarships to Cambridge University	Living and travel allowances, tuition expenses.	1-3 years	Applicants must be Australian citizens who are honours graduates or equivalent, and under 26 years of age. Applications close 15 October with The Secretary, Cambridge Commonwealth Trust, PO Box 252, Cambridge CB2 1TZ England.
The Rhodes Scholarship to Oxford University	Approximately L3600 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	\$19,923 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 of PhD degree. Tenable in Australia or overseas. Applications close 31 July with the AMLR&D Corporation, PO Box A498, Sydney South NSW 2000.
Water Industry Research Award	\$17,764 pa	2-4 years	Applications close with the Academic Registrar 10 January.

Prizes

Undergraduate University Prizes

The following table summarizes the undergraduate prizes awarded by the University. Prizes which are not specific to any School are listed under General. All other prizes are listed under the Faculty or Schools in which they are awarded.

Information regarding the establishment of new prizes may be obtained from the Examinations Section located on the Ground Floor of the Chancellery.

Undergraduate University Prizes

Donor/Name of Prize	Value \$	Awarded for
General		
Sydney Technical College Union Award	300.00	Leadership in the development of student affairs, and academic proficiency throughout the course
University of New South Wales Alumni	Statuette	Achievement for community benefit — students in their final or graduating year

Faculties of Applied Science and Engineering

Institution of Engineers, Australia	Medal and 200.00	The most proficient final year (or last 2 years part-time) student in the Bachelor of Engineering (or Bachelor of Science (Engineering)) degree courses offered by the following Schools: Civil Engineering Electrical Engineering and Computer Science Mechanical and Industrial Engineering Chemical Engineering and Industrial Chemistry Mining Engineering Textile Technology (Engineering option only)
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School of Mines

Department of Applied Geology

Crae Mapping Prize	250.00	Best performance in 25.312 Earth Environments 2 — Geological Field Mapping Tutorial in the Bachelor of Science degree course
F.C. Loughnan	340.00	Most outstanding student in Year 3 of the Geology course in the Bachelor of Science degree course.

School of Applied Bioscience

Department of Biotechnology

Mauri Foods	175.00	Best result in 42.101 Introduction to Biotechnology
	175.00	Best result in one of the Level 3 Biotechnology subjects. 42.102A Biotechnology A, 42.102B Biotechnology B, 42.102C Microbial Genetics in the Bachelor of Science degree course
	175.00	Best result in the Biothechnology honours degree program

Department of Food Science

Cottees General Foods	120.00	Best performance in 38.141 Food Regulation and Control in the Bachelor of Science in Food Technology course
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Undergraduate University Prizes (continued)

Donor/Name of Prize	Value \$	Awarded for
Nestle Australia Pty Ltd	200.00	Best performance in 38.140 Food Technology project in the Bachelor of Science degree course in Food Technology
Wilfred B. S. Bishop	75.00	General proficiency throughout Bachelor of Science degree course in Food Technology by a student who has made a significant contribution to staff and student activities

School of Chemical Engineering and Industrial Chemistry

Abbott Laboratories Pty Ltd	150.00	Best performance in Bachelor of Engineering degree course in Chemical Engineering — Year 4
Australasian Corrosion Association (NSW)	150.00 and one year's membership of the Association	Best performance in 48.121 Corrosion in the Chemical Industry
AGL Sydney Limited	200.00	Subject selected by Head of School
Australian Paper Manufacturers Ltd	150.00	48.163 Instrumentation and Process Control in Industrial Chemistry
	150.00	48.163. Instrumentation and Process Control in Chemical Engineering
Chemical Technology Society	25.00	Best graduate in Bachelor of Science degree in Industrial Chemistry
	25.00	Best graduate in Bachelor of Science degree course in Industrial Chemistry, Years 1 and 2 or Stages 1 to 4
CSR Limited	50.00	Subject within the discipline of Industrial Chemistry, selected by Head of School
Esso Australia Ltd	200.00	Best performance in Year 2 Chemical Engineering
Institution of Chemical Engineers	100.00 and medal	Best result for the thesis in the final year, or equivalent part time stage, of the Bachelor of Engineering degree course
Shell	100.00	General proficiency in Year 2 or its part-time equivalent in either the Chemical Engineering course or the Industrial Chemistry course
	100.00	General proficiency in Year 3 or its part-time equivalent in either the Chemical Engineering course or the Industrial Chemistry course
	100.00	General proficiency in Year 4 or its part-time equivalent in either the Chemical Engineering course or the Industrial Chemistry course
	100.00	For a student who, in the opinion of the Head of School, has performed some meritorious activity of note either inside or outside the University

