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FACULTY OF APPLIED SCIENCE
1974 HANDBOOK



THE UNIVERSITY OF NEW SOUTH WALES

80 CENTS

FACULTY OF APPLIED SCIENCE
1974 HANDBOOK
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THE UNIVERSITY OF NEW SOUTH WALES

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Faculty of Applied Science

NEW

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University of New South Wales—

Faculty of Applied Science — Periodicals

FOREWORD

The importance of the Applied Sciences in this University's development has always been recognized, and is especially referred to in our Act of Incorporation.

Undergraduate courses in the fields of Applied Geography, Applied Geology, Chemical Engineering, Chemical Technology, Metallurgy, Mining Engineering, Textile Technology and Wool and Pastoral Sciences are well established. Many of the Faculty's research contributions have achieved international recognition.

It is hoped that students who enter the Faculty will share the enthusiasm and the dedication of those who have taken part in its development. It is of the greatest importance that students should acquire, from the very beginning, the right approach to their studies, and that they should achieve a proper balance between their work and their extra-curricular activities.

In addition to this Handbook, pamphlets and brochures issued in conjunction with the enrolment period and Orientation Week are available. These should be consulted, together with the University Calendar, for further information on problems associated with courses.

It is hoped that this Handbook will be of value to present and prospective students in the Faculty and to employers.

M. CHAIKIN,

Dean,

Faculty of Applied Science.

CALENDAR OF DATES FOR 1974

Session 1: March 4 to May 19

May Recess: May 20 to May 26

May 27 to June 16

Midyear Recess: June 17 to July 21

Session 2: July 22 to August 25

August Recess: August 26 to September 1

September 2 to November 3

Study Recess: November 4 to November 10

JANUARY

Tuesday 1	New Year's Day—public holiday
Friday 11	Last day for application for review of results of annual examinations
	Last day for application for admission under "show cause" rules
Monday 14	Timetable for deferred examinations available
Tuesday 15	Last day for acceptance of applications from students graduating in 1974 for admission to University degrees and diplomas
Friday 18	Last day for application for deferred examinations
	Last day for acceptance of applications to enrol by new students and students repeating first year
Monday 28	Australia Day—public holiday
Tuesday 29	Deferred examinations begin

FEBRUARY

Friday 8	Last day for students to appeal against exclusion under the re-enrolment rules
Saturday 9	Deferred examinations end
Monday 18	Enrolment period begins for new students and students repeating first year
Monday 25	Enrolment period begins for students re-enrolling (second and later years)
	Deferred examination results available

MARCH

Friday 1	Last day for application for review of deferred examination results
	Last day for students with deferred examinations to appeal against exclusion under the re-enrolment rules
Monday 4	Session 1 begins
Thursday 7	Faculty of Applied Science meeting, 10 a.m.

MARCH

Friday 15	Last day for acceptance of enrolments by new students (late fee payable)
Friday 22	Last day for application for review of results of deferred examinations
Friday 29	Last day for changes in course programmes Last day for acceptance of enrolments by students re-enrolling (late fee payable)

APRIL

Thursday 4	Last day for discontinuation without failure of subjects which extend over the first session only
Friday 12 to Monday 15	Easter
Thursday 25	Anzac Day—public holiday

MAY

Tuesday 7	Provisional timetable for June/July examinations published
Tuesday 14	Last day for acceptance of corrected enrolment details forms
Monday 20	May Recess begins Last day for students to advise of examination timetable clashes
Sunday 26	May Recess ends Last date for discontinuation without failure of subjects which extend over the academic year

JUNE

Tuesday 4	Timetable for June/July examinations published
Thursday 6	Faculty of Applied Science meeting, 10 a.m.
Sunday 16	Session 1 ends
Monday 17	Queen's Birthday—public holiday Midyear Recess begins
Tuesday 18	Midyear examinations begin
Sunday 30	Last date for acceptance of applications for re-admission after exclusion under rules governing re-enrolment

JULY

Tuesday 2	Midyear examinations end
Sunday 21	Midyear Recess ends
Monday 22	Session 2 begins

AUGUST

Thursday 1	Foundation Day
Thursday 15	Faculty of Applied Science meeting, 10 a.m.
Thursday 22	Last day for discontinuation without failure of subjects which extend over the second session only

AUGUST

Monday 26	August Recess begins Holiday for non-academic staff
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SEPTEMBER

Sunday 1	August Recess ends
Tuesday 10	Provisional timetable for annual examinations published
Monday 16	Last day for return of corrected enrolment details forms
Monday 23	Last day for students to advise of examination timetable clashes

OCTOBER

Monday 7	Eight Hour Day—public holiday
Thursday 17	Faculty of Applied Science meeting, 10 a.m.
Tuesday 29	Timetable for annual examinations published

NOVEMBER

Monday 4	Study Recess begins
Sunday 10	Session 2 ends
Monday 11	Annual examinations begin

DECEMBER

Tuesday 3	Annual examinations end
Wednesday 25	Christmas Day—public holiday
Thursday 26	Boxing Day—public holiday

1975

Session 1: March 3 to May 11

May Recess: May 12 to May 18

May 19 to June 15

Midyear Recess: June 16 to July 20

Session 2: July 21 to August 24

August Recess: August 25 to August 31

September 1 to November 2

Study Recess: November 3 to November 9

JANUARY

Wednesday 1	New Year's Day—public holiday
Friday 10	Last day for application for review of results of annual examinations
Monday 13	Timetable for deferred examinations published

JANUARY

Friday 17	Last day for application for deferred examinations
	Last day for acceptance of applications to enrol by new students and students repeating first year
Monday 27	Australia Day—public holiday
Tuesday 28	Deferred examinations begin

FEBRUARY

Saturday 8	Deferred examinations end
Monday 17	Enrolment period begins for new students and students repeating first year
Friday 21	Results of deferred examinations available
Monday 24	Enrolment period begins for students re-enrolling (second and later years)

THE ACADEMIC YEAR

The academic year is divided into two sessions, each containing 14 weeks for teaching. There is a recess of five weeks between the two sessions as well as short recesses of one week within each of the sessions.

Session 1 commences on the first Monday of March.

FACULTY OF APPLIED SCIENCE

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CHAIRMAN—Professor R. T. Fowler

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N. Buchsbaum, BSc *Haiifa*, MSc *N.S.W.*

M. D. Young, BSc PhD *N.S.W.*

O. Zubzanda, DiplIng *T.U. Bratislava*

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E. M. Roberts, MAgrSc *N.Z.*, PhD *N.S.W.*, MAIAS

K. J. Whiteley, BSc *N.S.W.*, PhD *Leeds*, MAIAS

ADMINISTRATIVE ASSISTANT

J. E. Lawrence

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TUTOR/DEMONSTRATOR

Jean J. Carter, MSc *Syd.*

SENIOR INSTRUCTORS

J. R. Paynter

R. E. Sallaway

REQUIREMENTS FOR ADMISSION

A person who seeks to become a candidate for any degree of Bachelor of the University must first have qualified for matriculation and have satisfied the requirements for admission to the particular Faculty, course or subject chosen.

In addition to complying with these conditions candidates must be selected before being permitted to enrol in a course. In 1974 it will be necessary for the University to limit the number of students enrolling in all undergraduate courses.

Special Assistance for Aboriginal Students

The University may admit suitably qualified persons of Aboriginal descent outside of any quota restrictions.

Upon receipt of an application under this provision, the University will assess the applicant's potential to cope with University studies, and will make Student Counsellors available to discuss the choice of a course and subsequent career opportunities.

All enquiries relating to this scheme should be directed to the Registrar.

Matriculated Student

A candidate who has satisfied the conditions for matriculation and for admission to a course of study shall be classed as a "matriculated student" of the University, after enrolment.

A person who has satisfactorily met the conditions for admission may be provided with a statement to that effect on the payment of the prescribed fee.

Section A

General Matriculation and Admission Requirements

1. A candidate may qualify for matriculation by attaining in recognized matriculation subjects at one New South Wales Higher School Certificate Examination or at one University of Sydney Matriculation Examination a level of performance determined by the Professorial Board from time to time.

2. The level of performance required to qualify for matriculation shall be

- (a) passes in at least five recognized matriculation subjects, one of which shall be English and three of which shall be at Level 2 or higher; and
- (b) the attainment of an aggregate of marks, as specified by the Professorial Board, in not more than five recognized matriculation subjects, such marks being co-ordinated in a manner approved by the Board.

3. The following subjects, and such other subjects as may be approved by the Professorial Board from time to time, shall be recognised matriculation subjects:—

English	Greek	Chinese
Mathematics	Latin	Japanese
Science	French	Hebrew
Agriculture	German	Dutch
Modern History	Italian	Art
Ancient History	Bahasa Indonesia	Music
Geography	Spanish	Industrial Arts
Economics	Russian	

4. A candidate who has qualified to matriculate in accordance with the provisions of Clauses 1, 2 and 3 may be admitted to a particular Faculty, Course or Subject provided that:—

- (a) his qualification includes a pass at the level indicated in the subject or subjects specified in Schedule A as Faculty, Course or Subject Pre-Requisites; or
- (b) the requirements regarding these particular Faculty, Course or Subject Pre-Requisites, as specified in Schedule A, have been met at a separate Higher School Certificate or University of Sydney Matriculation Examination.

5. Notwithstanding any of the provisions of Clauses 1 to 4, the Professorial Board may grant matriculation status to any candidate at the Higher School Certificate or University of Sydney Matriculation Examination who has reached an acceptable standard and may admit him to any Faculty, Course or Subject.

NOTE

1. For the purposes of clause 2(a), Mathematics and Science BOTH PASSED at First Level or Second Level Full Course shall together count as three subjects.
2. For the purposes of clause 2(b), Mathematics and Science TAKEN either singly or together at first level or second level full course shall each count as one and one half subjects.

Schedule A

FACULTY OR COURSE	FACULTY OR COURSE PRE-REQUISITES
Applied Science (excl. Applied Geography and Wool and Pastoral Sciences courses) Biological Sciences Engineering Industrial Arts Course Medicine Military Studies (Engineering course and Applied Science course) Science Bachelor of Science (Education)	(a) Science at Level 2S or higher AND (b) either Mathematics at Level 2F or higher OR Mathematics at Level 2S, provided that the candidate's performance in this subject and his general level of attainment are at standards acceptable to the Professorial Board.
Architecture Applied Geography (Biogeography and Pedology specializations) Wool and Pastoral Sciences courses	(a) Science at Level 2S or higher AND (b) Mathematics at Level 2S or higher
Applied Geography (Economic Geography speciali- zation)	Either Mathematics at Level 2F or higher OR Mathematics at Level 2S, provided that the candidate's performance in this subject and his general level of attainment are at standards acceptable to the Professorial Board.

(see over)

SUBJECT	SUBJECT PRE-REQUISITES
1.011—Higher Physics I 1.001—Physics I	As for Faculty of Science
2.001—Chemistry I 17.011—Human Biology 25.001—Geology I 25.111—Geoscience I	Science at Level 2S or higher
10.011—Higher Mathematics I	Mathematics at Level 2F or higher
10.001—Mathematics I	Either Mathematics at Level 2F or higher OR Mathematics at Level 2S, provided that the candidate's performance in the subject and his general level of attainment are at standards acceptable to the Professorial Board.
10.021—Mathematics II	Mathematics at Level 2S or higher
15.102—Economics II	As for Faculty of Commerce
50.111—English I 51.111—History IA 51.121—History IB	English at Level 2 or higher
56.111—French I	French at Level 2 or higher
59.111—Russian I	Russian at Level 2 or higher
64.111—German I	German at Level 2 or higher
65.111—Spanish I	Spanish at Level 2 or higher
59.001—Russian IZ 64.001—German IZ 65.001—Spanish IZ	A foreign language, other than that in which enrolment is sought, at Level 2 or higher

Section B

Supplementary Provisions for Matriculation

Notwithstanding the provisions of Section A above, candidates may be accepted as “matriculated students” of the University under the conditions which are listed in the University Calendar.

ADMISSIONS AND ENROLMENT PROCEDURE

ADMISSIONS PROCEDURE

Details of the procedure to be followed by students seeking entry to first year courses at the University may be obtained from the Admissions Office or the Metropolitan Universities Admissions Centre.

Persons seeking entry to first year courses in one or more of the three Universities in the Sydney Metropolitan Area (Macquarie University, The University of New South Wales and the University of Sydney) are required to lodge a single application form with the Metropolitan Universities Admissions Centre, Third Floor, 13-15 Wentworth Avenue, Sydney (near Liverpool Street). Postal address: Box 7049, G.P.O., Sydney, 2001. Telephone: 26 6301. On the application form provision is made for applicants to indicate preferences for courses available in any of the three Universities. Students are notified individually of the result of their applications and provided with information regarding the procedures to be followed in accepting the offer of a place at this University and completing their enrolment at the Enrolment Bureau, Unisearch House, 221 Anzac Parade, Kensington.

ADMISSIONS OFFICE

The Admissions Office which is located in the Chancellery on the upper campus provides intending students (both local and overseas) with information regarding courses, admission requirements, scholarships and enrolment. Office hours are from 9.00 a.m. to 1.00 p.m. and 2.00 p.m. to 5.00 p.m. Monday to Friday. During the enrolment period, an evening service is also provided.

Applications for special admission, admission with advanced standing and from persons relying for admission on overseas qualifications should be lodged with the Admissions Office. The Office also receives applications from students who wish to transfer from one course to another, resume their studies after an absence of twelve months or more, or seek any concession in relation to a

course in which they are enrolled. It is essential that the closing dates for lodgment of applications are adhered to, and, for further details the sections on "Rules Relating to Students" and "Enrolment Procedure for Undergraduate Courses" should be consulted.

Applications for admission to undergraduate courses from students who do not satisfy the requirements for admission (see section on "Requirements for Admission"), from students seeking admission with advanced standing, and from students who have had a record of failure at another University, are referred by the Admissions Office to the Admissions Committee of the Professorial Board.

Students seeking to register as higher degree candidates should discuss their proposals initially with the Head of the School in which they wish to register. An application is then lodged on a standard form and the Admissions Office, after obtaining a recommendation from the Head of the School, refers the application to the appropriate Faculty or Board of Studies Higher Degree Committee.

ENROLMENT PROCEDURE

In 1974 it will be necessary for the University to limit entry into each Faculty and Board of Studies.

The enrolment procedure for the different classes of undergraduate students is as follows:

First Enrolments

(a) New South Wales residents already qualified for admission and persons who are applying for enrolment on the basis of qualifications gained or about to be gained outside New South Wales must lodge an application for enrolment with the Metropolitan Universities Admissions Centre, 13-15 Wentworth Avenue, Sydney (P.O. Box 7049 G.P.O., Sydney) by 26th October 1973.

(b) New South Wales residents qualifying for admission by the 1973 New South Wales Higher School Certificate Examination or the 1974 Sydney University Matriculation Examination and those who have attended a University in New South Wales in 1973 must apply for enrolment to the Metropolitan Universities Admissions Centre, 13-15 Wentworth Avenue, Sydney (P.O. Box 7049 G.P.O., Sydney) by 18th January 1974.

Students whose applications for enrolment are accepted will be required to complete their enrolment at a specified appointment

time before the beginning of Session 1. Compulsory fees must be paid on the day of the appointment. However, in special circumstances and provided class places are still available, students may be allowed to complete their enrolment after the prescribed week subject to the payment of a late fee.

Application forms for enrolment and details of the application procedures may be obtained on application to the Registrar, P.O. Box 1, Kensington, 2033.

Failure in First Year. First year students who failed more than half their programme at the 1973 Annual Examinations and who were not granted any deferred examinations will NOT follow the above procedure. They are required to 'show cause' why they should be allowed to continue in the course, and should await instructions in writing from the Registrar as to the procedure.

Later Year Enrolments. All students enrolling other than for the first time and not included above should attend the office of the appropriate School before proceeding on vacation to complete the necessary preliminary enrolment procedures. Draft enrolment programmes must be lodged with the School office no later than 18th January 1974.

Students in Applied Science are required to attend Unisearch House for enrolment in accordance with the following timetable:

a. Full-time Courses

Year 2, and Year 1 repeats	Thursday 28th February 9.30 a.m. to 12.30 p.m. (Courses 300-310) 2.00 p.m. to 4.30 p.m. (Courses 312-322)
Year 3	Tuesday 26th February 9.30 a.m. to 12.30 p.m. (Courses 300-310) 2.00 p.m. to 4.30 p.m. (Courses 312-322)
Year 4	Monday 25th February 9.30 a.m. to 12.30 p.m. (Courses 300-310) 2.00 p.m. to 4.30 p.m. (Courses 312-322)

b. Part-time Courses

Stage 1 repeats and Stage 2, 3, 4, 5, 6 and later stage students	Wednesday 27th February 2.00 p.m. to 4.30 p.m. (All courses) and 6.00 p.m. to 8.00 p.m. (All courses)
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Students who have completed the final examinations but have a thesis still outstanding are required to enrol for the period necessary to complete the thesis and to pay the requisite fees.

Miscellaneous Subject Enrolments. Students may be permitted to enrol for miscellaneous subjects (i.e., as students not proceeding to a degree or diploma) provided the Head of the School offering the subject considers it will be of benefit to the student and there is accommodation available. Only in exceptional cases will subjects taken in this way count towards a degree or diploma. Where a student is under exclusion he may not be enrolled in miscellaneous subjects unless given approval by the Professorial Board.

Final Dates for Completion of Enrolment. No enrolments will be accepted from *new students* after the end of the second week of Session 1 (15th March 1974) except with the express approval of the Registrar and the Head of the School concerned; no *later year enrolments* will be accepted after 29th March without the express approval of the Registrar which will be given in exceptional circumstances only.

University Union Card

All students other than miscellaneous students are issued with a University Union membership card. This card must be carried during attendance at the University and shown on request.

The number appearing on the front of the card above the student's name is the student registration number used in the University's records. This number should be quoted in all correspondence.

The card must be presented when borrowing from the University libraries, when applying for travel concessions and when notifying a change of address. It must also be presented when paying fees on re-enrolment each year when it will be made valid for the year and returned. Failure to present the card could result in some inconvenience in completing re-enrolment.

A student who loses a Union card must notify the University Union as soon as possible.

New students will be issued with University Union cards at the University Union Enquiry Desk as soon as practicable after payment of fees. In the meantime, fees receipt form should be carried during attendance at the University and shown on request. A period of at least three weeks should be allowed to elapse after payment of fees before making application for the card. Cards will not be posted under any circumstances.

FEES

Payment of Fees

As from 1st January, 1974, no fees for tuition will be payable. Other fees and charges will still be payable. These include those charges raised to finance the expenses incurred in operating student activities such as the University Union, the Students' Union, the Sports Association and the Physical Education and Recreation Centre. Late fees are also charged where a student fails to observe required procedures by the appropriate time. Charges may also be payable, sometimes in the form of a deposit, for the hiring of kits of equipment which are lent to students for their personal use during attendance in certain subjects. Accommodation charges and costs of subsistence on excursions, field work, etc. and for hospital residence (medical students) are payable in appropriate circumstances. In order to become a student member of the University in any particular course of study it is necessary to meet the entrance requirements for the course and to enrol formally in it. To effect enrolment it is necessary to present a duly completed and authorised enrolment form to the University cashier together with where payable, either the appropriate fees, or an authority authorising those fees to be charged to some other person or institution.

Completion of Enrolment

All students are required to attend the appropriate enrolment centre during the prescribed enrolment period* for authorisation of course programme. Failure to do so will incur a late fee of \$10.

First year students (including students repeating first year) must complete enrolment (including fee payment) before they are issued with class timetables or permitted to attend classes. A first year student who has been offered a place in a course to which entry is restricted and who fails to complete enrolment at the appointed time may lose the place allocated.

Fees should be paid during the prescribed enrolment period but will be accepted during the first two weeks of Session 1. (For late fees see below). **No student is regarded as having completed**

* The enrolment periods for Sydney students are prescribed annually in the leaflets on enrolment procedures.

an enrolment until fees have been paid. Fees will not be accepted (i.e. enrolment cannot be completed) from new students in year-long courses after the end of the second week of Session 1 (i.e. 15th March 1974), and after 31st March from students who are re-enrolling, except with the express approval of the Registrar, which will be given in exceptional circumstances only.

Students enrolling for the first time in any year at the commencement of Session 2 are required to pay all fees due within the first two weeks of that Session. Students Activities fees due will be one half of the annual fees.

These arrangements also apply to medical students and, although the structure of the academic year in the later years of the course in Medicine differs from that followed in other courses, medical students are required to observe the same dates for payment as apply to students in other courses.

Assisted Students

Scholarship holders or sponsored students who have not received an enrolment voucher or appropriate letter of authority from their sponsor at the time when they are enrolling should complete their enrolment paying their own fees. A refund of fees will be made when the enrolment voucher or letter of authority is subsequently lodged with the Cashier.

Extension of Time

Any student who is unable to pay fees by the due date may apply in writing to the Deputy Registrar (Student Services) for an extension of time. Such application must state year or stage, whether full-time or part-time, and the course in which enrolment is sought, describe clearly and fully why payment cannot be made and the extension is required. The application must be lodged before the date on which a late fee becomes payable. Normally the maximum extension of time for the payment of fees is one month for fees due in Session 1 and for one month from the date on which a late fee becomes payable in Session 2.

Where an extension of time is granted to a first year student in Session 1 such student may only attend classes on the written authority of the Registrar, but such authority will not normally be given in relation to any course where enrolments are restricted.

Failure to Pay Fees or Other Debts

Any student who fails to pay prescribed fees or charges or is otherwise indebted to the University and who fails to make a satisfactory settlement of his indebtedness upon receipt of due

notice ceases to be entitled to the use of University facilities. Such a student is not permitted to register for a further session, to attend classes or examinations, or to be granted any official credentials.

No student is eligible to attend the annual examinations in any subject where any portion of his fees for the year is outstanding after the end of the fourth week of Session 2 (16th August 1974).

In very special cases the Registrar may grant exemption from the disqualification referred to in the two preceding paragraphs upon receipt of a written statement setting out all relevant circumstances.

Student Fees*

All undergraduate students and students taking miscellaneous subjects (with the exception of External students) will be required to pay:—

University Union** \$20.00 — entrance fee

Student Activities Fees

University Union** \$30.00 — annual subscription

Sports Association** \$4.00 — annual subscription

Students' Union** \$7.00 — annual subscription

Miscellaneous \$17.00 — annual fee

(The miscellaneous fee is used to finance expenses generally of a capital nature relating to student activities. Funds are allocated to the various student bodies for projects recommended by the Student Affairs Committee and approved by the University Council).

Depending on the subject being taken, students may also be required to pay:—

Pathology Instrument Kit — \$10.

(Refundable on return in satisfactory condition.)

Special Examination Fees

Examinations conducted under

special circumstances — \$11 for each subject

Review of examination result — \$11 for each subject

* Fees quoted in the schedule are current at the time of publication and may be amended by the Council without notice.

** Life members of these bodies are exempt from the appropriate fee or fees.

Late Fees*Session 1 — First Enrolments*

Fees paid in the late enrolment period and before commencement of Session 1	\$10
Fees paid during the 1st and 2nd weeks of Session 1	\$20
Fees paid after the commencement of the 3rd week of Session 1 with the express approval of the Registrar and Head of the School concerned	\$40

Session 1 — Re-enrolments

Failure to attend enrolment centre during enrolment week	\$10
Fees paid after the commencement of the 3rd week of Session 1 to 31st March	\$20
Fees paid after 31st March where accepted with the express approval of the Registrar	\$40

Session 2 — All Enrolments

Fees paid in 3rd and 4th weeks of Session 2	\$20
Fees paid thereafter	\$40

Withdrawal from Course

1. Students withdrawing from a course are required to notify the Registrar in writing.
2. Where notice of withdrawal from a course is received by the Registrar before the first day of Session 1 a refund of all fees paid will be made.
3. On notice of withdrawal:
 - (a) a partial refund of the University Union Entrance Fee will be made on the following basis: any person who has paid the entrance fee in any year and who withdraws from membership of the University Union after the commencement of Session 1 in the same year, or who does not renew his membership in the immediately succeeding year may on written application to the Warden receive a refund of half the entrance fee paid.
 - (b) A partial refund of other Student Activities Fees will be made on the following basis:
University Union — \$7.50 in respect of each half session.

University of New South Wales Students' Union — where notice is given prior to the end of the fifth week of Session 1, \$3.50; thereafter no refund.

University of New South Wales Sports Association — where notice is given prior to the 5th week a full refund is made; thereafter no refund.

Miscellaneous Student Activities Fee — \$4.25 in respect of each half session.

4. Where initial enrolment is made at commencement of Session 2 in any year and the student subsequently withdraws, a refund of fees based on the above rules may be made.

Cashier's Hours

The Cashier's office is open for the payment of fees from 9.30 a.m. to 1.00 p.m. and from 2.00 p.m. to 4.30 p.m. Monday to Friday. It is open for additional periods during the first four weeks of Session 1. Students are advised to consult notice boards for details.

GENERAL RULES AND INFORMATION

GENERAL CONDUCT

Acceptance as a member of the University implies an undertaking on the part of the student to observe the regulations, by-laws and other requirements of the University, in accordance with the declaration signed at the time of the enrolment.

In addition, students are expected to conduct themselves at all times in a seemly fashion. Smoking is not permitted during lectures, in examination rooms or in the University Library. Gambling is also forbidden.

Members of the academic staff of the University, senior administrative officers, and other persons authorized for the purpose, have authority, and it is their duty to check and report on disorderly or improper conduct or any breach of regulations occurring in the University.

ATTENDANCE AT CLASSES

Students are expected to be regular and punctual in attendance at all classes in the course or subject in which they are enrolled. All applications for exemption from attendance at lectures or practical classes must be made in writing to the Registrar.

In the case of illness or of absence for some other unavoidable cause a student may be excused by the Registrar from non-attendance at classes for a period of not more than one month, or on the recommendation of the Dean of the appropriate Faculty for any longer period.

Applications to the Registrar for exemption from re-attendance at classes, either for lectures or practical work, may only be granted on the recommendation of the Head of the appropriate School. The granting of an exemption from attendance does not carry with it exemption from payment of fees.

Application forms for exemption from lectures are available at the Admissions Office and should be lodged there (with a medical certificate where applicable). If session examinations have been missed this fact should be noted in the application.

Where a student has failed a subject at the annual examinations in any year and re-enrols in the same course in the following year, he must include in his programme of studies for that year the subject in which he has failed. This requirement will not be applicable if the subject is not offered the following year; is not a compulsory component of a particular course; or if there is some other cause, which is acceptable to the Professorial Board, for not immediately repeating the failed subject.

Where a student has attended less than eighty per cent of the possible classes, he may be refused permission to sit for the examination in that subject.

INDEBTEDNESS TO THE UNIVERSITY

Any student who is indebted to the University and who fails to make a satisfactory settlement of his indebtedness upon receipt of due notice ceases to be entitled to membership and privileges of the University. Such a student is not permitted to register for a further session, to attend classes or examinations, or to be granted any official credentials.

In very special cases the Registrar may grant exemption from the disqualification referred to in the preceding paragraph upon receipt of a written statement setting out all relevant circumstances.

COURSE TRANSFERS

Students wishing to transfer from one course to another must apply on an application form obtainable from the Admissions Office, Chancellery, by Friday, 18th January. As the number of places in each course is limited, failure to apply by 18th January 1974 will probably result in the application for transfer being unsuccessful.

Students whose applications to transfer are successful are required to comply with the enrolment procedures for the year/stage of the new course in which they expect to enrol. Unless otherwise instructed they must present the letter granting approval of the transfer to the enrolling officer.

Students who have not received advice regarding their application to transfer before the date on which they are required to enrol should check with the Admissions Office.

Students should also advise the Enrolling Officer of the School in which they are enrolled of their intention to transfer.

CHANGES IN COURSE PROGRAMMES AND WITHDRAWAL FROM SUBJECTS

Students seeking approval to substitute one subject for another (including change of session), add one or more subjects to their programme or discontinue part or all of their programme must make application to the Registrar through the Head of the School responsible for the course on forms available from School offices. The Registrar will inform students of the decision. Application to enrol in additional subjects must be submitted by 31st March.

Approval of withdrawal from subjects is not automatic, each application being determined after considering the circumstances advanced as justifying withdrawal.

It is emphasized that withdrawal from:

- (1) a subject, tuition in which extends over the academic year, at any time after the May recess;
- (2) a subject, tuition in which extends over only one session, at any time after one month from the commencement of the subject; *or*
- (3) failure to sit for the examinations in any subject in which the student has enrolled

shall be regarded as failure to satisfy the examiners in the subject, unless written approval to withdraw without failure has been obtained from the Registrar.

If a student applies after the following dates to withdraw from a subject he will most likely be awarded a failure in the subject:

Subject taken over Session 1 only	4th April 1974
Subject taken over Session 2 only	22nd August 1974
Subject taken over both sessions	26th May 1974

STUDENT RECORDS

All students will receive enrolment details forms by 30th April and 2nd September. It is not necessary to return the forms unless any information recorded thereon is incorrect. Amended forms must be returned to the Examinations and Student Records Section by 14th May and 16th September respectively. Amendments notified after the closing date will not be accepted unless exceptional circumstances exist and approval is obtained from the Registrar. Amended forms returned to the Registrar will be acknowledged in writing within fourteen days.

RESUMPTION OF COURSES

Students wishing to resume their studies after an absence of twelve months or more are required to apply to the Admissions Office for permission to re-enrol by 18th January 1974. Students re-enrolling in this way will normally be required to satisfy conditions pertaining to the course at the time of re-enrolment. This condition applies also to students who have been re-admitted to a course after exclusion under the rules restricting students re-enrolling.

ADMISSION WITH ADVANCED STANDING

Any person who makes application to register as a candidate for any degree or other award granted by the University may be admitted to the course of study leading to such degree or award with such standing on the basis of previous attainments as may be determined by the Professorial Board.

Students should consult the University Calendar for complete details regarding "Admission with Advanced Standing".

ANNUAL EXAMINATIONS

Formal examinations in most faculties are held in June-July and November-December. Provisional timetables including the dates and times of examinations are posted on the central notice boards in the Wallace Wurth Medical School, Biological Sciences Building, the Chancellery, Central Lecture Theatre Block Dalton (Chemistry) School, Main Building (Mining and Physics), outside the Science Theatre and in the Western Grounds Area on 7th May and 10th September. Students must advise the Examinations Unit (Chancellery) of clash of examinations by 20th May and 23rd September. Final timetables will be displayed, and individual copies available for students, on 4th June and 29th October.

Misreading of the timetable is not an acceptable excuse for failure to attend an examination.

A student suffering from a physical disability which puts him at a disadvantage in written examinations should apply to the Registrar in writing, as early as possible, for special provisions to be made for him to take examinations. The request should be supported by medical or other evidence.

Examinations are conducted in accordance with the following rules and procedure:—

- (a) Candidates are required to obey any instruction given by an examination supervisor for the proper conduct of the examination.
- (b) Candidates are required to be in their places in the examination room not less than ten minutes before the time for commencement.
- (c) No bag, writing paper, blotting paper, manuscript or book, other than a specified aid, is to be brought into the examination room.
- (d) No candidate shall be admitted to an examination after thirty minutes from the time of commencement of the examination.
- (e) No candidate shall be permitted to leave the examination room before the expiry of thirty minutes from the time the examination commences.
- (f) No candidate shall be re-admitted to the examination room after he has left it unless during the full period of his absence he has been under approved supervision.
- (g) A candidate shall not by any improper means obtain, or endeavour to obtain, assistance in his work, give, or endeavour to give, assistance to any other candidate, or commit any breach of good order.
- (h) Smoking is not permitted during the course of examinations.
- (i) All answers must be in English unless otherwise directed. Foreign students who have the written approval of the Officer-in-Charge of Examinations may use standard translation dictionaries.
- (j) A candidate who commits any infringement of the rules governing examinations is liable to disqualification at the particular examination, to immediate expulsion from the examination room and to such further penalty as may be determined in accordance with the By-laws.

A student who through serious illness or other cause outside his control is unable to attend an examination is required to bring the circumstances (supported by a medical certificate or other evidence) to the notice of the Registrar not later than seven days after the date of the examination, and may be required to submit to medical examination.

A student who attempts an examination yet claims that his performance was prejudiced by sickness on the day of the examination, must notify the Registrar or Examination Supervisor, before, during or immediately after the examination and may be required to submit to medical examination.

A student who believes that his performance at an examination has been affected by serious illness during the year or by other cause outside his control, and who desires these circumstances to be taken into consideration in determining his standing is required to bring the evidence (supported by medical certificates or other evidence) to the notice of the Registrar not later than seven days after the date of the examination.

In the assessment of a student's progress, consideration is given to work in laboratory and class exercises and to any term or other tests given throughout the year, as well as to the results of written examinations.

Final examination results are posted to the term addresses of students and it is therefore essential that any change of address be advised to the Examination and Student Records Section. Results are also posted on School notice boards and in the foyer of the Library. No examination results will be given by telephone.

Examination results may be reviewed for a fee of \$9.00 a subject, which is refundable in the event of an error being discovered. Primarily such a review will ensure that all questions attempted by candidates have been marked and that the total of all marks awarded are correct. Applications for review must be submitted on the appropriate form to the Examinations and Student Records Section, together with the necessary fee by the date indicated on the notification of results.

Examination Results

Graded Passes

Passes will be graded as follows:

High Distinction (indicates a quite superior performance).

Distinction (indicates a superior performance).

Credit (indicates a good, but not superior performance).

Pass (indicates the achievement of an acceptable minimum level of competence in relation to the course objectives).

Pass Conceded

A pass conceded may be granted to students where the mark in the subject is slightly below the required standard and whose overall performance warrants it.

Terminating Pass

A terminating pass may be granted where the mark for the subject is below the required standard. A terminating pass will not permit a student to progress further in the subject or to enrol in any other subject for which a pass in the subject is a co-requisite or prerequisite. A student granted a terminating pass may attempt a deferred examination, if available, to improve his performance, but if the student fails the deferred examination, the terminating pass will stand.

DEFERRED EXAMINATIONS

Deferred examinations may be granted in the following cases:

- (i) When a student through illness or some other acceptable circumstance has been prevented from taking the annual examination or has been placed at a serious disadvantage during the annual examinations.

Applications for deferred examination in this category must be lodged with the Registrar with appropriate evidence of the circumstances (e.g., medical certificate) not later than seven days after the examination concerned.

All such applications shall be reported to the Head of the School responsible for the subject. Before a deferred examination is granted on medical grounds, regard shall be paid to the student's class and assignment work in the subject, to his general performance in the year, and to the significance of the annual examination in compiling the composite mark.

- (ii) To help resolve a doubt as to whether a student has reached the required standard in a subject.
- (iii) To allow a student by further study to reach the required standard in a subject. The granting of a deferred examination in such cases will be based on the general quality of the student's performance.
- (iv) Where a student's standing at the annual examinations is such that his progression or graduation could depend on his failure in one subject only, then his position in that subject shall be again reviewed with a view to determining whether a deferred examination may be granted notwithstanding his failure otherwise to qualify for such concession.

Deferred examinations must be taken at the centre in which the student is enrolled, unless he has been sent on compulsory industrial training to remote country centres or interstate. In this case the student must advise the Registrar, on a form available from his school or the Enquiry Desk, Chancellery, of relevant particulars, before leaving for his destination, in anticipation that deferred examination papers may have to be forwarded to him. Normally, the student will be directed to the nearest University for the conduct of the deferred examination.

A student eligible to sit for a deferred examination must lodge with the Accountant an application accompanied by the fee of \$8 per subject, by the date indicated on the notification of results.

Conceded Deferred Examination

A conceded deferred examination, may be granted to a student where the mark in the subject is below the standard at which deferred examinations have been granted in the subject but whose overall performance warrants such a concession.

APPLICATION FOR ADMISSION TO DEGREE

Applications for admission to a degree of the University must be made on the appropriate form by 30th September, in a student's final year. Applicants should ensure that they have completed all requirements for the degree, including industrial training where necessary. Any variation such as cancelling of application in order to proceed to an honours degree or submission of an application following discontinuation of honours programme, must be submitted in writing to the Registrar no later than 30th January.

RESTRICTION UPON STUDENTS RE-ENROLLING

The University Council has adopted the following rules governing re-enrolment with the object of requiring students with a record of failure to show cause why they should be allowed to re-enrol and retain valuable class places. These rules will be applied retrospectively from January 1971.

1. (i) A student shall show cause why he should be allowed to repeat a subject in which he has failed more than once. (Failure in a deferred examination as well as in the initial examination counts, for the purpose of this regulation, as one failure.) Where such subject is pre-

scribed as a part of the student's course he shall be required to show cause why he should be allowed to continue the course.

Notwithstanding the provisions of Clause 1(i)

- (ii) A student enrolled in the first year or first stage of any course, other than the medical course, who has failed in more than half the programme in which he is enrolled for that year or stage shall be required to show cause why he should be allowed to continue in the course.
- (iii) A student enrolled in the first year of the Medical course who has failed in more than one subject of that year shall be required to show cause why he should be allowed to continue in the Medical course.
- (iv) The provisions of sections (ii) and (iii) of this rule shall be deemed to apply to any student on transfer from another course or institution whose programme of studies in the first year of enrolment immediately following transfer is comprised of subjects so chosen that half or more of such subjects are listed in the University Calendar as first year subjects.

2. Notwithstanding the provisions of clause 1, a student shall be required to show cause why he should be allowed to continue a course which he will not be able to complete in the time set down in the following schedule:

Number of years in course	Total time allowed from first enrolment to completion (years)
3	5
4	6
5	8
6	9
7	11
8	12

3. No full-time student shall, without showing cause, be permitted to continue a course unless all subjects of the first year of his course are completed by the end of his second year of attendance. No student in the Faculty of Arts shall, without showing cause, be permitted to continue a course unless he completes four subjects by the end of his second year of attendance. No full-time

student in the Bachelor of Social Work course shall without showing cause be permitted to continue with the course unless he completes the equivalent of four full subjects by the end of his second year of attendance.

No part-time student in a course in which progression is by stage shall without "showing cause" be permitted to continue a course in which he will not be able to complete all subjects of the first two stages by the end of his fourth year of attendance and all subjects of the third and fourth stages of his course by the end of his seventh year of attendance.

No part-time student in the Science course shall, without showing cause, be permitted to continue a course in which he will not be able to complete level one Mathematics and six other level one units by the end of his fourth year of attendance and 14 units inclusive of at least three at level two of his course by the end of his seventh year of attendance.

No student in the Faculty of Medicine shall, without showing cause, be permitted to continue with the medical course unless he completes the second year of the course by the end of his third year of attendance, and the third year of the course by the end of his fourth year of attendance.

4. A student who has a record of failure in a course at another University shall be required to show cause why he should be admitted to this University. A student admitted to a course at this University following a record of failure at another University shall be required to show cause, notwithstanding any other provisions in these rules, why he should be permitted to continue in that course if he is unsuccessful in the annual examinations in his first year of attendance at this University.

5. Any student excluded under any of the clauses 1-3 may apply for re-admission after two academic years and such application shall be considered in the light of any evidence submitted by him.

6. A student wishing "to show cause" under these provisions shall do so in writing to the Registrar. Any such application shall be considered by a committee, hereinafter referred to as the Re-enrolment Committee, appointed by the Professorial Board, which shall determine whether the cause shown is adequate to justify his being permitted to continue his course or re-enrol as the case may be.

7. The Vice-Chancellor may on the recommendation of the Re-enrolment Committee exclude from attendance in a course or courses any student who has been excluded from attendance in any other course under the rules governing re-enrolment and whose record at the University demonstrates, in the opinion of the Re-enrolment Committee and the Vice-Chancellor, the student's lack of fitness to pursue the course nominated.

8. A student who has failed, under the provisions of Clause 6 of these rules, to show cause acceptable to the Re-enrolment Committee why he should be permitted to continue in his course, and who has subsequently been permitted to re-enrol in that course or to transfer to another course, shall also be required to show cause, notwithstanding any other provisions in these rules, why he should be permitted to continue in that course if he is unsuccessful in the annual examinations immediately following the first year of resumption or transfer of enrolment as the case may be.

9. Any student who is excluded from attendance in any course or subject under the provisions of these rules may appeal to an Appeal Committee constituted by Council for this purpose. The decision of the Appeal Committee shall be final.

10. The notification to any student of a decision by the Re-enrolment Committee to exclude the student from attendance in any course or subject shall indicate that the student may make application for review of the decision to an Appeal Committee. In lodging such application the student shall ensure that a complete statement is furnished of all grounds on which the application is based and shall indicate whether or not the student wishes to appear in person before the Appeal Committee.

In considering an application for review the Committee of Review, on the basis of the student's academic record and the stated grounds for review, shall decide:

- (i) whether there are grounds which justify the Committee seeing the student in person, or
- (ii) whether there is sufficient information available to the Committee to allow decision without seeing the student in person

and so proceed to determine the application accordingly.

RE-ADMISSION AFTER EXCLUSION

Applications for re-admission must be made on the standard form and lodged with the Registrar not later than 30th June of the year prior to that for which re-admission is sought. An application should include evidence of appropriate study in the subjects (or equivalents) on account of which the applicant was excluded. In addition, evidence that the circumstances which were deemed to operate against satisfactory performance at the time of exclusion are no longer operative or are reduced in intensity, should be furnished. An applicant may be required to take the annual examinations in the relevant subjects as qualifying examinations in which case re-admission does not imply exemption from the subject.

Late applications cannot be considered where, in the opinion of the University, insufficient time will be available for the student to prepare himself for any qualifying examinations which may be required.

It should be noted that a person under exclusion may not be enrolled in miscellaneous subjects unless he has received the approval of the Professorial Board on the recommendation of the Admissions Committee.

Persons who intend applying for re-admission to the University at a future date may seek advice as to ways in which they may enhance their prospects of qualifying for re-admission. Enquiries should be made on a form obtainable from the Examinations and Student Records Section, and lodged with the Registrar.

OWNERSHIP OF STUDENTS' WORK

The University reserves the right to retain at its own discretion the original or one copy of any drawings, models, designs, plans and specifications, essays, theses or other work executed by students as part of their courses, or submitted for any award or competition conducted by the University.

CHANGE OF ADDRESS

Students are requested to notify the Student Records Section of the Registrar's Division of any change in their address, as soon as possible. Failure to do this could lead to important correspondence not reaching students. The University cannot

accept responsibility if official communications fail to reach students who have not notified their change of address. A Change of Address Advice form is available at Faculty and School offices and at the Enquiry Counters on the Ground Floor of the Chancellery Building.

NOTICES

Official University notices are displayed on the notice boards and students are expected to be acquainted with the contents of those announcements which concern them.

LOST PROPERTY

All enquiries concerning lost property should be made to the Superintendent on Extension 2503 or to the Lost Property Office at the Union.

PARKING WITHIN THE UNIVERSITY GROUNDS

Because of the limited amount of parking space available, only the following categories of students may apply for a permit: motor cycle owners (annual fee \$3.90); higher degree students (limited issue, annual fee \$7.80); postgraduate, and senior undergraduate students who have completed three years of a full-time or part-time course (annual fee \$3.90). A permit will allow access to the campus between 5 p.m. and 11 p.m. on weekdays and during library hours on Saturdays, Sundays and public holidays. Enquiries should be made to the Property Section, Room 240, the Chancellery Building, or phone 663 0351, extension 2920. It should be noted that increasing demand for parking space may require the imposition of further restrictions.

APPLICATION OF RULES

General

Any student who requires information on the application of these rules or any service which the University offers, may make enquiries from the Admissions Office, the Student Counselling Unit or the Registrar.

Appeals

Section 5(c) of Chapter III of the By-laws provides that "Any person affected by a decision of any member of the Professorial Board (other than the Vice-Chancellor) in respect of breach of discipline or misconduct may appeal to the Vice-Chancellor, and in the case of disciplinary action by the Vice-Chancellor, whether on appeal or otherwise, to the Council".

STUDENT SERVICES

THE LIBRARY

The University Library is on the upper campus and adjacent to the Chancellery and the Arts and Commerce buildings.

The Library's Undergraduate Collection covers the teaching and research interests of the Faculty, and students are expected to read widely and critically from it.

It is recommended that students attend the "*Introduction to the Library*" which is held at advertized times during Orientation Week and the first week of session 1. The "*Introduction*" uses audiovisual aids to describe the physical layout of the undergraduate library and the services available to readers. Copies of the booklet *Guide to the Library* are available on request. Students who are interested in a subject approach to information may attend a course which outlines methods of searching for information in libraries. This course runs for eight hours over a period of one week. Individual assistance for readers with specific library problems is provided by the *Reader Assistance Unit* which is located in the foyer.

The Bio-Medical Library is in the Biological Sciences building with a branch at Prince Henry Hospital (phone 661-0111).