Undergraduate University Prizes (continued)

Donor/Name of Prize	Value \$	Awarded for
Simon-Carves Australia	100.00	48.135 Thermodynamics
Stauffer Australia Limited	100.00	Subject selected by Head of School
Western Mining Corporation Ltd	150.00	48.036 Chemical Engineering Laboratory 1
	150.00	48.044 Chemical Engineering Laboratory 2

Department of Fuel Technology

Australian Institute of Energy	50.00	For a fuel subject or allied subject project
Fuel Technology Staff	200.00	Best performance in Year 3 or 4 Fuel Technology subject in the Bachelor of Engineering degree course in Chemical Engineering
Shell	200.00	Subject selected by Head of School

School of Fibre Science and Technology
Department of Textile Technology

J. B. Speakman	50.00	Undergraduate thesis
Textile Institute	Two year's membership of the Institute	Best performance in 13.113 Textile Technology 3 in the Bachelor of Science in Textile Technology degree course
R. J. Webster	250.00	General proficiency throughout the Bachelor of Science degree course in Textile Technology

Department of Wool and Animal Science

Bayer Animal Health	120.00	General proficiency — Wool and Pastoral Sciences degree course, Year 2 and Year 3
Farmers Federation	150.000	Excellent academic attainment by a graduating student
C. R. Luckock	A book or a voucher to the value of 60.00 payable to University Co-op Bookshop Limited	Meat Science
Parkes Wool Promotion Committee	A shield held in the Department of Wool Science on which the successful student's name is engraved each year	Best performance in Practical Wool Studies in the Bachelor of Science degree in Wool and Pastoral Sciences
P. R. McMahon Memorial	100.00	Excellence in Wool Science

Undergraduate University Prizes (continued)

Donor/Name of Prize	Value \$	Awarded for
School of Geography		
Jack Mabbutt Medal	Medal	Best performance in Fourth Year Project in Applied Geography by a student proceeding to Bachelor of Science
Jack Mabbutt Prize	150.00	Best performance by a third year student proceeding to Honours in Geography

School of Materials Science and Engineering

Alcan Australia Ltd	200.00] Subject selected by Head of School
Austral Crane	150.00	
Australasian Corrosion Association (NSW Branch)	150.00	Best performance in 4.623B Metallurgical engineering by a Metallurgical Engineering student
Institute of Metals and Materials Australasia	100.00 and one years' membership of the Institute] Subject selected by Head of School
Australian Welding Institute	30.00 Book order	
The Broken Hill Proprietary Co Ltd	150.00	
The Max Hatherly	275.00	Best performance in the final year practical examination or an outstanding effort in Metallography
The Hugh Muir	275.00	Best performance in the final year seminar class or, by a student who in the Head of School's opinion has contributed most to the corporate life of the School of Materials Science and Engineering
Western Mining Corporation Ltd	150.00	Best overall performance in Year 3 full-time (or its equivalent part-time) in Bachelor of Engineering (or Bachelor of Science (Technology)) degree course
	150.00	Best overall performance in Year 4 full-time (or its equivalent part-time) in the Bachelor of Engineering (or Bachelor of Science (Technology)) degree course
The Z.C. Mines	200.00	Subject selected by Head of School

School of Mines

Joint Coal Board	200.00	Bachelor of Engineering degree course in Mining Engineering, Year 2
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Undergraduate University Prizes (continued)

Donor/Name of Prize	Value \$	Awarded for
	200.00	Bachelor of Engineering degree course in Mining Engineering, Year 3
	300.00	Bachelor of Engineering degree course in Mining Engineering — general proficiency throughout course
Western Mining Corporation Ltd	150.00	Best overall performance in final year of Bachelor of Engineering degree course
	200.00	General proficiency throughout the Bachelor of Engineering degree course
	150.00	Best overall performance in penultimate year of Bachelor of Engineering degree course

Graduate University Prizes

The following table summarizes the graduate prizes awarded by the University.