THE UNIVERSITY UNION

The University Union, housed in the circular building and joined by a courtyard to an adjacent rectangular building, is located near the entrance to the Kensington campus from Anzac Parade. The third building in the Union complex was completed in 1971. Membership of the Union is compulsory for all registered students of the University and is also open to all members of staff and graduates of the University.

On the lower campus the range of facilities provided by the Union includes a cafeteria service and other dining facilities, a large shopping centre, cloak room, banking and hairdressing facilities, showers, a women's lounge, common, games, reading, meeting, music, practice, craft and dark rooms. Photocopying,

sign printing, and stencil cutting services are also available. On the upper campus there is a cafeteria and coffee bar on the ground floor of the Sciences Building, a vending area and lounge off the Science Plaza, a similar facility off the Commerce Courtyard and a Snack Bar at the Golf House on the corner of High and Botany Streets.

The Union sponsors and conducts courses in many facets of the arts including weaving, photography, creative dance and yoga.

STUDENT ACCOMMODATION

RESIDENTIAL COLLEGES

The Kensington Colleges

Accommodation for students is provided within the group of The Kensington Colleges which comprise Basser College, Goldstein College and Philip Baxter College. The group houses 450 men and women students, as well as staff members. Tutors in residence provide tutorial assistance in a wide range of subjects.

Board and residence fees, which are payable on a session basis, amount to \$336 per session. Intending students should apply in writing to the Master, Box 24, Post Office, Kensington, N.S.W. 2033, from whom further information is available.

International House

International House accommodates over 180 students of whom half are Australian; the remaining half is made up of students from some twenty different countries. First-year students who have come to the University straight from school are not eligible for residence because preference is given to mature undergraduates and postgraduate students. Fees are \$24 per week.

Students should apply as soon as possible if they wish to reside at International House at a later date. They should write to the Warden, International House, P.O. Box 88, Kensington, N.S.W. 2033 for information.

New College

This Church of England College accommodates 220 men and women students in single study-bedrooms. There are no religious tests. Fees are \$25 per week and may change in 1974.

Enquiries should be addressed to the Master, New College, Anzac Parade, Kensington, N.S.W. 2033.

Warrane College

This College, an affiliated Roman Catholic residential college, provides accommodation for 200 male students and fourteen resident tutors.

Basic fees are \$28 per week for board and residence, payable on a session basis, and a registration fee of \$20. Fees may change in 1974. Intending students should write to the Master, Warrane College, Box 123, P.O. Kensington, N.S.W. 2033.

Shalom College

Shalom College provides accommodation for 86 men and women students. The basic fee for residents is \$28 a week, although this may change in 1974. Non-resident membership is available to students who wish to avail themselves of the Kosher dining room and tutorial facilities.

Applications for residence and further information should be addressed to the Master, Shalom College, The University of New South Wales, Box 1, P.O. Kensington, N.S.W., 2033.

OTHER ACCOMMODATION

Students requiring other than Residential College accommodation may make personal application to the Housing Officer (Extn. 3260) at the Student Amenities Unit. Current lists are kept of accommodation available at recognized boarding houses, private homes, and in serviced and unserviced apartments.

STUDENT AMENITIES UNIT

The Amenities Unit is concerned with student welfare and its activities are associated with sport and recreation, travel and student accommodation. It works in close liaison with the Sports Association, assisting the various clubs, and administering sporting facilities for both grade and social competitions. The Unit has the added responsibility of the Physical Education and Research Centre where attractive recreational programmes for students and staff are provided. Concessional application forms for all types of travel may also be obtained at the Enquiry Desk in the Chancellery or at the Student Amenities Unit. A Housing Officer is available to assist students with any off-campus accommodation problems.

Location: The Student Amenities Unit is located in Hut B at the foot of Basser Steps.

Phone: 663 0351, Extension 2235 Sports Association; 3271 Physical Education and Recreation Centre; 3261 Travel; 3260 Accommodation.

STUDENT EMPLOYMENT UNIT

The Student Employment Unit offers assistance with career employment for final year students and graduates of the University. This service includes the mailing of regular job vacancy notices to registered students and a campus interview programme for final year students. Careers advice and assistance is also available to undergraduates. Assistance is offered in finding vacation employment which gives either course related experience or industrial training experience where this is a course requirement. Information and advice regarding cadetships, undergraduate and postgraduate scholarships is also available.

The Service is located in the Chancellery on the ground floor. Telephone: 663 0351 ext. 3259 for employment and careers advice, or 663 0351 ext. 2086 for cadetships and industrial training information.

CHAPLAINCY CENTRE

This service is provided for the benefit of students and staff by five Christian Churches and by the Jewish congregation. Chaplains are in attendance at the University at regular times. A Chapel is also available for use by all denominations.

The University Chapel is in Hut F near the Chemistry Building. Full-time chaplains are also accommodated in Hut F and may be contacted by phone at the following extensions: Anglican 2684; Jewish 3273; Roman Catholic 2379; Churches of Christ, Methodist and Seventh Day Adventist 2683.

STUDENT HEALTH UNIT

A student health and first aid centre is situated within the University. It is staffed by two qualified medical practitioners, assisted by a nursing sister and two secretaries. The medical service, although therapeutic, is not intended to replace private or community health services. Thus, where chronic or continuing conditions are revealed or suspected, the student is referred to a private practitioner or to an appropriate hospital for specialist opinion and/or treatment. The health service is not responsible for fees incurred in these instances. The service is confidential

and students are encouraged to attend for advice on matters pertaining to health.

The service is available to all enrolled students by appointment, free of charge, between 9 a.m. and 5 p.m. Mondays to Fridays, and additionally to part-time students from 6 p.m. to 8 p.m. on Tuesdays and Thursdays during session. For staff members, immunizations are available and first aid service in the case of injury or illness on the campus.

The centre is located in Hut E on the northern side of the campus in College Road.

Appointments may be made by calling at the centre or by telephoning extension 2679 or 3275 during the above hours.

STUDENT COUNSELLING AND RESEARCH UNIT

The Student Counselling and Research Unit offers a free, confidential counselling service to help students, individually or in groups, to deal with problems, and to make plans and decisions associated with their personal, academic, and vocational progress.

Interviews, and group programmes, are available between 9 a.m. and 8 p.m. each week-day. Appointments may be made at the Unit, which is located at the foot of Basser Steps, or by ringing 663-0351, extensions 2600-2605 between 9 a.m. and 5 p.m.

UNIVERSITY CO-OPERATIVE BOOKSHOP LTD.

Membership is open to all students, on payment of a fee of \$5, refundable when membership is terminated. Members receive an annual rebate on purchases of books.

STUDENT ACTIVITIES

THE STUDENTS' UNION

The Students' Union was formed in 1952 as an organization, duly recognized by the University Council, to represent the student body and to provide a central organization for the administration of student activities. In the words of its constitution, "The Students' Union is formed for the purpose of advancing the interests of University men and women, facilitating their general scientific and technical education, and fostering a University spirit among them."

The Union affords a recognized means of communication between the student body and the University administration, and represents its members in all matters affecting their interests. It aims to promote the cultural, educational and recreational life of the University and to encourage a permanent interest among graduates in the life and progress of the University.

Membership of the Union is compulsory for all registered students of the University and the annual subscription is \$7.

The Students' Union is governed by a Council consisting of student representatives from the various faculties of the University, representatives of Life Members, overseas students, and of the University and the Sports Association. The Council is elected annually.

THE SPORTS ASSOCIATION

The Sports Association is a student organization within the University, and it caters for a variety of competitive sports for both men and women.

In December 1952 the University Council approved the establishment of the Sports Association which consisted of five clubs. As the University has grown, the Association has expanded, and today includes over thirty clubs.

The controlling body of the Association is the General Committee which consists of a President, Secretary, Treasurer, eight Vice-Presidents and two delegates from each of the affiliated clubs.

Membership of the Association is compulsory for all registered students, and the annual subscription is \$4.

STUDENT CLUBS AND SOCIETIES

Students have the opportunity of joining a wide range of clubs and societies. Affiliated with the Students' Union are the School and Faculty associations, and the numerous religious, social and cultural clubs. There are also many sporting clubs (33) 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.

THE UNIVERSITY REGIMENT

Enquiries should be made to the Adjutant at the Regimental Depot in Day Avenue just west of Anzac Parade.

THE NSW UNIVERSITY SQUADRON

Enquiries should be made to the Commanding Officer at Squadron Headquarters at the corner of City and Darlington Streets, Darlington 2008.

ROYAL AUSTRALIAN NAVY

Enquiries should be made to the Royal Australian Naval Liaison Officer, Professor J. S. Ratcliffe, Commander, R.A.N.V.R., at the School of Chemical Engineering. Phone 663-0351, ext. 2406.

PHYSICAL EDUCATION AND RECREATION CENTRE

The Physical Education and Recreation Centre consists of eight squash courts and a main building. The latter has a large gymnasium and ancillary practice rooms for fencing, table tennis, judo and weightlifting. The Supervisor of Physical Recreation is responsible for this Centre and provides a recreational programme for both students and staff. Those who desire to participate in the recreational programmes should contact the Supervisor on Extension 3271.

FINANCIAL ASSISTANCE

TERTIARY ALLOWANCES SCHEME

In 1974, no new awards will be offered under the Commonwealth University Scholarship Scheme. Instead a new system of Australian Government Assistance for tertiary students, called the Tertiary Allowance Scheme, will operate. This scheme will apply to students who commence approved courses in 1974 as well as those who commenced their courses earlier.

Means-tested living and other allowances will be available to full-time students enrolled in an approved course who satisfy certain academic and residence requirements, are unbonded and who do not receive assistance in excess of \$350 from other scholarships. *No age limit will apply.*

Students enrolled in the following types of university courses are eligible for assistance:

- Undergraduate and postgraduate bachelor degree courses
- Postgraduate diplomas
- Combined bachelor degree courses offered by institutions
- Master's qualifying courses

Benefits

Means tested Living Allowance: The maximum rates of living allowance are \$850 per annum for students living at home and \$1,400 per annum for students living away from home.

The maximum rates of living allowance will be paid where the adjusted family income is equal to *or* less than \$5,300 per annum. The adjusted family income is assessed by subtracting from the gross income of both parents business expenses and an amount of \$450 for each dependent child other than the student.

When the adjusted family income exceeds \$5,300 p.a. the amount of living allowance will be reduced by \$2 for every \$10 of income until the family income exceeds \$10,600 per annum. After this level, the living allowance will be reduced by \$3 for every \$10 of income.

A concession may be made where there are other children in the family undertaking tertiary education with scholarship assistance of less than \$350 p.a. from schemes other than the Tertiary Allowances Scheme.

Students qualifying for living allowance will also receive the following allowances, where appropriate:

Incidentals Allowance: The Incidentals Allowance of \$100 is designed to help students meet the cost of those fees which have not been abolished — the Students' Union, University Union and sports fees — and other expenses associated with their studies.

Travel Allowance: Students whose home is in the country may be reimbursed the cost of three return trips per year during vacation time.

Dependant's Allowance: This is made up of allowances of \$8 per week for a dependent spouse and \$4.50 per week for each child.

How to apply: Higher School Certificate students will be able to obtain application forms from their school. Students who do not already hold a scholarship may obtain forms from the Admissions Office, or from The Regional Director, New South Wales State Office, Department of Education, Sydney Plaza Building, 59 Gouburn Street, Sydney, N.S.W. 2000 — Telephone 2 0929.

N.B. *Current Commonwealth Scholarship holders will have application forms posted to them. All forms should be returned to the above address as soon as possible.*

SCHOLARSHIPS AND BURSARIES

Students undertaking courses in the Faculty of Applied Science are eligible to apply for the following scholarships. Not all scholarships are offered each year. Towards the end of December prospective applicants should enquire from the Student Employment and Scholarships Unit which scholarships are available.

Except where otherwise specified, applications on the form obtainable from the Admissions Office ('phone: 663-0351, ext. 2485) must be lodged with the Registrar, the University of New South Wales, P.O. Box 1, Kensington 2033. A separate application must be lodged for each category of scholarship.

In addition to these scholarships, a number of industrial organizations and Government Departments sponsor students at the University.

In the past, such students generally had their University fees paid by the employer and were employed at cadet rates of pay during the course. However these schemes, details of which are set out in Section B of the University Calendar are currently under review and interested persons should contact the relevant organization or department for up-to-date information.

Bursaries

Numbers of Bursaries tenable at the University are awarded to candidates of merit at the Higher School Certificate Examination whose family income falls within certain limits prescribed by the Bursary Endowment Board. Applications should be made to the Secretary, Bursary Endowment Board, Box 7077, G.P.O. Sydney, 2001.

Sam Cracknell Memorial Scholarship

This scholarship has a value in the range \$1,000 to \$1,500 and is open to students who are eligible to enrol in the final year of a full-time course leading to an honours degree of Bachelor. Candidates will be evaluated not only on academic merit but on the extent to which they have participated in the sporting programme of the University.

The Fell Scholarship (University Residential Colleges)

The Fell Scholarship is available to any undergraduate who is or will be in residence at one of the Colleges under the administration of the Kensington Colleges. The annual value of the Scholarship is \$100. It may be held concurrently with other scholarships.

In awarding the scholarship the academic merit and financial need of the applicant will be taken into consideration.

Applications must be made on the appropriate form and lodged with the Master, Kensington Colleges, Box 24, P.O. Kensington 2033.

Regent Scholarship in Engineering for Women Undergraduates

Mrs. G. O'Riordan and Mrs. J. Kouvelis have undertaken to provide a scholarship for female students wishing to enrol for the degree of Bachelor of Engineering in the Faculty of either Engineering or Applied Science. The scholarship is valued at \$200 per annum and is normally tenable for four years.

Australian Coal Association

The Association's scholarships for students wishing to undertake degree courses in Mining Engineering or Applied Geology are under review. Further details may be obtained from Australian Coal Industry Research Laboratories Ltd., P.O. Box 169, Chatswood, N.S.W. 2067.

The Broken Hill Pty. Co. Ltd.

Several scholarships are provided each year for students who wish to undertake degree courses in any branch of Engineering, Metallurgy, or Applied Science. Scholarships are also available to students who have completed at least one year of any of the degree courses mentioned. Students receive annually a \$400 subsistence allowance, plus \$115 book allowance, and a living-away-from-home allowance (\$10 to \$15 per week) where applicable. Application should be made to: Manager, Personnel and Training, The Broken Hill Pty. Co. Ltd., G.P.O. Box 86A, Melbourne, Vic., 3000.

Consolidated Gold Fields (Australia) Pty. Ltd.

This Company provides scholarships annually for students wishing to undertake a degree course in Mining Engineering, Metallurgy or Geology. The conditions for the scholarships are at present under review. Applications should be made to the Company, Gold Fields House, Sydney Cove.

Joint Coal Board Scholarships

The Joint Coal Board offers scholarships in full-time courses in Mining Engineering and Applied Geology.

Third year mining engineering students are expected to obtain suitable industrial training throughout Session 2 of that year. On graduation, all scholars are expected to gain employment in the coal mining industry or in a sphere closely allied thereto.

Applications on forms obtainable from headmasters or from the Secretary, Joint Coal Board, Box 3842, G.P.O. Sydney 2001 must be lodged with the Board's Secretary not later than seven days after the receipt of the Higher School Certificate results.

King Island Scheelite (1947) Limited

This Company provides up to four scholarships annually for students who have completed the first year of the degree course in Mining Engineering, Metallurgy or Geology. The conditions for the scholarships are at present under review. Applications to the Company at 100 Collins Street, Melbourne, 3000.

Mount Lyell Mining and Railway Company

The Company makes available each year a number of scholarships for students entering the full-time degree course in Geology, Metallurgy, and Mining, Electrical or Mechanical Engineering. Applications should be made to the Mount Lyell Mining and Railways Company Ltd., Queenstown, Tasmania 7467.

N.S.W. Public Service (Department of Mines)

The Department makes scholarships available for students wishing to undertake degree courses in Mining Engineering, Geophysics, Applied Geology or Chemical Engineering. Applications to The Secretary, Public Service Board, Box 2, G.P.O., Sydney 2001.

Peko-Wallsend Investments Ltd.

One or two scholarships are provided annually for students who have completed at least one year of the degree course in Mining Engineering, Metallurgy or Geology. The conditions of the scholarships are at present under review. Applications to the Company, 47-53 Macquarie Street, Sydney 2000.

Rum Jungle Undergraduate Scholarship

One scholarship is made available annually for students wishing to do a degree course in Mining Engineering, Metallurgy or Geology. It is open only to students who matriculated at a Northern Territory school. Applications to The Manager, Territory Enterprises Pty. Ltd., P.O. Box 368, Darwin, N.T. 5794.

The Australasian Vitreous Enamellers' Institute Scholarship in Ceramic Engineering

The Institute provides a scholarship, on the basis of academic merit and personality, for students who are British subjects and who have either met University requirements for admission to Year 1 of the Ceramic Engineering course or have satisfactorily completed Year 1 of the course. The scholarship has a value of \$250 p.a., and is normally tenable for four years.

Brick Manufacturers' Scholarship in Ceramic Engineering

The Brick Manufacturers' Association of New South Wales offers a scholarship in Ceramic Engineering, valued at \$900 per annum to students who are British subjects and who have satisfied the conditions for admission to the first year of the Ceramic Engineering course, or who have completed satisfactorily the first year of the BSc course in Ceramic Engineering or some other programme of equivalent academic standard. The scholarship is normally tenable for four years and may be held concurrently with other scholarships.

New South Wales State Brickworks Scholarship in Ceramic Engineering

The State Brickworks of the Department of Public Works of New South Wales has made available an undergraduate scholarship in Ceramic Engineering to the value of \$900 per annum for students who are British subjects and who have satisfied the conditions for admission to the first year of the Ceramic Engineering course or who have completed the first year of the BSc course in Ceramic Engineering or some other programme of equivalent academic standard. The scholarship will normally be tenable for four years.

Dalgety Australia Limited

Dalgety Australia Ltd. provides a scholarship for the Wool and Pastoral Sciences or Marketing full-time course for students eligible to enter Year 1 of either of these courses, who are British subjects and whose parents are permanently domiciled in New South Wales outside the Sydney, Newcastle and Wollongong metropolitan areas. The scholarship has a value of \$800 to \$1,000 per annum and is normally tenable for a period of four years. Applications must be lodged on the prescribed form with the Registrar by 14th January each year.

Gallard & Robinson Scholarship in Ceramic Engineering

Gallard & Robinson Pty. Ltd. offer, usually quadrennially, a scholarship in Ceramic Engineering to students who are British subjects and who are eligible to enter Year 1 of the Ceramic Engineering course or who have completed satisfactorily Year 1 of the course or some other programme of equivalent academic standing. The scholarship has a value of \$600 p.a., and is normally tenable for four years. Applications must be lodged on the prescribed form with the Registrar by 14th January.

Western Mining Corporation Ltd.

The Company provides scholarships annually to undergraduates at any Australian university who have completed at least the first year of their course in chemical engineering, metallurgy or mining engineering. The conditions of the scholarships are at present under review.

Food Technology Scholarships

A number of scholarships are usually made available by firms in the food processing industries. These scholarships have a value of \$800-\$1,000 per annum, payable as a living allowance to students enrolled full-time in the Food Technology degree course. These scholarships may be held concurrently with other scholarships.

Australian Industries Fuel Scholarships

Under the auspices of The Institute of Fuel (Australian Membership) a number of awards of \$300 each are offered to students who are about to enrol in or have already completed one or more years of an approved course leading to professional qualifications in fuel. The awards are unbonded. Applications giving age, details of previous education, examination record and the names of two referees should reach the Honorary Secretary, The Institute of Fuel (Australian Membership), Box 169 P.O., Chatswood, N.S.W. 2067, by 1st February.

James Howden Scholarship in Fuel Engineering

James Howden & Co. provide one scholarship for students who are British subjects and qualified to enter the first or any later year of the full-time BE course in Chemical Engineering with Fuel Electives. The scholarship has a value of \$300 per annum and is normally tenable for one year but may be extended subject to satisfactory progress in the course and availability of funds.

John Strevens' Fuel Engineering Scholarship

Mr. John Strevens offers a scholarship to the value of \$300, on the basis of academic merit and personality, for students who are British subjects and have met University requirements for admission to any year of the full-time BE course in Fuel Engineering (with Fuel Engineering electives). The scholarship is normally tenable for one year, but application for extensions will be considered subject to satisfactory progress in the course and the availability of funds.

Waste Disposal Conference Committee Scholarships in Fuel Engineering

The Waste Disposal Conference Organizing Committee provides each year two scholarships of \$300 each for students eligible to enter any year of the full-time BE course in Chemical Engineering with fuel electives. The scholarships are normally tenable for one year but may be extended subject to satisfactory progress in the course and availability of funds.

School of Metallurgy Scholarships

Staff members of the School of Metallurgy have undertaken to provide finance for the establishment of undergraduate scholarships in Metallurgy. The scholarships, which are tenable at the University of New South Wales for students wishing to enrol in the first year of the full-time course for the degree of BSc (pass and honours) in Metallurgy, are tenable for four years. Each scholarship has a value of \$500 per annum. In awarding the scholarships the academic merit and personality of the applicant and his interest in a career in metallurgy will be taken into account.

C.I.G.-E.M.F. Scholarships in Metallurgy

The Commonwealth Industrial Gases Ltd. provides scholarships tenable at the University of New South Wales for students wishing to enrol in the full-time course for the BSc degree in Metallurgy. The scholarships are tenable for a maximum of four years, and have a value of \$600 per annum payable in fortnightly instalments as a living allowance.

Conzinc Riotinto of Australia Ltd.

The Company offers each year scholarships for students wishing to qualify for the degree of Bachelor of Science in Metallurgy or Bachelor of Engineering in Mining Engineering.

Metal Manufactures Clement Blazey Memorial Scholarship in Metallurgy

Metal Manufactures Ltd. of Port Kembla provide the Clement Blazey Memorial Scholarships for students enrolling in the full-time course in Metallurgy leading to the Degree of Bachelor of Science. A scholarship is offered in each alternate year and has a value of \$650 per annum payable to students as a living allowance. It is normally tenable for four years.

Mining and Metallurgical Bursaries

The Trustees of the Mining and Metallurgical Bursaries Fund offer bursaries to the value of \$100 to full-time students who are British subjects and who intend to enter the mining and metallurgical industries, and who have completed, at least, the first year of bachelor degree courses in Geology, Mining Engineering or Metallurgy. The bursaries are tenable for one year, although the same student may receive an award in successive years of his course. Closing date for applications is 31st March, and they must be lodged with the Head of the School of Mining Engineering, Metallurgy or Applied Geology.

Stan Sawyer Memorial Scholarship for Coal Mining Students

The Colliery Managers' Association of New South Wales provides one scholarship in Mining Engineering for students eligible to enter the third or fourth years of the course. Conditions for the Scholarship, which has a value of \$200 per annum, are at present under review.

Textile Technology Scholarships

The textile companies listed below have undertaken to provide a number of scholarships for students wishing to enrol in courses leading to the degree of Bachelor of Science (Pass and Honours) in Textile Technology: Bradmill Industries Ltd., Bond's Industries Ltd., F. & T. Industries (Aust.) Ltd., Fibremakers Ltd. and Prince-Smith and Stells Ltd. Each scholarship has a value of \$1,000 per annum.

Wool and Pastoral Sciences Scholarships

Several firms and banks associated with the wool industry endow scholarships in courses leading to the Bachelor of Science degree in Wool and Pastoral Sciences. They are: Merck Sharp & Dohme (Aust.) Pty. Ltd., the Commercial Banking Company of Sydney Ltd., the National Council of Wool Selling Brokers of Australia and The Australian Estates Co. Ltd. Valued at \$1,000 per annum, these scholarships are normally tenable for four years.

Wool Research Trust Fund Scholarships in Wool and Pastoral Sciences and Textile Technology

Two scholarships for the course in Wool and Pastoral Sciences and eight for the course in Textile Technology may be made available by the Wool Research Trust Fund (Commonwealth Government). The scholarships provide an allowance of \$1,000 per annum for living expenses for four years.

Shell Refining (Australia) Pty. Ltd. Scholarship in Chemical Engineering

This scholarship has a value of \$400 per annum. It is available to full-time students who have successfully completed the first year or its equivalent of the BE course in Chemical Engineering.

OTHER FINANCIAL ASSISTANCE

In addition to the Tertiary Allowances Scheme financed by the Australian Government (see **Scholarships** for details), the following forms of assistance are available.

- (a) The Students' Union and the University have co-operated to provide assistance to students who are in financial difficulties which are considered likely to prejudice their progress with their studies.

Three main forms of assistance are available:

1. *Deferment of Payment of Fees*

Deferments may be granted for a short period, usually one month, without the imposition of a late fee penalty, provided the deferment is requested prior to the due date for fee payments.

In exceptional circumstances the University may consider granting deferments for up to twelve months or even longer. In cases where payment is deferred to 31st December, examination results will not be published or made available until such time as the outstanding fees are paid. Where deferments are granted to a date beyond 31st December, the University may require the student to enter into a formal agreement to repay the fees.

2. *Short Term Cash Loans*

Donations from the Students' Union, the University Union and other sources have made funds available for urgent cash loans not exceeding \$100. These loans are normally repayable within one month.

3. *Long Term Cash Loans*

An amount of up to \$300 is available from this fund, repayable usually after twelve months or within twelve months of graduation or upon withdrawal from the course. This scheme is funded jointly by the University and the Students' Union. Students are required to enter into a formal agreement with the University to repay such a loan.

- (b) Early in 1973 the Australian Government made funds available to the University to provide loans to students in financial difficulty. The loans are to provide for living allowances and other approved expenses associated with attendance at University. Under this scheme allowances are paid approximately monthly during the academic year. Repayment usually commences after twelve months of graduation or upon withdrawal from the course. Students are required to enter into a formal agreement with the University to repay the loan.

From the same source of funds as mentioned in the preceding paragraph students who are in extremely difficult financial circumstances may apply for assistance by way of non-repayable grant. In order to qualify for a grant a student must generally show that the financial difficulty has arisen from misfortune beyond his control.

Applications for all forms of assistance may be made personally to the Deputy Registrar (Student Services).

Financial Assistance to Aboriginal Students

Financial assistance is available from a number of sources to help Aboriginal students. Apart from the Australian Government's Tertiary Allowances Scheme, to be introduced in 1974, there is a Commonwealth Aboriginal Study Grant Scheme. Furthermore, the University may assist Aboriginal students with some essential living expenses in exceptional circumstances.

All enquiries relating to this scheme should be directed to the Deputy Registrar (Student Services).

PRIZES

Undergraduate prizes awarded by the University are summarized in the Calendar.

UNDERGRADUATE COURSES

The Faculty of Applied Science consists of the Schools of Applied Geology, Chemical Engineering, Chemical Technology, Geography, Metallurgy, Mining Engineering, Textile Technology and Wool and Pastoral Sciences. 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 degree of Bachelor of Science (Technology) or Bachelor of Science (Engineering).

Full-Time Courses

Full-time courses of four years' duration leading to the degree of Bachelor of Science are offered in Applied Geography, Applied Geology, Ceramic Engineering, Food Technology, Industrial Chemistry, Metallurgy, Textile Technology and Wool and Pastoral Sciences. Four-year courses leading to the degree of Bachelor of Engineering are offered in Chemical Engineering and Mining Engineering.

Honours: Candidates for honours are required to undertake special reading and other assignments as directed by the Head of the School concerned. In considering the award of Honours special attention is paid to the performance of a candidate in the final research project, for which a thesis describing a theoretical or experimental study is required. Honours are awarded in Class I, Class II division (I), and Class II division (II).

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 programme 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 programme of practical training of at least 100 days.

Part-Time Courses

Six-year, part-time courses leading to the degree of Bachelor of Science (Technology) are offered in Chemical Engineering and Food Technology by the School of Chemical Engineering; in Ceramics and Industrial Chemistry by the School of Chemical Technology; in Metallurgy by the School of Metallurgy; and in Mineral Processing by the School of Mining Engineering (at Broken Hill only). The part-time Mining Engineering course leading to the degree of Bachelor of Science (Engineering) is available at Broken Hill and Wollongong.

Students who qualify for the BSc(Tech) degree in the Faculty of Applied Science and who wish to proceed to 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 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) and BSc(Eng) courses, but one of the conditions for the award of the BSc(Tech) and BSc(Eng) degrees is that at least three years of approved industrial experience be gained before graduation. This requirement will apply to students transferring from full-time courses.

BSc(Tech) and BSc(Eng) Courses With Partial Full-Time Attendance

BSc(Tech) and BSc(Eng) courses may be completed by a combination of full-time and part-time study. The first two stages are to be completed part-time; in the following two years students complete the second and third years of the corresponding full-time course; and in the fifth stage a special programme is prepared. Full details are set out below under the Schools which provide the courses.

General Studies Programme

Almost all undergraduates in Faculties other than Arts and Law are required to complete a General Studies programme. The only course in the Faculty of Applied Science which does not have this requirement is the new Bachelor of Science course in Economic Geography commencing in 1974.

The Department of General Studies publishes its own Handbook which is available free of charge. All details regarding General Studies courses and requirements are contained in it, and students are advised to obtain a copy. All enquiries about General Studies should be made to the General Studies Office, Room G15, Morven Brown Building (663-0351 Extn. 2091).

General Rules for Progression

1. Course programmes will be stated and timetabled by year and by stage.

2. Students must satisfy the rules governing re-enrolment, particularly those requiring that all first-year subjects must be completed by the end of two years full-time or four years part-time study.

3. Before being permitted to enrol in any subject, students must satisfy the relevant pre-requisite subject requirements. Normally this will necessitate students attempting to satisfy requirements of subjects of a particular year or stage before proceeding to subjects in the next part of the course. Details of pre-requisite subjects, co-requisite subjects and any special rules governing progression in particular courses should be obtained from the relevant school.

4. Only in exceptional circumstances will students be permitted to enrol in subjects extending over more than two years of a full-time course, or two stages of a part-time course, or for more than 28 hours of course work per week if full-time or 14 hours per week if part-time. Students repeating subjects are required to select a programme with the approval of the Head of School which limits their hours of course work to 24 hours per week if full-time and 12 hours per week if part-time. Extension of these hours will need the special permission of the Head of School.

5. Students shall enrol in courses as full-time students or in those Schools offering part-time courses as part-time students. Transference between full-time and part-time courses will be permitted once only. Students who transfer will be expected to remain in their new course until the completion of all academic and practical requirements of that course.

6. Notwithstanding the above, students can enrol in any non-standard programme only with permission of the Head of School. A non-standard programme is one that involves enrolment in subjects from more than one year, or two stages, or which comprises subjects which do not normally constitute a particular year's course work.

SCHOOL OF APPLIED GEOLOGY

The development of natural resources necessitates a type of training for geologists which embraces basic geological instruction and various features of its application in practice. The structure and syllabus of the course in Applied Geology are designed to enable graduates to enter immediately into various aspects of applied geology and to play an effective part in associated engineering and technological practice.

In the early part of the course students receive instruction in the allied fundamental sciences as well as in introductory geology. Later geological instruction is developed and emphasis is placed progressively on engineering applications and on economic aspects of geology.

The applied nature of the course is indicated by the inclusion of such subjects as Geomechanics, Mining, and Mineral Process Engineering. Courses in Surveying, Geophysics, Exploration and Mining Geology, Engineering Geology and Petroleum Geology are added to the basic geology subjects in the later stages of the course. It is also recommended that before graduation students obtain a minimum of eight weeks' professionally oriented, or industrial, experience.

Attendance at the University for students taking the full-time professional course in Applied Geology is for twenty-eight weeks per year on the basis of two sessions of fourteen weeks each. The second session of the fourth year is devoted to work on a project.

A three-year course (full-time) and a seven-year course (part-time) are also available to students in the Faculty of Science. Selected students in the Faculty of Science may read for an honours degree in Geology.

In order to meet the demands for trained Geophysicists in the Commonwealth a Graduate Diploma course in Applied Geophysics is offered.

A Master of Applied Science course in Hydrogeology-Engineering Geology has also been instituted to train people to deal with the problems of underground water supply.

300. Applied Geology—Full-Time Course Bachelor of Science

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 1					
25.001	Geology I*	3	3	3	3
1.001	Physics I <i>or</i>	3	3	3	3
1.011	Higher Physics I }				
2.001	Chemistry I	2	4	2	4
10.001	Mathematics I <i>or</i>				
10.011	Higher Mathematics I	4	2	4	2
		<hr/>	<hr/>	<hr/>	<hr/>
		12	12	12	12
		<hr/>	<hr/>	<hr/>	<hr/>

* Three field tutorials, involving up to five days in all, are an essential part of the course. Attendance is compulsory.

YEAR 2

25.002	Geology II†§	5	4	4	5
1.112A	Physics II <i>and</i> }	2	—	5	3
1.112C	Physics II }				
1.212	Physics IIT (units B and C)	1½	1½	1½	1½
2.022	Chemistry II (M)	3	2½	3	2½
	General Studies Elective	1	½	1	½
plus one of the following:					
5.010	Engineering A* <i>and</i> }	4	2	—	—
5.020	Engineering B* }				
10.111A	Pure Mathematics II† <i>and</i> }	4	—	4	—
10.111B	Pure Mathematics II† }				
10.211A	Applied Mathematics II†	2/6	—	6/2	—
10.211B	Applied Mathematics II†				
10.211C	Applied Mathematics II†				
17.011	Human Biology* <i>and</i> }	4	2	—	—
17.021	Comparative Functional Biology*				
27.001	Applied Geography I	2	4	2	4

* One session only.

† Attendance is compulsory at field tutorials, to which approximately 14 days will be devoted during the year.

§ Prerequisites: 25.001 Geology I and 2.001 Chemistry I.

‡ If 10.111 or 10.211 is taken, the totals for Lec. and Lab./Tut. vary slightly depending on the parts selected. The basic second-year mathematics course consists of the *three* units 10.111A, 10.111B and 10.211A. Students contemplating a mathematics option are advised to consult an enrolment officer from the School of Mathematics.

		Hours per week			
		SESSION 1		SESSION 2	
		Lab.		Lab.	
YEAR 3		Lec.	Tut.	Lec.	Tut.
25.003	Geology III*†	6	6	6	6
25.023	Geology III (Applied)† 	5	6	5	6
	Two General Studies				
	Electives	2	1	2	1
		<hr/> 13	<hr/> 13	<hr/> 13	<hr/> 13

‡ Field work is an essential part of the course and consists of ten days of field tutorials.

|| A geological surveying camp of 10 days' duration is held in the May vacation.

* Prerequisites: 25.002 Geology II

† Corequisites: 25.003 Geology III.

YEAR 4*

7.023	Mining and Mineral Process Engineering	2	2	0	0
25.0041	Geology IV, Adv. Applied Geology	6	3	0	0
25.0045	Geology IV, Project	0	0	0	30
	General Studies Elective	2	1	0	0

Plus one of the following:

25.0042	Geology IV, Engineering Geology	5	5	0	0
25.0043	Geology IV, Mineral Exploration	5	5	0	0
25.0044	Geology IV, Sedimentary Basins	5	5	0	0

* Session 2 is devoted to field and laboratory work on a project.

SCHOOL OF CHEMICAL ENGINEERING

The School of Chemical Engineering consists of the Departments of Biological Process Engineering, Chemical Engineering, Food Technology and Fuel Technology. The course in Chemical Engineering contains a number of electives in technical areas, including Biological Process Engineering and Fuel Engineering.

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.

Biological Process Engineering is the extension of chemical engineering principles to systems involving biological materials. Typical areas of interest are: the manufacture of antibiotics; the fermentation industries; bacterial mineral extraction; and the production of industrially useful materials by the growth and utilisation of micro-organisms.

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.

Food Technology is concerned with the management of foods from the time of production until they reach the consumer. It is the responsibility of the food technologist to see that foods do not spoil or perish. This covers handling, transportation, storage and packaging of fresh and prepared foods and the techniques for preservation such as cold storage, freezing, canning, dehydration and packaging.

For the award of honours, 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 recommended that before graduation students in the full-time courses obtain a minimum of eight weeks' professionally oriented, or industrial, experience. Students in the part-time courses must complete three years of industrial training concurrently with their University work.

DEPARTMENT OF CHEMICAL ENGINEERING

304. Chemical Engineering—Full-Time Course Bachelor of Engineering

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 course is accepted by the Council of Engineering Institutions, U.K., the Institution of Engineers, Australia, and the Royal Australian Chemical Institute as sufficient qualification for corporate membership.

		Hours per week			
		SESSION 1		SESSION 2	
		Lab.		Lab.	
YEAR 1		Lec.	Tut.	Lec.	Tut.
1.001	Physics I	3	3	3	3
2.001	Chemistry I	2	4	2	4
5.010	Engineering A	4	2	—	—
5.030	Engineering C	—	—	3	2
10.001	Mathematics I <i>or</i> }	4	2	4	2
10.011	Higher Mathematics I }				
		13	11	12	11
YEAR 2					
2.002A	Physical Chemistry	3	3	0	0
2.002B	Organic Chemistry	0	0	3	3
2.002C	Inorganic Chemistry	0	0	2	4
3.111	Chemical Engineering Principles I	2	0	1	2
3.112	Chemical Engineering Material Balances and Thermodynamics	1	2	1	2
8.112	Materials and Structures	1	2	1	2
10.031	Mathematics	1	1	1	1
10.331	Statistics SS	1	1	1	1
	Two General Studies Electives	2	1	2	1
		11	10	12	16

YEAR 2 (Cont.)	Hours per week			
	SESSION 1		SESSION 2	
	Lec.	Lab. Tut.	Lec.	Lab. Tut.
Plus one of the following Electives:				
3.311 Fuel Engineering I	1½	½	1½	½
4.031 Physics of Metals	1	2	1	0
25.201 Mineralogy	1	1	1	1
44.111 Microbiology	1	2	1	2

YEAR 3

3.121 Chemical Engineering Principles II	5	6	0	3
3.122 Chemical Engineering Thermodynamics and Reaction Engineering	3	1	1	1
3.123 Chemical Engineering Design I A and B	2	0	7	5
3.124 Chemical Engineering Design and Practice*				
6.801 Electrical Engineering	1	2	1	2
10.032 Mathematics	1	1	1	1
General Studies Elective	1	½	1	½

Plus one of the following electives:

2.221 Chemistry and Enzymology of Foods	1	3	1	3
3.321 Fuel Engineering II	2	1	2	1
4.121 Principles of Metal Extraction	3	0	3	0
18.121 Production Management	3	0	3	0
22.113 Industrial Chemistry Processes†	1½	2½	1½	2½

Any Year 2 elective not previously studied‡

* The hours for this subject, which is normally conducted throughout the year, cannot be predetermined.

† Less factory visits. These are part of 3.123 Chemical Engineering Design 1A and B.

‡ Students taking a Year 2 elective at this point may prejudice their honours degree.

YEAR 4		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
3.131	Chemical Engineering Principles III	3	0	1	0
3.132	Chemical Engineering Process Dynamics and Control ..	1½	3½	1½	3½
3.133	Chemical Engineering Design II	4	4	0	0
	General Studies Advanced Elective	1	½	1	½
	Project	0	1	0	11
		9½	9	3½	15

The project to be selected from the following:

- 3.140 Chemical Engineering Design Project
- 3.150 Chemical Engineering Experiment Project
- 3.240 Food Technology Project
- 3.340 Fuel Engineering Project
- 3.440 Biological Process Engineering Project

Plus *one or more* of the following electives to a total of 7 hrs/week for 28 weeks.

3.134	Advanced Chemical Engineering Principles*	2	2	2	2
3.135	Chemical Engineering Practice*	2	1	2	1
3.136	Oil and Gas Engineering	3	0	3	0
3.233	Food Technology	4	3	4	3
3.331	Fuel Engineering III	2	2	2	0
3.332	Fuel Engineering IV	2	4	2	0
3.411	Biological Process Engineering	4	3	4	3
7.314	Mineral Processing I†	6	0	6	0
18.551	Operations Research	3	0	3	0
23.051	Nuclear Power Technology	3	0	3	0
	Any Year 2 or Year 3 elective not previously studied.‡				

* Students taking 3.134 must also take 3.135 and vice versa.

† Students choosing this elective must also take 7.023 Mining and Mineral Process Engineering, Part II (2 hours per week in Session I).

‡ Students taking Year 2 or Year 3 electives at this point may prejudice their honours degree.

305. Chemical Engineering—Part-Time Course Bachelor of Science (Technology)

This course, which extends over six years of part-time study, covers approximately the same subject matter as the first three years of the full-time course, and is designed to meet the requirements of students who are employed in the chemical processing industries.†

† See page B13 for outline of this course involving combined full-time and part-time study.

Students who have completed the requirements of this course qualify for the degree of Bachelor of Science (Technology) and may proceed to the degree of Bachelor of Engineering by attending for one full-time year and completing the subjects listed in the fourth year of the full-time course. Students desiring to proceed to a Bachelor of Engineering degree must apply to the Head of the School not later than December 31 of the year in which the sixth stage is completed.

The BSc(Tech) degree is recognized by the Institution of Engineers, Australia, and the Royal Australian Chemical Institute, as sufficient qualification, and by the Institution of Chemical Engineers, U.K., as partial qualification, for corporate membership.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
STAGES 1 and 2*					
1.001	Physics I	3	3	3	3
2.001	Chemistry I	2	4	2	4
5.010	Engineering A	4	2	—	—
5.030	Engineering C	—	—	3	2
10.001	Mathematics I <i>or</i>				
10.011	Higher Mathematics I†	4	2	4	2
		<u>12</u>	<u>12</u>	<u>12</u>	<u>12</u>

* Two of the subjects listed will be taken in the first year and the other two in second year (as directed).

† There will be no evening lectures in this subject.

STAGE 3

2.002A	Physical Chemistry	3	3	0	0
2.002B	Organic Chemistry	0	0	3	3
2.002C	Inorganic Chemistry	0	0	2	4
10.031	Mathematics	1	1	1	1
	Two General Studies				
	Electives	2	1	2	1
		<u>6</u>	<u>5</u>	<u>8</u>	<u>9</u>

STAGE 4

3.111	Chemical Engineering Principles I	2	0	1	2
3.112	Chemical Engineering Material Balances and Thermodynamics	1	2	1	2
8.112	Materials and Structures	1	2	1	2
10.331	Statistics SS	1	1	1	1
		<u>5</u>	<u>5</u>	<u>4</u>	<u>7</u>

Hours per week			
SESSION 1		SESSION 2	
Lab.		Lab.	
Lec.	Tut.	Lec.	Tut.

Plus one of the following
Electives:

3.311	Fuel Engineering I	1½	½	1½	½
4.031	Physics of Metals	1	2	1	0
25.201	Mineralogy	1	1	1	1
44.111	Microbiology	1	2	1	2

STAGE 5

3.122	Chemical Engineering Thermodynamics and Reaction Engineering	3	1	1	1
3.1231	Chemical Engineering Design IA	2	0	2	2
6.801	Electrical Engineering	1	2	1	2
10.032	Mathematics	1	1	1	1
		7	4	5	6

Plus one of the following
Electives:

2.221	Chemistry and Enzymology of foods	1	3	1	3
3.321	Fuel Engineering II	2	1	2	1
4.121	Principles of Metal Extraction	3	0	3	0
18.121	Production Management	3	0	3	0
22.113	Industrial Chemistry Processes*	1½	2½	1½	2½
Any Year 2 Elective not previously studied.					

* Less factory visits. These are part of 3.123 Chemical Engineering Design 1A and B.

STAGE 6

3.121	Chemical Engineering Principles II	5	6	0	3
3.1232	Chemical Engineering Design IB	0	0	5	3
3.124	Chemical Engineering Design and Practice*				
	General Studies Elective	1	½	1	½
		6	6½	6	6½

* The hours for this subject, which is normally conducted throughout the year, cannot be predetermined.

305. Chemical Engineering BSc(Tech) in Full-Time—Part-Time Study

Students enrolling in the Chemical Engineering, BSc(Tech) course may reduce the time required for completion by undertaking the following programme of combined part-time/full-time study:

- Stage 1 Part-time (as for BSc(Tech) course above)
- Stage 2 Part-time (as for BSc(Tech) course above)
- Stage 3A Full-time (as for second year of full-time BE course above)
- Stage 4A Full-time (as for third year of full-time BE course above)
- Stage 5A Part-time (as set out below)

STAGE 5A*

A programme of 6-9 hours per week selected from the following subjects on the advice of the Head of the School of Chemical Engineering:

- 3.321 Fuel Engineering II
- 4.011 Metallurgy I
- 7.314 Mineral Processing I†
- 22.112 Industrial Chemistry II
- 22.211 Ceramics I
- 22.311 Polymer Science I
- 44.111 Microbiology

Any other subject approved by the Professorial Board on the recommendation of the Head of School or Department.