Donor/Name of Prize	Value \$	Awarded for
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School of Chemical Engineering and Industrial Chemistry

The Clean Air Society of Australia and New Zealand	100.00	48.391G Atmospheric Pollution Control and 48.392G Practical Aspects of Air Pollution Measurement and Control
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School of Fibre Science and Technology

Department of Textile Technology

Malcolm Chaikin	200.00 and bronze medal	For the most outstanding thesis for the degree of Doctor of Philosophy in the Department of Textile Technology
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The University of New South Wales Kensington Campus

Theatres

Biomedical Theatres E27
 Central Lecture Block E19
 Classroom Block (Western Grounds) H3
 Rex Vowels Theatre F17
 Keith Burrows Theatre J14
 Main Building (Physics) Theatre K14
 Mathews Theatres D23
 Parade Theatre E3
 Science Theatre F13
 Sir John Clancy Auditorium C24

Buildings

Affiliated Residential Colleges
New (Anglican) L6
Shalom (Jewish) N9
Warrane M7
 Applied Science F10
 Architecture H14
 Arts (Morven Brown) C20
 Banks F22
 Barker Street Gatehouse N11
 Basser College C18
 Biological Sciences D26
 Central Store B13
 Chancellery C22
 Chemistry
Dalton F12
Robert Heffron E12
 Civil Engineering H20
 Commerce and Economics (John Goodsell) F20
 Dalton (Chemistry) F12
 Electrical Engineering G17
 Geography and Surveying K17
 Goldstein College D16
 Golf House A27
 Gymnasium B5
 House at Pooh Corner N8
 International House C6
 Io Myers Studio D9
 John Goodsell (Commerce and Economics) F20
 Kanga's House O14
 Kensington Colleges C17 (Office)
Basser C18
Goldstein D16
Philip Baxter D14

Link B6
 Maintenance Workshop B13
 Materials Science and Engineering E8
 Mathews F23
 Mechanical and Industrial Engineering J17
 Medicine (Administration) B27
 Menzies Library E21
 Morven Brown (Arts) C20
 New College (Anglican) L6
 Newton J12
 NIDA D2
 Parking Station H25
 Philip Baxter College D14
 Robert Heffron (Chemistry) E12
 Sam Cracknell Pavilion H8
 Shalom College (Jewish) N9
 Sir Robert Webster (Textile Technology) G14
 Squash Courts B7
 Swimming Pool B4
 Unisearch House L5
 University Regiment J2
 University Union (Roundhouse) – Stage I E6
 University Union (Blockhouse) – Stage II G6
 University Union (Squarehouse) – Stage III E4
 Wallace Wurth School of Medicine C27
 Warrane College M7