* This course is subject to revision.

† Students choosing this elective must also take 7.023 Mining and Mineral Process Engineering, Part II (2 hours per week in Session 1).

DEPARTMENT OF BIOLOGICAL PROCESS ENGINEERING

Biological Process Engineering at the undergraduate level is a course in Chemical Engineering with electives in the areas of microbiology and biological process engineering.

304. Chemical Engineering with Biological Process Engineering Electives—Full-Time Course—Bachelor of Engineering

Year 1 is the same as for the Chemical Engineering course; Years 2, 3 and 4 are also the same as for the corresponding years in Chemical Engineering, but in Year 2 the appropriate elective is 44.111 Microbiology; in Year 3 it is 2.221 Chemistry and Enzymology of Foods; and in Year 4 3.411 Biological Process Engineering, plus 3.440 Biological Process Engineering Project.

Successful completion of this course is sufficient qualification for corporate membership of the Institution of Engineers, Australia, the Royal Australian Chemical Institute, and the Institution of Chemical Engineers, U.K.

DEPARTMENT OF FUEL TECHNOLOGY

This Department, the first of its kind in Australia, was established to meet the growing need of Australian industrial and research establishments for graduates trained in the science and technology of fuels and their utilization.

One constant problem of the fuel industries is that of improving and developing methods of processing and using solid, liquid and gaseous fuels to meet the continuously shifting patterns of demand. It is in this field of activity that the university-trained fuel technologist has a most important part to play.

In Australia, there is a growing need for people trained in the technology of fuels, and opportunities for employment and advancement of fuel engineers are therefore particularly good.

Many exciting and revolutionary possibilities are apparent in the fuel and energy conversion industries, and there is a wide and varied field of activity which offers opportunity and challenge in the application of chemistry, physics and engineering to the problems of Fuel Science and Engineering, Combustion Engineering and Environmental Pollution Control. Opportunities for postgraduate studies and research for higher degrees in these areas are wide-ranged and interesting.

The Council of the Institute of Fuel has accepted the degree courses in Chemical Engineering with the fuel electives as providing exemption from the examination required for admission to corporate membership of the Institute. In addition, the fuel subjects in the course, if taken separately, carry exemption from the advanced fuel subjects of the London City and Guilds Institute, conducted on behalf of the Institute of Fuel, and are thus a recognized qualification for admission to corporate membership.

Successful completion of the BE course in Chemical Engineering with fuel electives is accepted by the Council of Engineering Institutions, U.K., the Royal Australian Chemical Institute, and the Institution of Engineers, Australia, as sufficient qualification for corporate membership.

304. Chemical Engineering with Fuel Electives—Full-Time Course—Bachelor of Engineering

Fuel Engineering is essentially a course in Chemical Engineering with an orientation to the fuel and energy conversion and utilization industries. This course is available as an elective option in the Chemical Engineering BE degree. Year 1 is the same as for the Chemical Engineering course; Years 2, 3 and 4 are also the same as for the corresponding years in Chemical Engineering, but in Year 2 the appropriate elective is 3.311 Fuel Engineering I; and in Year 3 it is 3.321 Fuel Engineering II. In Year 4, 3.331 Fuel Engineering III or 3.332 Fuel Engineering IV or 3.340 the Fuel Engineering Project can be taken.

The final year is devoted entirely to professional subjects which cover refractories and insulating materials, constitution, processing and utilization of fuels, flames and gas reactions, progress and developments in fuel science and fuel and combustion engineering. The latter includes the design, construction and performance evaluation of boilers and furnaces, instrumentation and automatic control.

DEPARTMENT OF FOOD 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. He studies foods 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 responsi-

bility for the quality and safety of man's 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 of Food Technology offers a four-year, full-time course leading to the degree of Bachelor of Science and a six-year part-time course leading to 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.

306. Food Technology—Full-Time Course Bachelor of Science

This course is designed to provide depth and breadth in the relevant physical and biological sciences on which food technology is based. Graduates will be able to pursue more advanced studies in any of these sciences.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 1					
1.001	Physics I	3	3	3	3
2.001	Chemistry I	2	4	2	4
10.001	Mathematics I <i>or</i>				
10.011	Higher Mathematics I	4	2	4	2
17.011	Human Biology	4	2	—	—
17.021	Comparative Functional Biology	—	—	2	4
		13	11	11	13
YEAR 2					
2.002A	Physical Chemistry	3	3	0	0
2.002B	Organic Chemistry	0	0	3	3
2.002C	Inorganic Chemistry	0	0	2	4
3.201	Food Technology I	1	2	1	2
10.031	Mathematics	1	1	1	1
41.101	Biochemistry I (Units A and B)	4	8	0	0
44.101	Introductory Microbiology	0	0	2	4
	General Studies Elective	1	$\frac{1}{2}$	1	$\frac{1}{2}$
		10	14 $\frac{1}{2}$	10	14 $\frac{1}{2}$

YEAR 3

2.261	Chemistry and Enzymology of Foods	2	4	2	4
3.211	Food Technology II	2	4	1	2
3.212	Food Technology III	0	0	4	8
3.231	Food Engineering I	2	1	2	1
10.331	Statistics SS	1	1	1	1
44.142	Microbiology	2	4	0	0
	General Studies Elective	1	$\frac{1}{2}$	1	$\frac{1}{2}$
		<u>10</u>	<u>14$\frac{1}{2}$</u>	<u>11</u>	<u>16$\frac{1}{2}$</u>

YEAR 4

3.221	Food Technology IV	3	4	3	4
3.250	Project	0	8	0	8
	General Studies Elective	1	$\frac{1}{2}$	1	$\frac{1}{2}$
	General Studies Advanced Elective	1	$\frac{1}{2}$	1	$\frac{1}{2}$
		<u>5</u>	<u>13</u>	<u>5</u>	<u>13</u>

Plus one or more of the following electives to a total of not less than 6 hrs/week

2.003B	Organic Chemistry	2	4	2	4
3.232	Food Engineering II	3	0	3	0
18.121	Production Management	3	0	3	0
18.551	Operations Research	2	1	2	1
28.012	Marketing Models	3	1	—	—
28.022	Marketing Systems	—	—	2	2
41.102A	Biological Macromolecules and Cell Biochemistry	3	9	0	0
41.102B	Metabolic Pathways and Control Mechanisms	0	0	3	9
42.102	Fermentation Technology	0	0	2	4

—or such other electives, to a total of not less than 6 hrs/week, as approved by the Head of School

During the second, third and fourth years of the course excursions will be made to various food industries. Detailed reports of some of these visits are required.

A detailed report of the student's activities during his period in industry will be required, and will be taken into account in the classification for the Honours list.

307. Food Technology—Part-Time Course Bachelor of Science (Technology)

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 degree of Bachelor of Science (Technology). A minimum of three years' concurrent industrial training is required before graduation.

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 degree of Bachelor of Science (Technology) may proceed to the degree of Bachelor of Science by attending for one full-time year and completing the subjects listed in fourth year of the full-time course. Students desiring to proceed to a BSc degree must apply to the Head of the School not later than December 31 of the year in which the sixth stage is completed.

		Hours per week			
		SESSION 1		SESSION 2	
		Lab.		Lab.	
STAGES 1 and 2*		Lec.	Tut.	Lec.	Tut.
1.001	Physics I	3	3	3	3
2.001	Chemistry I	2	4	2	4
10.001	Mathematics I or	4	2	4	2
10.011	Higher Mathematics I†				
17.011	Human Biology	4	2	—	—
17.021	Comparative Functional Biology	—	—	2	4
		13	11	11	13

* Two of the subjects listed will be taken in first year and the other two in second year (as directed).

† There will be no evening lectures in this subject.

STAGE 3

2.002A	Physical Chemistry	3	3	0	0
2.002B	Organic Chemistry	0	0	3	3
2.002C	Inorganic Chemistry	0	0	2	4
10.031	Mathematics	1	1	1	1
	Two General Studies Electives	2	1	2	1
		6	5	8	9

		Hours per week			
		SESSION 1		SESSION 2	
		Lab.		Lab.	
STAGE 4		Lec.	Tut.	Lec.	Tut.
3.201	Food Technology I	1	2	1	2
41.101	Biochemistry I (Units A and B)	4	8	0	0
44.101	Introductory Microbiology	0	0	2	4
		<u>5</u>	<u>10</u>	<u>3</u>	<u>6</u>

STAGE 5

2.261	Chemistry and Enzymology of Foods	2	4	2	4
3.211	Food Technology II	2	4	1	2
3.213	Food Engineering I	2	1	2	1
		<u>6</u>	<u>9</u>	<u>5</u>	<u>7</u>

STAGE 6

3.212	Food Technology III	2	0	2	8
10.331	Statistics SS	1	1	1	1
44.142	Microbiology	2	4	0	0
	General Studies Elective	1	$\frac{1}{2}$	1	$\frac{1}{2}$
		<u>6</u>	<u>5$\frac{1}{2}$</u>	<u>4</u>	<u>9$\frac{1}{2}$</u>

307. Food Technology BSc(Tech) in Full-Time/Part-Time Study

Students enrolling in the Food Technology BSc(Tech) course may reduce the time required for completion by undertaking the following programme of combined part-time/full-time study:

- Stage 1..... Part-time (as for BSc(Tech) course above)
- Stage 2..... Part-time (as for BSc(Tech) course above)
- Stage 3A..... Full-time (as for second year of full-time BSc course above)
- Stage 4A..... Full-time (as for third year of full-time BSc course above)
- Stage 5A..... Part-time (a programme of 6-9 hours per week selected from undergraduate subjects on the advice of the Head of the School).

SCHOOL OF CHEMICAL TECHNOLOGY

Courses are offered on a four-year, full-time basis in the fields of Industrial Chemistry and Ceramic Engineering leading to the award of the degree of Bachelor of Science. Six-year part-time courses are also available in Industrial Chemistry and Ceramics.

Polymer Science options in the Industrial Chemistry course are provided for students with a particular interest in organic and physical chemistry who wish to make a study of macromolecules — natural and synthetic resins, plastics and elastomers.

It is recommended that before graduation students in the full-time courses obtain a minimum of eight weeks' professionally oriented, or industrial, experience. Students in the part-time courses must complete three years of industrial training concurrently with their University work.

DEPARTMENT OF INDUSTRIAL CHEMISTRY

The courses in Industrial Chemistry are designed to provide scientists trained for industries and organisations concerned with the development, manufacture and use of inorganic and organic industrial chemicals. Graduates from these courses will play an effective role in the research and development, production control, quality control and technical sales and service aspects of the chemical industries.

Arrangements have been made with Wollongong University College for students who have completed a specified programme to be admitted with advanced standing to Year 3 of the Industrial Chemistry course at the University of New South Wales.

DEPARTMENT OF CERAMIC ENGINEERING

The Department of Ceramic Engineering offers courses designed to provide scientists and engineers fitted for service in industries and organisations concerned with the development, manufacture and use of materials in the fields of: whitewares, structural ceramic productions, high-temperature materials,

electrical ceramics, glass, ceramic surface coatings, abrasives, cermets and nuclear ceramics. Graduates from these courses would be able to find employment in the general field of ceramics in the following capacities: ceramist or ceramic engineer on research and development, production control, quality control, product evaluation, technical sales and service.

Arrangements have been made with the University of Newcastle and the Wollongong University College for students who have completed a specified programme at these institutions to be admitted with advanced standing to Year 3 of the Ceramic Engineering course at the University of New South Wales.

DEPARTMENT OF POLYMER SCIENCE

The Department of Polymer Science provides options in the Industrial Chemistry courses and supervises Honours Projects which Industrial Chemistry students may elect to take. The options introduce Industrial Chemistry students to the basic principles of polymer chemistry and polymer physics, giving them a familiarity with the surface coatings, plastics and rubber industries.

Students wishing to receive an intensive training in polymer science are advised, on graduation, to enrol in the Graduate Diploma course in Polymer Technology.

310. Industrial Chemistry—Full-Time Course Bachelor of Science

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
YEAR 1			
1.001	Physics I	3	3
2.001	Chemistry I	2	4
10.001	Mathematics I <i>or</i>	4	2
10.011	Higher Mathematics I }		
<i>Plus one of:—</i>			
5.010	Engineering A*† <i>and</i>	3	2
5.030	Engineering C*†	4	2
17.011	Human Biology* <i>and</i>	4	2
17.021	Comparative Functional Biology*	2	4
25.111	Geoscience I‡	2	4

* One session only.

† Chemical Technology students take Introduction to Systems and Computers in 5.030 and Materials in 5.010.

‡ Three field excursions, up to five days in all, are an essential part of the course.

		Hours per week			
		SESSION 1		SESSION 2	
		Lab.		Lab.	
YEAR 2		Lec.	Tut.	Lec.	Tut.
1.212	Physics IIT (Unit B)*	1½	1½	0	0
2.311	Physical Chemistry	1½	3	1½	3
2.411	Inorganic Chemistry	1	2	1	2
2.611	Organic Chemistry	1½	3	1½	3
10.031	Mathematics	1	1	1	1
10.331	Statistics SS	1	1	1	1
22.112	Chemical Process Equipment	1	0	1	0
22.122	Instrumental Analysis	1	2	1	2
	General Studies Elective	1	½	1	½
		10½	14	9	12½

* 14 weeks' course.

YEAR 3*

2.622	Organic Chemistry	2	4	0	0
3.111	Chemical Engineering Principles I	2	0	1	2
3.311	Fuel Engineering I	1½	½	1½	½
18.551	Operations Research	2	1	2	1
22.113	Industrial Chemistry Processes	1½	2½	1½	2½
22.123	Chemical Thermodynamics and Kinetics	1½	1½	1½	1½
22.133	Data Processing	0	0	2	2
22.153	Material and Energy Balances	1	2	0	0
	Two General Studies Electives	2	1	2	1
		13½	12½	11½	10½

* Students who have completed a specified programme at Wollongong University College will be admitted with advanced standing to Year 3 at this University.

Options: With the approval of the Head of School, students may substitute 22.313 Polymer Processes, 22.323 Physical Chemistry of Polymers I and 22.333 Polymer Physics I for 22.153 Material and Energy Balances, 3.311 Fuel Engineering I and the Inorganic Industrial Chemistry lectures and the laboratory assignments of 22.113 Industrial Chemistry Processes.

YEAR 4	Hours per week			
	SESSION 1		SESSION 2	
	Lec.	Lab. Tut.	Lec.	Lab. Tut.
22.114 Processes	0	0	2	0
22.124 Applied Kinetics	2	1	0	0
22.134 Applied Thermodynamics	1	1	0	0
22.144 Instrumentation and Process Control	4	4	0	0
22.154 Process Simulation	0	0	1	2
22.164 Management Science	0	0	2	0
22.174 Seminars	0	3	0	3
22.184 Process Analysis	0	0	0	4
22.194 Project	0	6	0	8
General Studies Advanced Elective	1	‡	1	‡
	8	15‡	6	17‡

Option: With the approval of the Head of School, students may substitute either 22.314 Polymer Chemistry and 22.324 Physical Chemistry of Polymers II or 22.334 Polymer Physics II for 22.114 Processes.

311. Industrial Chemistry—Part-Time Course Bachelor of Science (Technology)

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
STAGES 1 and 2*			
1.001	Physics I	3	3
2.001	Chemistry I	2	4
10.001	Mathematics I <i>or</i> }	4	2
10.011	Higher Mathematics I† }		
Plus <i>one</i> of:—			
5.010	Engineering A**§ <i>and</i>	3	2
5.030	Engineering C**§	4	2
17.011	Human Biology** <i>and</i>	4	2
17.021	Comparative Functional Biology**	2	4
25.111	Geoscience I‡	2	4

* Two of the first four subjects listed will be taken in the first year, the other two in second year (as directed).

† There will be no evening lectures in this subject.

** One session only.

§ Chemical Technology students take Introduction to Systems and Computers in 5.030 and Materials in 5.010.

‡ Three field excursions, up to five days in all, are an essential part of the course.

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
STAGE 3			
1.212	Physics IIT (Unit B)*	1½	1½
2.611	Organic Chemistry I	1½	3
10.031	Mathematics	1	1
10.331	Statistics SS	1	1
	General Studies Elective	1	½
		<hr/> 6	<hr/> 7

* 14 weeks' course.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
STAGE 4					
2.311	Physical Chemistry	1½	3	1½	3
2.411	Inorganic Chemistry	1	2	1	2
22.112	Chemical Process Equipment	1	0	1	0
22.122	Instrumental Analysis	1	2	1	2
	General Studies Elective	1	½	1	½
		<hr/> 5½	<hr/> 7½	<hr/> 5½	<hr/> 7½

STAGE 5

3.111	Chemical Engineering Principles I	2	0	1	2
3.311	Fuel Engineering I	1½	½	1½	½
22.113	Industrial Chemistry Processes	1½	2½	1½	2½
22.153	Material and Energy Balances	1	2	0	0
		<hr/> 6	<hr/> 5	<hr/> 4	<hr/> 5

Option: With the approval of Head of School, students may substitute 22.313 Polymer Processes, 22.323 Physical Chemistry of Polymers I and 22.333 Polymer Physics I for 22.153 Material and Energy Balances, 3.311 Fuel Engineering I and the Inorganic Industrial Chemistry lectures and the laboratory assignments of 22.113 Industrial Chemistry Processes.

		Hours per week			
		SESSION 1		SESSION 2	
		Lab.		Lab.	
STAGE 6		Lec.	Tut.	Lec.	Tut.
2.622	Organic Chemistry	2	4	0	0
18.551	Operations Research	2	1	2	1
22.123	Chemical Thermodynamics and Kinetics	1½	1½	1½	1½
22.133	Data Processing	0	0	2	2
	General Studies Elective	1	½	1	½
		6½	7	6½	5

302. Ceramic Engineering—Full-Time Course Bachelor of Science

YEAR 1

1.001	Physics I	3	3	3	3
2.001	Chemistry I	2	4	2	4
5.010	Engineering A*†	3	2	0	0
5.030	Engineering C*†	0	0	4	2
10.001	Mathematics I <i>or</i>	4	2	4	2
10.011	Higher Mathematics I }				
22.231	Introductory Ceramic Engineering†				

* One session only.

† Chemical Technology students take Introduction to Systems and Computers in 5.030 and Materials in 5.010.

‡ A series of 10 one hour lectures given in Session 2.

Hours per week for 2 Sessions

		Lab.	
YEAR 2		Lec.	Tut.
1.212	Physics IIT (Units B and C)	1½	1½
2.311	Physical Chemistry	1½	3
2.411	Inorganic Chemistry	1	2
2.511	Analytical Chemistry	1	3
8.112	Materials and Structures	1	2
10.031	Mathematics	1	1
10.331	Statistics SS	1	1
	General Studies Elective	1	½
		9	14

YEAR 3*		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
3.111	Chemical Engineering Principles I	2	0	1	2
3.311	Fuel Engineering I	1½	½	1½	½
7.023	Part 2, Mineral Process Engineering	1	1	0	0
22.123	Chemical Thermodynamics (Unit A)	1½	1½	0	0
22.153	Material and Energy Balances	1	2	0	0
22.213	Chemical Ceramics	2	2	2	4
22.2331	Ceramic Process Principles	1½	2½	1½	2½
22.2332	Ceramic Engineering I	1	0	1	0
25.201	Mineralogy	1	1	1	2
	Two General Studies Electives	2	1	2	1
		<hr/>		<hr/>	
		14½	11½	10	12
		<hr/>		<hr/>	

* Students who have completed a specified programme at the University of Newcastle or at Wollongong University College will be admitted with advanced standing to Year 3 at this University.

YEAR 4

18.121	Production Management (O.R.)	0	0	2	0
22.144	Instrumentation and Process Control	4	4	0	0
22.224	Physical Ceramics	3	3	3	3
22.234	Ceramic Engineering	2	2	2	2
22.294	Project	0	3	0	10
	General Studies Advanced Elective	1	½	1	½
		<hr/>		<hr/>	
		10	12½	8	15½
		<hr/>		<hr/>	

303. Ceramics—Part-Time Course

Bachelor of Science (Technology)

			Hours per week for 2 Sessions	
			Lec.	Lab. Tut.
STAGES 1 and 2*				
1.001	Physics I		3	3
2.001	Chemistry I		2	4
5.010	Engineering A**§		3	2
5.030	Engineering C**§		4	2
10.001	Mathematics I <i>or</i>	}	4	2
10.011	Higher Mathematics I†			
22.231	Introductory Ceramic Engineering‡			

* Two subjects will be taken in the first year and the other two in the second year (as directed).

** One session only.

§ Chemical Technology students take Introduction to Systems and Computers in 5.030 and Materials in 5.010.

† There will be no evening lectures in this subject.

‡ A series of 10 one hour lectures given in Session 2.

STAGE 3

1.212	Physics IIT (Units B and C)	1½	1½
2.311	Physical Chemistry	1½	3
10.031	Mathematics	1	1
10.331	Statistics SS	1	1
		<hr/> 5	<hr/> 6½

STAGE 4

2.411	Inorganic Chemistry	1	2
2.511	Analytical Chemistry	1	3
8.112	Materials and Structures	1	2
	General Studies Elective	1	½
		<hr/> 4	<hr/> 7½

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
STAGE 5					
3.111	Chemical Engineering Principles I	2	0	1	2
7.023	Part 2, Mineral Process Engineering	1	1	0	0
22.153	Material and Energy Balances	1	2	0	0
22.2331	Ceramic Process Principles	1½	2½	1½	2½
22.2332	Ceramic Engineering I	1	0	1	0
	General Studies Elective	1	½	1	½
		<u>7½</u>	<u>6</u>	<u>4½</u>	<u>5</u>
STAGE 6					
3.311	Fuel Engineering I	1½	½	1½	½
22.123	Chemical Thermodynamics (Unit A)	1½	1½	0	0
22.213	Chemical Ceramics	2	2	2	4
25.201	Mineralogy	1	1	1	1
	General Studies Elective	1	½	1	½
		<u>7</u>	<u>5½</u>	<u>5½</u>	<u>6</u>

SCHOOL OF GEOGRAPHY

Geographers study the spatial relationships of the phenomena which make up man's physical and social environment, and aim to establish principles which govern those relationships. The geographer may concentrate on selected variables, as in systematic geography, or may deal with variables operative in 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 finding such professional employment; for instance, geomorphologists and biogeographers are undertaking resource-inventory surveys in northern Australia, and economic geographers are engaged as regional planners and market researchers.

Applied Geography—Full Time Courses Bachelor of Science

The School offers three four-year full-time courses leading to the degree of Bachelor of Science. These four-year full-time undergraduate courses aim to train professional geographers for entry into applied fields, with elective specialisation in biogeography, economic geography with emphasis on urban geography, or geomorphology and pedology. The physical basis of geography is studied systematically in the first year, while in the second year there is similar treatment of economic and social geography with additional consideration of geographic methods in general. There is progressive specialisation in the following years, but all courses in physical geography have common training in fundamental observation and data handling. For the award of honours, 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 thesis will be required.

It is recommended that all students spend a period of four to six weeks with organisations concerned with the investigation and planned use of resources *et cetera*.

301. Applied Geography—Full-Time Course

Bachelor of Science

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
<i>BIOGEOGRAPHY AND BIOCLIMATOLOGY</i>					
YEAR 1					
2.001	Chemistry I	2	4	2	4
10.001	Mathematics I <i>or</i>	4	2	4	2
10.011	Higher Mathematics I <i>or</i>				
10.021	Mathematics II				
17.011	Human Biology	4	2	0	0
17.021	Comparative Functional Biology	0	0	2	4
27.001	Applied Geography I*	2	4	2	4
		12	12	10	14

* Up to 5 days' field tutorials are an essential part of the course.

YEAR 2					
1.001	Physics I	3	3	3	3
27.002	Applied Geography II*	2	4	2	4
43.101A	Genetics and Biometry	3	3	0	0
43.101C	Plant Physiology	0	0	2	4
	General Studies Elective	1	$\frac{1}{2}$	1	$\frac{1}{2}$
		9	10 $\frac{1}{2}$	8	11 $\frac{1}{2}$

* Up to 5 days' field tutorials are an essential part of the course.

YEAR 3					
27.013	Geographic Methods	0	1 $\frac{1}{2}$	0	1 $\frac{1}{2}$
27.103	Climatology	2	3 $\frac{1}{2}$	0	0
27.203	Biogeography*	0	0	2	3 $\frac{1}{2}$
27.333	Agricultural Geography* <i>or</i>	2	2 $\frac{1}{2}$	0	0
27.413	Geomorphology*				
27.423	Pedology*				
43.102E	Environmental Botany	0	0	2	4
43.101B	Plant Evolution and Ecology	2	4	0	0
	Two General Studies Electives	2	1	2	1
		8	12 $\frac{1}{2}$	8	12 $\frac{1}{2}$

* Up to 5 days' field tutorials are an essential part of the course.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 4					
27.104	Bioclimatology*	2	4	0	0
27.204	Advanced Biogeography*	3	6	0	0
27.504	Project (Biogeography)	0	2	0	16
	General Studies Advanced				
	Elective	1	$\frac{1}{2}$	1	$\frac{1}{2}$
		<u>6</u>	<u>12$\frac{1}{2}$</u>	<u>1</u>	<u>16$\frac{1}{2}$</u>

* Up to 5 days' field tutorials are an essential part of the course.

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
GEOMORPHOLOGY AND PEDOLOGY			
For students enrolling in 1974.			
YEAR 1			
2.001	Chemistry I	2	4
10.001	Mathematics I <i>or</i>	4	2
10.011	Higher Mathematics I <i>or</i>		
10.021	Mathematics II		
25.111	Geoscience I	3	3
27.001	Applied Geography I*	2	4
		<u>11</u>	<u>13</u>

* Up to 5 days' field tutorials are an essential part of the course.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 2					
1.001	Physics I	3	3	3	3
25.112	Geoscience II A and B	5	4	4	5
27.002	Applied Geography II*	2	4	2	4
	General Studies Elective	1	$\frac{1}{2}$	1	$\frac{1}{2}$
		<u>11</u>	<u>11$\frac{1}{2}$</u>	<u>10</u>	<u>12$\frac{1}{2}$</u>

* Up to 5 days' field tutorials are included in these subjects.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 3					
25.0303	Geology for Geomorphologists and Pedologists	3	6	0	0
27.013	Geographic Methods	0	1½	0	1½
27.103	Climatology	2	2½	0	0
27.203	Biogeography*	0	0	2	2½
27.413	Geomorphology*	2	3½	0	0
27.423	Pedology*	0	0	2	3½
	Two General Studies Electives	2	1	2	1
		<u>9</u>	<u>14½</u>	<u>6</u>	<u>8½</u>

† 3 selected strands other than Geological Surveying (and Photogeology).

* Up to 5 days' field tutorials are an essential part of the course.

YEAR 4

25.414	Advanced Geomorphology* ..	3	4	0	0
25.424	Advanced Pedology*	3	4	0	0
27.504	Project (Geomorphology and Pedology)	0	2	0	16
	General Studies Advanced Elective	1	½	1	½
		<u>7</u>	<u>10½</u>	<u>1</u>	<u>16½</u>

* Up to 5 days' field tutorials are an essential part of the course.

For students enrolled before 1974.

		Hours per week for 2 Sessions	
		Lab.	
		Lec.	Tut.
YEAR 2			
1.001	Physics I	3	3
25.111	Geoscience I	3	3
27.002	Applied Geography II*	2	4
	General Studies Elective	1	½
		<u>9</u>	<u>10½</u>

* Up to 5 days' field tutorials are included in these subjects.

These courses meet the formal educational requirements for admission to the professional metallurgical institutes, such as the Australasian Institute of Mining and Metallurgy and the Institution of Metallurgists (London). Further details about membership of these institutes, the Australian Institute of Metals and the undergraduate Metallurgical Society of the University, all of which students are encouraged to join, may be obtained from the Head of the School.

While the emphasis in the course is on providing a broad fundamental background in all branches of metallurgy, provision is made for a limited amount of specialization of the student's own choice in the final year.

312. Metallurgy—Full-Time Course Bachelor of Science

Students in this course attend the University for twenty-eight weeks over two sessions from March to November (excluding examinations and recesses).

Students are required, before graduation, to have gained at least sixteen weeks of approved industrial experience, and to have submitted satisfactory reports on the work done to comply with this requirement. Industrial experience is normally obtained during the long vacations at the end of second and third years. During the second, third and fourth years of the course, visits are made to various metallurgical works, and students are required to submit reports on some of these.

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
YEAR 1			
1.001	Physics I	3	3
2.001	Chemistry I	2	4
10.001	Mathematics I <i>or</i> }	4	2
10.011	Higher Mathematics I }		
<i>Plus one of:</i>			
5.010	Engineering A* <i>and</i> }	4	2
5.030	Engineering C† } <i>or</i>	3/4	2
25.111	Geoscience I	2	4

* Session 2 only.

† Session 1 only.

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 2		Lec.	Lab. Tut.	Lec.	Lab. Tut.
2.022	Chemistry II (M)	3	4	3	3
4.011	Metallurgy I	5	6	5	6
4.031	Physics of Metals	1	0	1	2
10.031	Mathematics	1	1	1	1
5.010	Engineering A*† and }	4	2	4	2
5.030	Engineering C*† } or	3/4	2	3/4	2
25.201	Mineralogy	1	1	1	1
	General Studies Elective	1	½	1	½

* One session only.

† Part only.

		Hours per week for 2 Sessions	
YEAR 3		Lec.	Lab. Tut.
4.012	Metallurgy II*	9	10
4.041	Mathematical Methods or	2½	½
6.801	Electrical Engineering	1	2
	Two General Studies Electives	2	1
		12/13½	11½/13
*Session 2		8	11

YEAR 4			
4.013	Metallurgy III*	8	10
4.021	Metallurgy Project†	0	5
	General Studies Advanced Elective	1	½
		9	15½

*Session 2

†From Week 12 in Session 1

Project includes three weeks' laboratory work during mid-year recess.

313. Metallurgy—Part-Time Course‡ Bachelor of Science (Technology)

The part-time course extends over six years of two sessions each. Students are required to obtain at least three years' approved experience in a metallurgical industry or research establishment concurrently with studies.

‡ See below for outline of this course involving combined full-time and part-time study.

During the last three years of the course visits are made to various metallurgical works, and students are required to submit reports on some of these.

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
STAGES 1 and 2*			
1.001	Physics I	3	3
2.001	Chemistry I	2	4
10.001	Mathematics I <i>or</i>	4	2
10.011	Higher Mathematics I† }		
<i>Plus one of:</i>			
5.010	Engineering A**† <i>and</i> }	4	2
5.030	Engineering C**† } <i>or</i>	3/4	2
25.111	Geoscience I	2	4

* Two of the first four subjects listed will be taken in first year and the other two in second year.

† There will be no evening lectures in this subject.

** One session only.

† Part only.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
STAGE 3					
2.022	Chemistry II (M)	3	4	3	3
4.031	Physics of Metals	1	0	1	2
10.031	Mathematics	1	1	1	1
	General Studies Elective	1	†	1	†
		<u>6</u>	<u>5†</u>	<u>6</u>	<u>6†</u>

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
STAGE 4			
4.011	Metallurgy I	5	6
25.201	Mineralogy <i>or</i>	1	1
5.010	Engineering A*† <i>and</i> }	1	1
5.030	Engineering C*† }		
		<u>6</u>	<u>7</u>

* One session only.

† Part only.

		Hours per week for 2 Sessions	
			Lab.
STAGE 5		Lec.	Tut.
4.0121	Metallurgy IIA*	5	4
4.041	Mathematical Methods <i>or</i>	2	$\frac{1}{2}$
6.801	Electrical Engineering	1	2
	General Studies Elective	1	$\frac{1}{2}$
		<hr/> 7/8	<hr/> 5/6 $\frac{1}{2}$

*Session 2 5 6

STAGE 6			
4.0122	Metallurgy IIB*	4	6 $\frac{1}{2}$
	General Studies Elective	1	$\frac{1}{2}$
		<hr/> 5	<hr/> 7
*Session 2	5	6

Metallurgy BSc(Tech) in Full-Time/Part-Time Study*

Students enrolling in the Metallurgy BSc(Tech) course may reduce the time required for completion by undertaking the following programme of combined part-time/full-time study:

- Stage 1.....Part-time (as for BSc(Tech) course above)
- Stage 2.....Part-time (as for BSc(Tech) course above)
- Stage 3A.....Full-time (as for second year of full-time BSc course above)
- Stage 4A.....Full-time (as for third year of full-time BSc course above)
- Stage 5A.....Part-time (as set out below)

		Hours per week for 2 Sessions	
			Lab.
STAGE 5A		Lec.	Tut.
4.0123	Metallurgy IIC	2	2
4.0131	Seminar	0	1
4.0124	Report	0	0
		<hr/> 2	<hr/> 3

* This course is subject to revision.

After graduation it is normal for mining engineers to obtain the abovementioned statutory certificate of competency from one of the State Government Departments of Mines. Graduates in Mining Engineering are examined principally in the applications of the above mentioned Acts.

It is possible for students to undertake the First and Second Years of the BE course on a part-time basis.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 1					
1.001	Physics I	3	3	3	3
2.001	Chemistry I <i>or</i>	3	3	3	3
2.021	Chemistry IE	3	3	0	0
5.010	Engineering A*	4	2	4	2
5.030	Engineering C*	3	2	3	2
10.001	Mathematics I <i>or</i> }	4	2	4	2
10.011	Higher Mathematics }				

* One session only. Students will take this subject in either Session 1 or 2.

YEAR 2

4.941	Materials	0	0	1	1
5.711	Thermodynamics	0	0	1	1
6.801	Electrical Engineering	1	2	1	2
7.012	Mineral Resources Parts 1 & 2	1	0	1	0
8.151	Mechanics of Solids	2	1	2	1
8.250	Properties of Materials	2	1	0	0
8.510	Hydraulics	2	2	0	0
10.022	Engineering Mathematics II	3	1	3	1
25.101	Geology for Engineers I*	0	0	2	1
29.441	Engineering Surveying	1	3	1	3
29.491	Survey Camp**	0	0	0	0
	General Studies Elective	1	½	1	½
		13	10½	13	10½

* Two one-day Geology excursions are an essential part of the course.

** Students are required to attend a one-week Survey Camp, equivalent to 40 class contact hours.

Note: One half of the students will take the subjects 4.941, 25.101 and 5.711 in the first Session and the subjects 8.250, and 8.510 in the second Session. The other half will take these subjects in reverse order of sessions.

		Hours per week	
		SESSION 1	
		Lab.	
YEAR 3		Lec.	Tut.
7.023	Mining and Mineral Process Engineering— Parts 1 and 2	2	2
7.113	Mining Engineering I	5	3
7.213	Mine Surveying and Control Engineering	1	1
25.102	Geology for Engineers II*	4	3
	Two General Studies Electives	2	1
		<hr/> 14	<hr/> 10

* A Geology excursion will be conducted at the end of the session.

Note: After Session 1 students will be required to obtain industrial experience. They will write a report on this which will be assessed first by their employers and then by the School. The range of experience obtained and the report submitted will be considered when grading degrees at the end of the course.

		Hours per week			
		SESSION 1		SESSION 2	
		Lab.		Lab.	
YEAR 4		Lec.	Tut.	Lec.	Tut.
7.124	Mining Engineering II*	3	3	3	3
7.134	Mining Engineering III }	1	3	0	0
7.324	or Mineral Processing II }				
7.144	Mining Engineering IV }	0	0	1	3
7.334	or Mineral Processing III }				
7.224	Mine Valuation	1	1	0	0
7.234	Mineral Economics	0	0	1	1
7.314	Mineral Processing I*	2	4	2	4
7.414	Mineral Industry Elective Project	1	4	1	4
	General Studies Advanced Elective†	1	$\frac{1}{2}$	1	$\frac{1}{2}$
		<hr/> 9	<hr/> 15 $\frac{1}{2}$	<hr/> 9	<hr/> 15 $\frac{1}{2}$

* Examined in two parts.

† An additional General Studies Elective may be included in Year 4.

421. Mining Engineering—Part-Time Courses Bachelor of Science (Engineering)

(W. S. and L. B. Robinson University College, Broken Hill)

The School of Mining Engineering offers a part-time course in Mining Engineering, leading to the degree of Bachelor of Science (Engineering).

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
STAGES 1 and 2*			
1.001	Physics I	3	3
2.001	Chemistry I	2	4
5.010	Engineering A†	4	2
5.030	Engineering C†	3	2
10.001	Mathematics I <i>or</i> }	4	2
10.011	Higher Mathematics I }		
		12/13	11

* Two of the four subjects listed will be taken in Year 1 and the other two in Year 2.

† One session only. Students will take this subject in either Session 1 or 2.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
STAGE 3					
4.941	Materials	1	1	0	0
7.012R	Mineral Resources—Parts 1 & 2	1	0	1	0
8.151	Mechanics of Solids	2	1	2	1
8.250	Properties of Materials	0	0	2	2
10.022	Engineering Mathematics II ..	2	2	2	2
		6	4	7	5

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
STAGE 4			
5.611	Fluid Mechanics/Thermodynamics	2	2
7.023R	Mining and Mineral Process Engineering, Parts 1 and 2*	1	1
	General Studies Elective	1	½
29.441	Engineering Surveying†	1½	0
25.101	Geology for Engineers‡	1	1
		6½	4½

* Course consists of 44 lectures and also four visits, each of three hours, to mines or mineral processing plants.

† Includes 42 hours of practical work.

‡ Two short Geology excursions are an essential part of the course.

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
STAGE 5			
6.801	Electrical Engineering	1	2
7.113R	Mining Engineering I	2	2
7.213R	Mine Surveying and Control Engineering	1	0
25.1021	Geology for Mining Engineers*	2	2
	General Studies Elective	1	$\frac{1}{2}$
		<hr/> 7	<hr/> 6 $\frac{1}{2}$

* Geology excursion will be conducted during the year.

STAGE 6			
7.124R	Mining Engineering II*	3	2
7.315R	Mineral Processing for Mining Engineers	1	2
7.414R	Mineral Industry Elective Project†	0	2
	General Studies Elective	1	$\frac{1}{2}$
		<hr/> 5	<hr/> 6 $\frac{1}{2}$

* A mining excursion of five days will be conducted during the year.

† Project for an award with merit will be more advanced than that required for the award of the pass degree.

Bachelor of Science (Engineering)

(Wollongong University College)

For details of this course potential candidates should refer to the Wollongong University College Handbook.

422. Mineral Processing—Part-Time Course

Bachelor of Science (Technology)

(W. S and L. B. Robinson University College, Broken Hill)

This course is designed to meet the requirements of students who are employed by the mineral processing industries. It extends over six part-time years of study and leads to the degree of Bachelor of Science Technology. A minimum of three years' concurrent industrial training in approved industries is required before graduation.

STAGES 1 and 2*

1.001	Physics I	3	3
2.001	Chemistry I	2	4
5.010	Engineering A†	4	2
5.030	Engineering C†	3	2
10.001	Mathematics I or	4	2
10.011	Higher Mathematics I }		
		<hr/> 12/13	<hr/> 11

* Two of the first four subjects listed will be taken in first year, and the other two in second year.

† One session only. Students will take this subject in either Session 1 or 2.

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
STAGE 3					
2.311	Physical Chemistry I	1½	3	1½	3
4.941	Materials	1	1	0	0
8.250	Properties of Materials	0	0	2	2
10.022	Engineering Mathematics II	2	2	2	2
	General Studies Elective	1	½	1	½
		<u>5½</u>	<u>6½</u>	<u>6½</u>	<u>7½</u>

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
STAGE 4			
2.511	Analytical Chemistry I	1	3
7.023R	Mining and Mineral Process Engineering—Parts 1 and 2*	1	1
10.331	Statistics SS	1	1
25.101	Geology for Engineers†	1	1
25.201	Mineralogy	1	1
		<u>5</u>	<u>7</u>

* Course consists of 44 lectures, and four visits, each of three hours, to mines or mineral processing plants.

† Two short Geology excursions are an essential part of the course.

STAGE 5

6.801	Electrical Engineering	1	2
7.314R	Mineral Processing I—Parts 1 & 2	3	3
7.411	Fluid Mechanics	1	1
	General Studies Elective	1	½
		<u>6</u>	<u>6½</u>

STAGE 6

7.316R	Mineral Processing II	3	4
7.326R	Mineral Industry Processes, Parts 1 and 2	1	1
7.414R	Mineral Industry Elective Project†	0	2
	General Studies Elective	1	½
		<u>5</u>	<u>7½</u>

† The Project for an award with merit will be more advanced than that required for the award of the pass degree.

SCHOOL OF TEXTILE TECHNOLOGY

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. Graduates with a good background in physics, chemistry or engineering, together with a broad training in the whole range of textile sciences and technologies, as provided in the courses in Textile Technology, will substantially meet the present and future technological requirements of the textile and allied industries. Since present day textile technology is based on engineering and the fundamental sciences, excellent opportunities also await university-trained scientists and technologists in research and development organisations. Such scientists and technologists will play a decisive part in bridging the gap which exists between fundamental research and its industrial application.

Students are given the opportunity of choosing from four courses, viz., Textile Chemistry, Textile Physics, Textile Engineering and Textile Manufacture. The course in Textile Manufacture, which includes subjects in Commerce and Applied Psychology, is especially designed to meet the undoubted need for executives in industry who have been given a comprehensive technological training. Each course extends over four years. All students take a common first year, and they need not choose the option they desire to follow until the end of that year. The aim of all four courses is to produce graduates who have acquired a comprehensive knowledge of all the textile sciences and technologies, the courses themselves differing only in the subjects offered outside the School in the second and third years. Students are required to undertake a minimum of eight weeks' industrial training during the long recesses between Years 2 and 3, and 3 and 4. The fourth year is common to all four Textile Technology courses.

317. Textile Technology—Full-Time Course Bachelor of Science

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
YEAR 1 (All courses)			
1.001	Physics I <i>or</i>	3	3
1.011	Higher Physics I } *		
2.001	Chemistry I	2	4
5.010	Engineering A†	4	2
5.030	Engineering C††	3	2
10.001	Mathematics I <i>or</i>	4	2
10.011	Higher Mathematics I }		
		<hr/> 12/13	<hr/> 11

* Students who do not intend to take the Textile Physics Option may substitute 1.001 Physics I.

† One session only.

‡ Textile Technology students take Engineering Drawing and Introduction to Systems and Computers.

TEXTILE CHEMISTRY

YEAR 2

2.002	Chemistry II	3	6
10.031	Mathematics	1	1
10.331	Statistics SS	1	1
13.111	Textile Technology I	3	5
13.211	Textile Science I	2	1
	General Studies Elective	1	½
		<hr/> 11	<hr/> 14½

YEAR 3

2.003A	Physical Chemistry	2	4
2.003B	Organic Chemistry		
13.112	Textile Technology II	6	7
13.212	Textile Science II	2	0
13.311	Textile Engineering I	1	0
	Two General Studies Electives	2	1
		<hr/> 13	<hr/> 12

Hours per week for
2 Sessions

TEXTILE PHYSICS

YEAR 2

	Lec.	Lab. Tut.
1.112 Physics II <i>or</i> }	5	3
1.122 Higher Physics II }		
10.331 Statistics SS	1	1
10.111A Pure Mathematics II <i>or</i> }	1½	½
10.121A Higher Pure Mathematics II }		
10.111B Pure Mathematics II <i>or</i> }	1½	½
10.121B Higher Pure Mathematics II }		
10.211A Applied Mathematics II <i>or</i> }	1½	½
10.221A Higher Applied Mathematics II }		
13.111 Textile Technology I	3	5
13.211 Textile Science I	2	1
General Studies Elective	1	½
	<hr/> 16½	<hr/> 12

YEAR 3

1.213 Physics III* <i>or</i> }	4	3
1.223 Higher Physics III† }		
13.112 Textile Technology II	6	7
13.212 Textile Science II	2	0
13.311 Textile Engineering I	1	0
Two General Studies Electives	2	1
	<hr/> 15	<hr/> 11

* Units A, B and C of 1.113, and Unit A of 1.133. *17*† Units A, B and C of 1.223 and Unit A of 1.133. *17**123,*

TEXTILE ENGINEERING

YEAR 2

5.020 Engineering B*	4	2
5.311 Engineering Mechanics*	1½	½
5.611 Fluid Mechanics*	2	2
8.112 Materials and Structures	1	2
10.031 Mathematics	1	1
10.331 Statistics SS	1	1
13.111 Textile Technology I	3	5
13.211 Textile Science I	2	1
General Studies Elective	1	½

* One session only.