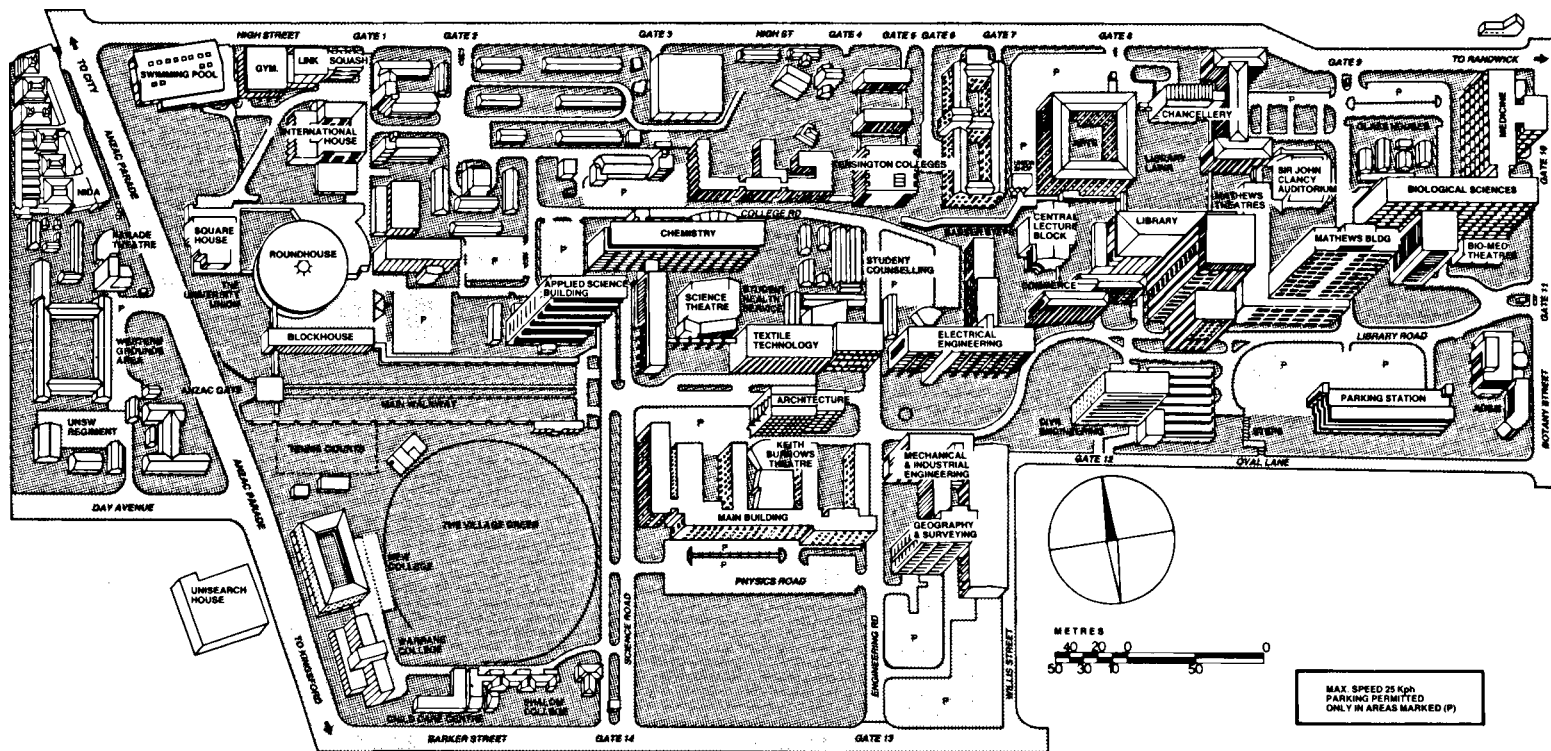
General

Academic Staff Office C22
 Accounting F20
 Admissions C22
 Adviser for Prospective Students F15
 Anatomy C27
 Applied Economic Research G14
 Applied Geology F10
 Applied Science (Faculty Office) F10
 Architecture (including Faculty Office) H14
 Arts (Faculty Office) C20
 Audio Visual Unit F20
 Australian Graduate School of Management G27
 Banking and Finance F20
 Biochemistry D26
 Biological and Behavioural Sciences (Faculty Office) D26
 Biomedical Engineering A28
 Biomedical Library F23
 Biotechnology D26
 Bookshop G17
 Building H14
 Careers and Employment F15
 Cashier's Office C22
 Chaplains E15
 Chemical Engineering and Industrial Chemistry F10
 Chemistry E12
 Child Care Centres N8, O14
 Civil Engineering H20
 Commerce and Economics (Faculty Office) F20
 Community Medicine D26
 Computing Services Department F21, D26
 Continuing Education Support Unit F23
 Counselling and Careers Service F15
 Economics F20
 Education G2
 Education Testing Centre E15
 Electrical Engineering and Computer Science G17
 Energy Research, Development and Information Centre F10
 Engineering (Faculty Office) K17
 English C20
 Ethics Committees Secretariat B8
 Examinations C22
 Fees Office C22
 Food Science and Technology F10
 French C20
 General Staff Office C22
 Geography K17
 German Studies C20
 Graduate Office and Alumni Centre E4
 Graduate School of the Built Environment H14
 Groundwater Management and Hydrogeology F10
 Health Administration C22
 History C20
 Industrial Arts H14
 Industrial Relations and Organizational Behaviour F20
 Information Systems F20
 Kanga's House O14
 Kindergarten (House at Pooh Corner) N8
 Landscape Architecture K15
 Law (Faculty Office) F21
 Law Library F21
 Legal Studies and Taxation F20
 Liberal and General Studies C20
 Librarianship F23
 Library E21

Lost Property C22
 Marine Science D26
 Marketing F20
 Materials Science and Engineering E8
 Mathematics F23
 Mechanical and Industrial Engineering J17
 Medical Education C27
 Medicine (Faculty Office) B27
 Microbiology D26
 Mineral Processing and Extractive Metallurgy E8
 Mining Engineering K15
 Music B11
 National Institute of Dramatic Art D2
 Off-campus Housing C22
 Optometry J12
 Pathology C27
 Patrol and Cleaning Services C22
 Petroleum Engineering D12
 Philosophy C20
 Physics K15
 Physiology and Pharmacology C27
 Political Science C20
 Printing Unit C22
 Psychology F23
 Public Affairs Unit C22
 Publications Section C22
 Remote Sensing K17
 Russian Studies C20
 Safety Science J17
 Science and Mathematics Course Office D26
 Science and Technology Studies C20
 Social Work G2
 Sociology C20
 Spanish and Latin American Studies C20
 Sport and Recreation Centre B6
 Student Health E15
 Student Records C22
 Students' Union E4 and C21
 Surveying K17
 Tertiary Education Research Centre E15
 Textile Technology G14
 Theatre Studies B10
 Town Planning K15
 Union Shop (Upper Campus) D19
 University Archives E21
 University Press A28
 University Union (Blockhouse) G6
 Waste Management H20
 WHO Regional Training Centre C27
 Wool and Animal Science B8

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