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
YEAR 3			
5.111	Mechanical Engineering Design	2	2
5.331	Dynamics of Machines I	1½	½
6.801	Electrical Engineering	1	2
13.112	Textile Technology II	6	7
13.212	Textile Science II	2	0
13.311	Textile Engineering I	1	0
	Two General Studies Electives	2	1
		<u>15½</u>	<u>12½</u>

*TEXTILE MANUFACTURE***YEAR 2**

10.331	Statistics SS	1	1
12.101	Psychology	3	0
13.111	Textile Technology I	3	5
13.211	Textile Science I	2	1
14.501	Accounting and Financial Management IA*	4	-†
14.511	Accounting and Financial Management IB*	4	-‡
15.111	Economics IN	3	1
	General Studies Elective	1	½
		<u>17</u>	<u>8½</u>

* One session only.

† Laboratory sessions as required in Session 1.

‡ Laboratory sessions as required in Session 2.

YEAR 3

13.112	Textile Technology II	6	7
13.212	Textile Science II	2	0
13.311	Textile Engineering I	1	0
14.081	Introduction to Business Finance	2	0
26.124	Psychology	1½	½
28.012	Marketing Systems†	4	0
28.022	Marketing Models†	4	0
	General Studies Elective*	1	½
		<u>17½</u>	<u>8</u>

† One session only.

* Not to include Economics or Psychology.

YEAR 4 (All courses)

13.113	Textile Technology III	4	3
13.213	Textile Science III	2	3
13.312	Textile Engineering II	1½	0
13.411	Project	0	7
	Optional*	2	0
	General Studies Advanced Elective	1	½
		<u>10½</u>	<u>13½</u>

*** Optional Subjects**

- 13.223 Advanced Textile Chemistry
 13.233 Advanced Textile Physics
 13.313 Advanced Textile Engineering
 14.602 Information Systems

SCHOOL OF WOOL AND PASTORAL SCIENCES

Motivated by strong competition from cheaply-produced man-made fibres, wool producers, by the implementation of the Wool Use Promotion Act of 1945 and subsequent legislation, have undertaken a programme to improve efficiency through research, increased extension services, and adequate publicity for wool. The full development of this programme requires specialist personnel trained to give service to the pastoral industry.

To meet this need the School of Wool and Pastoral Sciences offers a full-time course in Wool and Pastoral Sciences, leading to the degree of Bachelor of Science (pass or honours).

From 1972 the School has provided the course in Wool and Pastoral Sciences (Education Option), previously offered under the title "Sheep and Wool Technology (Education Option)" within the Board of Professional Studies. The purpose of the course is to provide training at the tertiary level for teachers of sheep husbandry and wool science in the Department of Technical Education and in the Agricultural High Schools and Colleges. Students who complete the course successfully will be eligible to become certificated teachers. Graduates could proceed to higher degrees in the field of Rural Extension or of certain scientific aspects of the pastoral industry.

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

The Wool and Pastoral Sciences courses aim to provide a pool of graduates in whom has been inculcated a liberal scientific outlook, and the habit of exact and logical thought. These graduates will be familiar with the latest developments in the various fields relating to Wool and Pastoral Sciences and the utilization of the products stemming from the industry. Graduates of the School are keenly sought after for positions as research workers, teachers, extension workers, agricultural journalists, valuers, and managers of estates, and for other professional occupations in the pastoral industry.

The first year of the BSc course consists of a basic training in general science; vocational subjects essential to all branches of the wool industry are given in the second, third and fourth years. The fourth year work includes a project which will give each student an opportunity to express initiative and originality. By association with lecturers, and teachers who are all engaged in research, we aim to provoke both curiosity and interest in students who will themselves endeavour to contribute to the advance of efficiency.

In Years 3 and 4 provision is made for students who wish to specialize in Plant Sciences, Animal Production, Wool Technology, Farm Management and Economics or in the appropriate scientific areas of Genetics and Biostatistics, Physiology, Nutrition and Biochemistry, Rural Extension, Agricultural Chemistry or Parasitology.

From time to time obligatory excursions, farm tours and consolidated courses on University field stations are arranged for senior students.

Requirements for Industrial Training

Each student is required to complete satisfactorily twenty-four weeks' practical work on approved sheep properties, sixteen weeks of which work should be concurrent with the course. If a student has done practical work before entering the course, this may be taken into consideration in determining any further work required. Students in the Education Option are also required to obtain in Years 3 and 4 the equivalent of three hours per week classroom experience in Agricultural High Schools and/or the Department of Technical Education.

In order to obtain recognition of practical work carried out students shall:

1. Make application for the approval of the properties where they intend to carry out the practical work. Students should endeavour to obtain experience in the pastoral, sheep-wheat, and high rainfall zones.

2. At the conclusion of each period of work, produce certificates from employers stating periods of employment and reporting on the quality of the student's work.

3. Supply reports as hereunder:

(i) On work carried out in the long vacation—

- (a) Monthly interim reports setting out briefly the nature of the work engaged in, with any notes of topical interest.
- (b) A final report on both the district and property, to be submitted within one month of resumption of lectures.

(ii) On work carried out in short vacations—A brief report to be submitted within one week of the resumption of the session.

(iii) By students who carry out work for twenty-four weeks on a property or properties—

- (a) Interim reports to be submitted every two months.
- (b) Final reports to be submitted by March 31 in the year of resumption of studies. The nature of the interim and final reports shall be as required for work carried out in the long vacation.

322. Wool and Pastoral Sciences—Full-Time Course

Bachelor of Science

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
YEAR 1			
2.001	Chemistry I	2	4
10.001	Mathematics I <i>or</i>	4	2
10.011	Higher Mathematics I <i>or</i> }		
10.021	Mathematics IT		
17.011	Human Biology†	4	2
17.021	Comparative Functional Biology†	2	4
27.001	Geography*	2	4

† One session only.

* Students wishing to specialize in Wool Science or Wool Technology may substitute 1.011 Higher Physics I or 1.001 Physics I for 27.001 Geography I.

YEAR 2

9.121	Livestock Production I	3	0
9.221	Agronomy	2	2
9.411	Agricultural Chemistry I	1	3
9.531	Wool Technology I	2	6
9.601	Animal Physiology I	2	3
10.331	Statistics SS	1	1
	General Studies Elective	1	$\frac{1}{2}$
		<u>12</u>	<u>15$\frac{1}{2}$</u>

YEAR 3	Hours per week			
	SESSION 1		SESSION 2	
	Lec.	Lab. Tut.	Lec.	Lab. Tut.
9.131	Animal Health and Preventive Medicine I	0 0	2 1	
9.231	Pastoral Agronomy	1 1	2 2	
9.311	Agricultural Economics I	2 0	0 0	
9.801	Genetics I	2 0	2 1	
41.101	Biochemistry I	4 8	2 4	
	Two General Studies Electives	2 1	2 1	
		<u>11 10</u>	<u>10 9</u>	

Plus at least *two* of the following subjects in each session as approved by the Head of the School (maximum 26 hours):

9.122	Livestock Production II	1 1	0 0
9.123	Livestock Production III	0 0	1 1
9.232	Crop Agronomy	0 0	2 0
9.312	Agricultural Economics II	0 0	2 0
9.313	Farm Management I	1 1	0 0
9.314	Farm Management II	0 0	2 0
9.316	Analysis of Rural Development Projects	0 0	2 0
9.532	Wool Technology II (Wool Study)	0 2	0 2
9.533	Wool Technology III (Wool Metrology)	1 2	1 2
9.534	Wool Technology IV (Raw Materials)	0 0	2 0
9.602	Animal Physiology II	2 0	2 0

YEAR 4

9.001	Project	0	6	0	6
9.811	Biostatistics	2	2	2	2
	General Studies Advanced				
	Elective	1	1	1	1

Plus subjects providing at least 12 hours per week of lecture, tutorials and laboratory work in each session, selected from the following. The choice of subjects is to be approved by the Head of the School.

9.124	Livestock Production IV	1	1	1	1
9.132	Animal Health and Preventive				
	Medicine II	2	1	0	0
9.232	Crop Agronomy	0	0	2	0
9.412	Agricultural Chemistry II	2	4	2	4
9.421	Animal Nutrition	3	0	0	0
9.533	Wool Technology V	1	1	1	1
9.535	Wool Technology VI	2	2	2	2
9.536	Animal Physiology III	2	2	2	2
9.802	Genetics II	2	2	2	2
9.901	Rural Extension	2	2	2	2
9.312	Agricultural Economics II	0	0	2	0
9.313	Farm Management I	1	1	0	0
9.314	Farm Management II	0	0	2	0
9.315	Farm Management III	2	0	0	0
9.316	Analysis of Rural Development				
	Projects	0	0	2	0
43.101C	Plant Physiology	0	0	2	4
43.102E	Environmental Botany	2	4	0	0

TABLE OF PROGRESSION IN SUBJECTS

Year 1		Year 2		Year 3		Year 4	
27.001	Geography I	9.221	<i>Agronomy</i>	9.231	<i>Pastoral Agronomy</i>	9.232	Crop Agronomy
						43.101C	Plant Physiology
						43.102E	Environmental Botany
17.011	<i>Human Biology</i>	9.601	<i>Animal Physiology I</i>	9.602	Anim. Physiol. II	9.603	Anim. Physiol. III
17.021	<i>Comparative</i>	9.121	<i>Livestock</i>	9.122	L'stck Prodn. II	9.421	Anim. Nutrition
	<i>Functional Biology</i>		<i>Production I</i>	9.123	L'stck Prodn. III	9.123	L'stck Prodn. III
				9.131	<i>Animal Health and</i> <i>Prev. Medicine I</i>	9.132	Anim. Health and Prev. Medicine II
2.001	<i>Chemistry I</i>	9.411	<i>Agricultural</i> <i>Chemistry I</i>	41.101	<i>Biochemistry I</i>	9.412	Agric. Chemistry II
10.001	} <i>Mathematics I</i>	10.331	<i>Statistics SS</i>	9.801	<i>Genetics I</i>	9.811	<i>Biostatistics</i>
10.011						9.802	Genetics II
10.021							
				9.311	<i>Agricultural</i> <i>Economics I</i>	9.312	Agric. Economics II
				9.312	Agricultural Economics II	9.313	Farm Management I
				9.313	Farm Management I	9.314	Farm Management II
				9.314	Farm Management II	9.315	Farm Management III
				9.316	Analysis of Rural Development Projects	9.316	Analysis of Rural Development Projects
						9.901	Rural Extension
1.001	} Physics I	9.531	<i>Wool Technology I</i>	9.532	Wool Technology II	9.535	Wool Technology V
1.011				9.533	Wool Technology III	9.536	Wool Technology VI
				9.534	Wool Technology IV		

- NOTE 1. Students may take either Geography I or Physics I.
 2. Subjects in italics are compulsory.
 3. Course requires yearly progression and apart from compulsory subjects, there are no co- or pre-requisites.

321. Wool and Pastoral Sciences (Education Option)—Full-Time Course—Bachelor of Science

Years 1 and 2 of this course are the same as for the existing BSc degree course in Wool and Pastoral Sciences.

		Hours per week for 2 Sessions			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 3					
9.122	Livestock Production II	1	1	0	0
9.123	Livestock Production III	0	0	1	1
9.131	Animal Health and Preventive Medicine I	0	0	2	1
9.231	Pastoral Agronomy	1	1	2	2
9.311	Agricultural Economics I	2	0	0	0
9.313	Farm Management I	1	1	0	0
9.801	Genetics I	2	0	2	1
44.101	Introductory Microbiology ...	3	0	3	0
58.401	Education IA	3	1	2	1
58.061	Methods of Teaching*	2	1	3	0
	Two General Studies Electives	2	1	2	1
		<hr/> 17	<hr/> 6	<hr/> 17	<hr/> 7

* Teaching Practice will be arranged by the School of Wool and Pastoral Sciences over 3 hours each week which will be additional to the hours shown. Part of this requirement may be met outside University sessions.

YEAR 4

9.124	Livestock Production IV	1	1	1	1
9.132	Animal Health and Preventive Medicine II	2	1	0	0
9.232	Crop Agronomy	0	0	1	1
9.312	Agricultural Economics II	0	0	2	0
9.315	Farm Management III	1	1	0	0
9.421	Animal Nutrition	3	0	0	0
43.101C	Plant Physiology	0	0	2	4
58.062	Methods of Teaching*	2	1	3	0
58.402	Education IIA	4	1	4	1
	Seminar and Thesis on Edu- cational Issues	0	2	0	2
	General Studies Advanced Elective	1	1	1	1
		<hr/> 14	<hr/> 8	<hr/> 14	<hr/> 10

* Teaching Practice will be arranged by the School of Wool and Pastoral Sciences over 3 hours each week which will be additional to the hours shown. Part of this requirement may be met outside University sessions.

POSTGRADUATE STUDY

The Faculty provides facilities for students to proceed to the higher degrees of Doctor of Philosophy, Master of Engineering, Master of Science and Master of Applied Science. 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 may read for the degree in this Faculty and are normally involved in three years' work. The work for the Master's degree may be completed in a minimum of one year, but normally requires two years of study.

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.

Numbers of courses are also offered at the postgraduate 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 Corrosion Technology, Food Technology, Fuel Technology, Polymer Technology, Mining and Mineral Engineering and Wool Technology.

Courses leading to the degree of Master of Applied Science and to Graduate Diplomas are available at Kensington only. Candidates may register for all the research degrees at Kensington and for the degrees of Master of Science and Master of Engineering at Wollongong University College and the W. S. and L. B. Robinson University College, Broken Hill, subject to adequate research

facilities and satisfactory supervision being available in the candidate's particular field of study. Where these special conditions can be met the Professorial Board may grant permission to a candidate to register for the degree of Doctor of Philosophy in these centres.

The conditions governing the award of the various higher degrees and graduate diplomas are set out in the Calendar.

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.

POSTGRADUATE ENROLMENT PROCEDURE

Students seeking to enrol for a postgraduate degree or diploma must do so on the appropriate application form which must be lodged with the Registrar by the date specified in the conditions of the award set out in Section C of the Calendar. Successful applicants will be advised by letter of the method of enrolment.

Second and later year students must re-enrol at the beginning of each academic year in which they are proceeding to a degree or diploma. Those who have completed their formal course of study, but who have not submitted a thesis or project report to the Registrar for examination, must re-enrol and pay the appropriate fees. Details of re-enrolment procedure may be found in the current leaflet on enrolment procedure which is available from Schools and from the Admissions and Higher Degrees Section towards the end of each academic year.

Failure to comply with instructions concerning the time of enrolment or re-enrolment will incur late fees.

POSTGRADUATE FEES

As from 1st January 1974 no fees for tuition will be payable. Other fees and charges will still be payable. They include those charges raised to finance the expenses incurred in operating student activities such as the University Union, the Students' Union, the Sports Association and the Physical Education and Recreation Centre.

Late fees are also charged where a student fails to observe required procedures by the appropriate time. Charges may also be payable, sometimes in the form of a deposit, for the hiring of kits of equipment which are lent to students for their personal use during attendance in certain subjects. Accommodation charges and costs of subsistence on excursions, field work etc. are payable in appropriate circumstances.

In order to become a student member of the University in any particular course of study it is necessary to meet the entrance requirements for the course and to enrol formally in it. To effect enrolment it is necessary to present a duly completed and authorised enrolment form to the University Cashier together with, where payable, either the appropriate fees or an authority authorising those fees to be charged to some other person or institution.

Completion of Enrolment

Students enrolling in postgraduate courses which include formal instruction are required to attend the appropriate enrolment centre during the prescribed enrolment period[†] for authorisation of course programmes. Failure to do so will incur a late fee of \$10.

Fees should be paid during the prescribed enrolment period but will be accepted without incurring a late fee during the first two weeks of Session 1. (For late fees see below). No student is regarded as having completed an enrolment until fees have been paid. Fees will not be accepted (i.e. enrolment cannot be completed) after 31st March except with the express approval of the Registrar, which will be given in exceptional circumstances only.

[†]The enrolment periods for Sydney are prescribed annually in the leaflet "Enrolment Procedure for Students Re-enrolling".

Students enrolling for the first time in any year at the commencement of Session 2 are required to pay all fees due within the first two weeks of that session.

Assisted Students

Scholarship holders or sponsored students who have not received an enrolment voucher or appropriate letter of authority from their sponsor at the time when they are enrolling should complete their enrolment paying their own fees. A refund of fees paid will be made when the enrolment voucher or letter of authority is subsequently lodged with the Cashier.

Extension of Time

Any student who is unable to pay fees by the due date may apply in writing to the Registrar for an extension of time. Such application must state year of study, the name of course and whether enrolment is sought on a full-time or part-time basis; it must describe clearly and fully why payment cannot be made and what extension is required; and must be lodged before the date on which a late fee becomes payable.

Normally the maximum extension of time for the payment of fees is one month for fees due in Session 1 and for one month from the date on which a late fee becomes payable in Session 2.

Failure to Pay Fees

Any student who fails to pay prescribed fees or charges or is otherwise indebted to the University and who fails to make a satisfactory settlement of his indebtedness upon receipt of due notice ceases to be entitled to the use of University facilities. Such a student is not permitted to register for a further session, to attend classes or examinations or to be granted any official credentials.

No student is eligible to attend the annual examinations in any subject where any portion of his fees for the year is outstanding after the end of the fourth week of Session 2 (16th August 1974).

In very special cases the Registrar may grant exemption from the disqualification referred to in the two preceding paragraphs upon receipt of a written statement setting out all relevant circumstances.

STUDENT FEES*

All students registered for a postgraduate degree or diploma and students taking postgraduate subjects as miscellaneous subjects or to qualify for registration as a candidate for a higher degree will be required to pay:—

University Union** \$20 entrance fee

Student Activities Fees†

University Union** \$30 annual subscription

Sports Association** \$4 annual subscription

Students' Union** \$7 annual subscription

Miscellaneous \$17 annual fee

(The miscellaneous fee is used to finance expenses of a capital nature relating to student activities. Funds are allocated to the various student bodies for projects approved by the student Affairs Committee of University Council.)

Examinations conducted under special circumstances — \$11 for each subject.

Review of examination result — \$11 for each subject.

Breakage and Key Deposit (School of Highway Engineering) — \$15 payable at beginning of course and refundable on its termination, less any charge for lost keys and/or breakages.

Late fees

Session 1

Fees paid from commencement of third week of the session to 31st March — \$20

Fees paid after 31st March where accepted with the express approval of the Registrar (see above) — \$40

Session 2

Fees paid in third and fourth weeks of the session — \$20

Fees paid thereafter — \$40

*Fees quoted in this schedule are current at time of publication and may be amended by Council without notice.

**Life members of these bodies are exempt from the appropriate fee or fees.

†The following students are exempt from the Student Activities Fees:

(a) External students

(b) Students resubmitting a thesis or project

(c) Students not in attendance at the University and who are enrolling in a thesis or project other than for the first time.

RESEARCH DEGREES — SPECIAL NOTE

A candidate who at the end of a year has completed all work for the degree other than the writing up of the thesis and who anticipates submitting the thesis to the Registrar for examination during the following year is required to re-enrol for that year and pay the appropriate student fees outlined above. However, when the student submits his thesis for examination he will receive a refund of the student fees on the same basis as if he had notified his withdrawal from the course.

LATE FEES

Initial Registration

Fees paid from commencement of sixth week after date of offer of registration to end of eighth week — \$20

Renewal at commencement of each Academic Year

Fees paid from commencement of third week of Session 1 to 31st March — \$20

Fees paid after 31st March where accepted with the express approval of the Registrar — \$40

WITHDRAWAL FROM COURSE

1. Students withdrawing from a course are required to notify the Registrar in writing.
2. Where notice of withdrawal from a course is received by the Registrar before the first day of Session 1, a refund of all fees paid will be made.
3. On notice of withdrawal:
 - (a) a partial refund of the University Union Entrance Fee will be made on the following basis: any person who has paid the Entrance Fee in any year and who withdraws from membership of the University Union after the commencement of Session 1 in the same year, or who does not renew his membership in the immediately succeeding year may, on written application to the Warden receive a refund of half the Entrance Fee paid:
 - (b) a partial refund of other Student Activities Fees is made on the following basis:
University Union — \$7.50 in respect of each half session.

University of New South Wales Students' Union — where notice is given prior to end of fifth week of Session 1 \$3.50; thereafter no refund.

University of New South Wales Sports Association — where notice is given prior to 30th April a full refund is made; thereafter no refund.

Miscellaneous Student Activities Fee — \$4.25 in respect of each half session.

4. Where initial registration is made at the commencement of Session 2 in any year and the student subsequently withdraws a refund of fees based on the above rules may be made.

POSTGRADUATE SCHOLARSHIPS TENABLE AT THE UNIVERSITY OF NEW SOUTH WALES

Brief particulars of scholarships tenable at this University are listed below. Additional scholarships in a variety of fields become available from time to time, and the Dean of the Faculty of Applied Science and the Heads of the Schools in the Faculty will be pleased to receive inquiries concerning the availability of such scholarships.

Students completing the final year of a course may apply but, in general, applicants should hold degrees with honours or equivalent qualifications.

Applications should be lodged by 31st October with the Registrar, P.O. Box 1, Kensington, New South Wales, 2033, on forms available from the University's Postgraduate Scholarships Unit. Each applicant from outside this University must arrange for a transcript (in triplicate) of his academic record to be forwarded by his University to reach the Registrar at about the same time as his application. He must also arrange for reports (in triplicate) by two referees, to be forwarded direct to the Registrar. If possible, one of the reports should be from a professor, and both should be from people familiar with the applicant's academic and professional performance.

Unless otherwise stated, the annual stipend for all scholarships is \$2,900 per annum and a dependants' allowance at the rate of \$650 per annum for a dependent wife and first child with a further \$234 per annum for each other child.

University Postgraduate Research Scholarships

The University of New South Wales provides each year a number of scholarships for postgraduate study and research in any field approved by the University.

These awards are normally for graduates of Australian Universities who are domiciled in Australia. They are tenable for up to a maximum of four years, subject to annual renewal.

Australian Postgraduate Course Awards

The Australian Government provides a number of awards for full-time postgraduate study in courses leading to the degree of Master by formal course work. Persons permanently domiciled in Australia who are under 45 years of age on 1st January of the year in which the award is to be taken up and who are University graduates or will graduate in the current academic year are eligible for the awards. Award holders receive a living allowance of \$2,900 paid over the academic year. Other allowances may also be paid in certain cases.

Applications for awards tenable at the University must be lodged with the Registrar by 30th September each year.

Australian Postgraduate Research Awards.

The Australian Government also provides each year a number of awards for full-time postgraduate study and research. The awards are renewable annually up to a maximum duration of two years in the case of a candidate for a Masters degree or three years in the case of a PhD candidate. In special circumstances, a PhD candidate may be granted an extension of tenure into a fourth year. Persons permanently domiciled in Australia who are under 35 years of age on 1 January of the year in which the award is to be taken up and who are University graduates or will graduate in the current academic year are eligible for the awards. Award holders receive a living allowance of \$3,050 per annum. Other allowances may also be paid in certain cases. The closing date for applications is 31 October each year.

The General Motors-Holden's Postgraduate Research Fellowships

General Motors-Holden's Limited has agreed to provide annually eight postgraduate research fellowships throughout Australia, three to be tenable in universities in New South Wales and the Australian Capital Territory, to enable the recipients to undertake a recognized full-time course leading to the degree of Master, or Doctor of Philosophy. Stipend ranges in value from \$3,000 to \$3,400 p.a.

The Clean Air Society of Australia and New Zealand Scholarship in Environmental Pollution Control

The Clean Air Society provides a scholarship to enable students to proceed to a Master of Applied Science degree in Environmental Pollution Control. The scholarship has a value of \$500 and is

normally tenable for one year, although it may be awarded to a student doing the course in two years of part-time study, in which case the value would be \$250 in each year. Applications must be lodged by 31st December each year.

Lever & Kitchen Pty. Ltd. Scholarship in Environmental Pollution Control

Lever & Kitchen Pty. Ltd. provide a scholarship to allow students to proceed to the degree of Master of Applied Science in Environmental Pollution Control. The scholarship has a value of \$1,000 per annum and is normally tenable for one year. Applications must be lodged by 31st December each year.

Foundry Research Fellowships in Metallurgy

Fellowships for research on foundry metallurgy, having an annual value up to \$3,000 each, are available to graduates in metallurgy and related disciplines. The fellowships are financed from the Foundry Research Trust Fund, set up by the Foundry Research Association. Holders of the awards are required to work for a higher degree. The Fellowships are tenable for a maximum of three years, subject to annual renewal.

Australian Wool Corporation Research Scholarships in Textile Technology

Several scholarships are provided by the Australian Wool Corporation for graduates in Textile Physics, Chemistry or Engineering for research in the fields of wool textile physics, wool textile chemistry or wool textile engineering. The scholarships have a value of \$2,900 per annum, plus fees and certain allowances and are tenable for a maximum of four years, subject to annual renewal.

Australian Wool Corporation Research Scholarships in Wool and Pastoral Sciences

Scholarships provided by the Australian Wool Corporation are available for graduates in Applied Science, Science, Agricultural Science, or Veterinary Science, wishing to work in the fields of Wool and Pastoral Sciences such as Agronomy, Animal Husbandry and Parasitology.

The scholarships have a value of \$2,900 per annum plus fees and certain allowances, and are tenable for a maximum of four years, subject to annual renewal.

OTHER POSTGRADUATE AWARDS

Particulars of the conditions applying to the undermentioned awards should be obtained from the persons with whom applications are to be lodged.

Australian Government Service Awards

The field of study is unrestricted. The awards are available only to officers of the Australian Government Service. Enquiries should be directed to the Commonwealth Public Service Board, Canberra.

C.S.I.R.O. Studentships

Studentships have a value of \$3,100 per annum, plus compulsory university fees, and allowances for dependants and for maintenance and travel expenses. Duration of awards up to three years. Applications to be lodged with the Secretary, Studentship Selection Committee, C.S.I.R.O., P.O. Box 225, Dickson, A.C.T., 2602, by early November.

Rothmans Fellowships Award

The field of study is unrestricted. The range of value of the awards is: Junior—Not more than \$7,750 p.a.; and Senior—Not more than \$12,000 p.a. The duration of the awards is not specified. Applications should be lodged with the Secretary, Rothmans University Endowment Fund, Sydney University, by early September.

Royal Australian Chemical Institute Masson Scholarship

One scholarship is provided annually for students proceeding to a higher degree in specified fields, including Chemical Engineering, Industrial Chemistry and Metallurgy. The scholarships are tenable for one year and have a value of \$1,200. Applications to the Executive Secretary, R.A.C.I., 55 Exhibition Street, Melbourne.

Australian Institute of Nuclear Science and Engineering Studentships

The Institute provides awards for students holding an Honours degree to proceed to higher degrees in specified fields, including Metallurgy. At least one-quarter of the student's period of tenure must be spent attached to the Institute at Lucas Heights, N.S.W. The awards are tenable for one to three years, and have a value

ranging from \$3,100 to \$3,500, plus University fees. The Institute also provides awards for post-doctoral research for one year renewable. The value of these awards is \$6,304 to \$8,984.

Conzinc Riotinto of Australia Limited

The award is given for postgraduate study and research in the fields of Mining, Chemical Engineering, Geology or Metallurgy. The value of the award is \$2,600 p.a. plus university fees for one to three years. Where applicable, allowances may also be payable for dependants, travel, thesis and materials. Applications should be lodged with Conzinc Riotinto of Aust. Ltd., Box 384D, Melbourne, Victoria, 3001, by 31st December.

Australian Meat Research Committee

The value of the awards is \$3,100 p.a., plus fees and certain allowances. They are tenable for two years, with possible extension for a further two years for study leading to the degree of Doctor of Philosophy. Applications to the Secretary, C.S.I.R.O., 314 Albert Street, East Melbourne, Vic., 3002, by 31st July.

OUTLINES OF POSTGRADUATE COURSES

Facilities are provided for students to carry out research for the degrees of Doctor of Philosophy, Master of Engineering or Master of Science. Master of Applied Science courses (MAppSc) and Graduate Diploma courses (GradDip) which contain a substantial component of formal study are available from a number of Schools in the Faculty. Master of Applied Science courses are offered in Hydrogeology-Engineering Geology by the School of Applied Geology; in Biological Process Engineering, Chemical Engineering, Environmental Pollution Control, Food Technology and Fuel Technology, by the School of Chemical Engineering; and in Metallurgy by the School of Metallurgy. Graduate Diploma courses are offered: in Corrosion Technology, Food Technology and Fuel Technology by the School of Chemical Engineering; in Polymer Technology by the School of Chemical Technology; in Mining and Mineral Engineering by the School of Mining Engineering; and in Wool Technology by the School of Wool and Pastoral Sciences.

545. GRADUATE DIPLOMA IN INDUSTRIAL ENGINEERING

Students who have graduated from schools of the Faculty of Applied Science and who wish to continue their studies in the field of scientific management, may enrol in the Graduate Diploma in Industrial Engineering offered by the School of Mechanical and Industrial Engineering.

This course provides instruction in accountancy, economics, industrial law, economic analysis, the use of human and physical resources, organization and administration, operations research and production control. Students take part in a case-study programme and staff from the Schools of the Faculty of Applied Science participate so that effective application of the principles of the course can be made to a student's own special industry.

SCHOOL OF APPLIED GEOLOGY

**802. Hydrogeology-Engineering Geology Graduate Course
(Master of Applied Science)**

The purpose of this course, which leads to the degree of Master of Applied Science, is to train graduates who have a suitable background as specialist hydrogeologists and engineering geologists. It is designed to provide a bridge between civil engineering and geology for graduates who wish to study and work in the field of water resources or civil engineering geology.

The normal requirement for admission to the course is a four year degree in Geology. Other graduates with suitable academic and professional attainments may be permitted to register.

The programme may be completed in one year on a full-time basis or two years on a part-time basis. The course consists of:

25.403G — Project

25.404G Environmental Geology

together with *four* of the following elective subjects to be selected according to the student's interests, after discussion with the Professor of Engineering Geology:

25.121G Engineering Geology

25.402G Hydrogeology

8.241 Geomechanics

8.757G Foundation Engineering

8.842G Groundwater Hydrology

27.901G Geomorphology for Hydrologists

Each of these subjects will consist of $1\frac{1}{2}$ hours per week lecture and $1\frac{1}{2}$ hours of laboratory work, extending over 2 sessions. The project is expected to occupy the student on an average of 9 hours per week.

SCHOOL OF CHEMICAL ENGINEERING

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

The MAppSc courses involve a project, 3.900G, 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.

Graduate Courses Specialising in:

**800. Biological Process Engineering; 801. Chemical Engineering; 803. Food Technology; and 806. Fuel Technology.
(Master of Applied Science)**

The MAppSc courses provide for a comprehensive study of theoretical and practical aspects of many advanced topics. The courses are elective in nature and provide an opportunity for graduates to apply their basic skills in fields in which the School has developed special expertise, namely: Chemical Engineering and Fuel Technology; Biological Process Engineering and Food Technology.

The courses specializing in Chemical Engineering and Fuel Technology are primarily intended for graduates in Applied Science, Engineering, or Science with principal interests in Chemistry, Mathematics and/or Physics. The courses specializing in Biological Process Engineering and Food Technology are primarily intended for graduates in Agriculture, Applied Science, and Science with principal interests in Biochemistry, Chemistry and/or Microbiology. They are designed to allow the maximum flexibility consistent with the standing of the award. Intending candidates are invited to submit proposed study programmes to the Head of the School for advice and recommendation.

An acceptable course is a programme of formal study aggregating approximately twenty hours weekly for two sessions full-time or ten hours weekly for four sessions part-time, comprising:

1. a major strand of course material making up 75% of the total programme. This includes a project constituting not less than 15% and not more than 30% of the programme;
2. a minor strand of broader-based supporting material making up to 25% of the total programme; and
3. undergraduate material (generally designated as subjects without a suffixed G number in the Calendar), which may be included in one or both strands but may not exceed 25% of the total programme.

Approximately 60% of the programme (including the project) must be undertaken in the School of Chemical Engineering. The remainder, subject to approval and availability, may be undertaken in other Schools within the University. Full details of all subjects are given in Section D of the University Calendar.

804. Environmental Pollution Control Graduate Course (Master of Applied Science)

The graduate course in Environmental Pollution Control leads to the degree of Master of Applied Science. It extends over one full-time year or two part-time years. The course is primarily intended for candidates in Chemical Engineering and Industrial Chemistry who have completed a four year degree programme, but candidates from other disciplines in Science or Engineering may be admitted.

The advent of new laws governing the disposal of effluents into the environment will make the problems of industry more acute as industrial processes are developed and expanded. This course is intended to cover the problems in environmental engineering which may be encountered by industrial plants.

		Hours per week for 2 Sessions Lec./Lab.
(a)		
3.170G	Process Principles or Graduate Elective	2
(b)		
3.162G	Urban Planning	½
3.164G	Medical and Legislative Aspects	1
25.701G	Subsurface Geology and Pollution Control	1
27.902G	Meteorological and Hydrological Principles	1
27.903G	Geographic Background to Pollution Problems	½
44.111	Microbiology	3
(c)		
3.163G	Industrial Use and Re-use of Water	1
3.242G	Treatment and Utilization of Biological Effluents	2
3.391G	Atmospheric Pollution and Control	2
3.396G	Unit Operations in Waste Management	1
	Optional Elective(s) and	3
3.901G	Minor Project	3
	or	
3.900G	Project	

3.170G Process Principles is a bridging course for all candidates other than Chemical Engineering and Industrial Chemistry graduates. Candidates who have passed the equivalent of first year Chemistry take 3.170G Process Principles, and those who have passed the equivalent of second year Chemistry may take specified parts of 3.170G Process Principles and an approved graduate elective each for one hour per week. Graduates in Chemical Engineering or Industrial Chemistry take an approved elective.

All electives must be approved by the Head of the School, but applications will be considered regarding any subject available in the University which has a relevance to Pollution Control.

Students intending to undertake the course over two part-time years may do so by attending on one afternoon and two evenings per week. Every effort should be made to include in the first part-time year the subjects listed in (a) and (b) above.

The work involved in the Theoretical Project must be embodied in a report and submitted in accordance with the requirements of the School.

501. Corrosion Technology Graduate Course (Graduate Diploma)

The Graduate Diploma course in Corrosion Technology is open to graduates in Engineering, Applied Science or Science. At present it may only be taken as a two-year part-time course.

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. It is anticipated that in training personnel to reduce corrosion losses the University will make a substantial contribution to Australian industrial economics.

For graduates from Engineering (non-chemical) or Science (in a particular major) a bridging course is a necessary introduction to the graduate level of certain subjects. For this purpose the subject, 3.170G Process Principles, is specified.

The first year of the course introduces elementary aspects of corrosion technology and suitably orientates students depending on their initial qualifications. The second year of the course contains more detailed instruction at a graduate level in Corrosion Theory and Prevention, together with suitable laboratory assignments.

YEAR 1	Hours per week for 2 Sessions Lec./Lab.	
3.170G Process Principles <i>or</i>		
3.172G Corrosion Laboratory	2	
3.171G Corrosion Technology I	3	
	<hr/>	5
	<hr/>	

Chemical Engineering graduates will undertake:

3.172G Corrosion Laboratory

Science graduates who have passed the equivalent of second year Chemistry will undertake parts of:

3.170G Process Principles—1 hr./wk.

3.172G Corrosion Laboratory—1 hr./wk.

Graduates who have passed only the equivalent of first year Chemistry will undertake 3.170G Process Principles.

YEAR 2

3.173G	Corrosion Materials	2
3.174G	Corrosion Technology II	3
3.175G	Seminar	1
3.176G	Corrosion Literature Review	2†
3.177G	Testing Laboratory (by roster)	2†
		<hr/>
		10
		<hr/>

502. Food Technology Graduate Course (Graduate Diploma)

The graduate diploma course in Food Technology is designed to provide professional training at an advanced level in food technology for graduates in science, applied science or engineering who have not had previous training in this field.

In addition to a first degree, candidates may also be required to undertake assignments or complete successful examinations as directed by the Head of the School.

The course is a blend of formal lectures and laboratory work at the undergraduate and postgraduate levels. The Diploma in Food Technology (GradDip) is awarded on the successful completion of one year full-time study (18 hours a week), or two years of part-time study (9 hours a week). It involves the following programme:

		Hours per week for 2 Sessions
3.201	Food Technology I	1
3.211	Food Technology II	2
3.212	Food Technology III	2
3.213G	Food Process Laboratory	3
3.243G	Food Technology Seminar	2
	Electives	8
		<hr/>
		18
		<hr/>

† This is the weekly equivalent of total hours for the subject. These hours may, however, be concentrated in one period.

Electives are to be selected from the following list of subjects, according to availability and with the approval of the Head of School. The hours for these electives must include at least four devoted to graduate subjects.

2.271G	Chemistry and Analysis of Foods	3
3.231	Food Engineering I	2
3.232	Food Engineering II	3
3.242G	Treatment and Utilization of Biological Effluents	2
42.211G	Principles of Biology	1½
42.212G	Principles of Biochemistry	1½
42.213G	Biochemical Methods	1½
42.214G	Biotechnology	1½
44.111	Microbiology	3
or such other electives, to a total of 3 hours/week, approved by the Head of School.		

503. Fuel Technology Graduate Course (Graduate Diploma)

The Graduate Diploma Course in Fuel Technology has been designed to provide professional training and specialization in fuel science and engineering for graduates in Science, Applied Science or Engineering who have not had previous training in this field.

Applicants holding an appropriate degree or equivalent qualification in Science, Applied Science or Engineering are eligible for admission to the course. They may also be required to undertake assignments or complete successfully examinations as directed by the Head of the School.

The Graduate Diploma in Fuel Technology is awarded on the successful completion of one year of full-time study (18 hours per week) or two years of part-time study (9 hours per week). The course is a blend of formal lectures and laboratory work at undergraduate and postgraduate levels.

		Hours per week for 2 Sessions Lec./Lab.
<i>A. Introductory Stage (up to nine hours per week)</i>		
3.381	Principles of Fuel Technology	3
3.382	Combustion Engineering	3
3.383	Fuel Plant Evaluation and Assignments	3
		<hr/> 9 <hr/>

**Hours per week
for 2 Sessions**

Lec./ Lab.

B. Advanced Stage (up to nine hours per week)

3.390G	Post-graduate Seminar	1
	Advanced Electives*	8
		<hr/> 9

* Subjects to be selected from the following according to availability and specialisation required:—

3.391G	Atmospheric Pollution and Control	2
3.392G	Fuel Science	3
3.393G	Fuel Engineering Plant Design	3
3.394G	Thermal Engineering and Fuel Processing	3
3.395G	Research Techniques and Extension Methods	2
3.396G	Unit Operations in Waste Management	2

When appropriate, up to three hours per week may be selected from approved courses offered by other Schools within the University, e.g., Coal Preparation, Instrumentation and Automatic Control, Ceramics, Nuclear Engineering, etc.

SCHOOL OF CHEMICAL TECHNOLOGY**506. Polymer Technology Graduate Course
(Graduate Diploma)**

The Graduate Diploma course in Polymer Technology is designed for persons holding a degree, or equivalent qualifications, in Science or Engineering who wish to specialize in Polymer Technology and extend their theoretical knowledge and practical experience in fields such as plastics, rubbers, synthetic resins, adhesives and surface coatings.

Two years of study on a part-time basis are required for completion of this course, which leads to the Graduate Diploma in Polymer Technology (GradDip). However, candidates may be required, depending upon their formal training in Organic Chemistry, Physical Chemistry, Statistics and Mathematics, to spend a preliminary period of study before actually embarking upon the formal programme of the diploma.

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 1—PART-TIME		Lec.	Lab. Tut.	Lec.	Lab. Tut.
22.311G	Polymer Processes I	1	0	1	2½
22.321G	Physical Chemistry of Polymers I	1	0	1	2½
22.331G	Polymer Engineering I	2	5	2	0
		4	5	4	5
YEAR 2—PART-TIME					
22.312G	Polymer Processes II	1	2½	1	0
22.322G	Physical Chemistry of Polymers II	1	2½	1	0
22.332G	Polymer Engineering II	2	0	2	5
		4	5	4	5

SCHOOL OF METALLURGY

The School of Metallurgy conducts courses which may lead to the award of Master of Applied Science, and also, from time to time, short courses on topics in Chemical and Extractive Metallurgy and Physical Metallurgy.

In addition to these opportunities for formal postgraduate studies, the School welcomes enquiries from graduates in Science, Engineering and Metallurgy who are interested in doing research in metallurgy for the degrees of Master of Science, Master of Engineering and Doctor of Philosophy.

The Head of the School will be pleased to give information about research scholarships, fellowships and grants-in-aid. Graduates are advised to consult him before making a formal application for registration.

805. Metallurgy Graduate Course (Master of Applied Science)

This course provides for a comprehensive study of theoretical and practical topics at an advanced level. It is designed to allow the maximum flexibility in choice of topics consistent with the standing of the award.

Intending candidates are invited to discuss proposed study programmes with the Head of the School for advice and recommendation.

An acceptable programme would be:

- (a) a programme of formal study (including a project) totalling approximately twenty hours per week for two sessions full-time.
- (b) a project comprising about twenty per cent of the programme.

At least eighty per cent of the total programme must be composed of units selected from those available as part of the post-graduate subjects listed below, except that not more than eight hours per week for two sessions may be devoted to each of 4.211G Metallurgical Practice and 4.231G Advanced Theoretical Metallurgy and not more than six hours per week for two sessions may be devoted to 4.221G Advanced Metallurgical Techniques.

POSTGRADUATE SUBJECTS

	Hours per week* for 2 sessions
4.241G Graduate Metallurgy Project	Not less than 4
4.211G Metallurgical Practice	4 to 8
Detailed studies relating to one or more of the following:—	
(a) Extractive Metallurgy	
(b) Metal working and forming	
(c) Foundry practice	
(d) Welding and metal fabrication	
(e) Metal finishing and corrosion protection	
4.221G Advanced Metallurgical Techniques	1 to 2
4.231G Specialist Lectures in Advanced Theoretical Metallurgy	Offered in units of 7 hours (i.e. 1 hour/week for 7 weeks)
4.251G Advanced Materials Technology	3

* These courses may be presented at twice the weekly rate over one session.

UNDERGRADUATE SUBJECTS

These subjects are intended for inclusion in qualifying courses and to satisfy pre- and co-requisite requirements for students whose first degree is in a field other than metallurgy.

	Hours per week for 2 sessions
4.121 Principles of Metal Extraction	3
4.131 Principles of Physical and Mechanical Metallurgy	3
4.141 Experimental Techniques in Physical Metallurgy	2

The above Undergraduate subjects offered by the School of Metallurgy and undergraduate and graduate subjects offered by other Schools of the University may be included, but may not exceed 20 per cent of the total programme.

SCHOOL OF MINING ENGINEERING

The School offers a postgraduate course, leading to the award of a Graduate Diploma (GradDip).

504. Mining and Mineral Engineering Graduate Course (Graduate Diploma)

The Graduate Diploma Course 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 mining and the beneficiation of minerals and coal.

The Graduate Diploma (GradDip) will be awarded on the successful completion of one year of full-time or two years of part-time study. The course is a blend of lecture and laboratory work and allows the choice of elective specialization in mining or the beneficiation of minerals or the preparation of coal.

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. Normally, the programme will be arranged so that it may be completed in one year full-time or two years part-time. It should be noted that some degree of specialization will be possible in the laboratory investigations.

		Hours per week	
		SESSION 1	SESSION 2
		Lec./Lab.	Lec./Lab.
YEAR 1—PART-TIME			
7.023	Mining and Mineral Process Engineering Parts 1 and 2	4	0
7.033	Mineralogical Assessment	1	0
7.234	Mineral Economics	0	2
7.311G	Mineral Beneficiation	0	3
7.111G	Mining Engineering	0	3
		—	—
		5	8
		—	—

		Hours per week	
		Lec./Lab.	Lec./Lab.
YEAR 2—PART-TIME			
7.122G	Mining Engineering Technology	6	0
	or		
7.322G	Mineral Beneficiation Technology	6	0
7.132G	Mining Engineering Laboratory and		
	Project	0	6
	or		
7.332G	Mineral Engineering Laboratory	0	6
		<hr/> 6	<hr/> 6
		<hr/>	<hr/>

When appropriate up to three hours per week may be selected from other approved courses available within this School or those offered by other Schools within the University.

SCHOOL OF WOOL AND PASTORAL SCIENCES

508. Wool Technology Graduate Course (Graduate Diploma)

The Graduate Diploma Course in Wool Technology 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.

Recently the course was made more flexible to permit prospective students to specialize in particular graduate aspects of Wool and Pastoral Sciences, and at the same time, to do supporting work in related undergraduate fields which they may not have covered in their undergraduate training, or which, having covered, they wish to revise.

The normal requirement for admission to the course is a degree in Agriculture, Veterinary Science or Science, in an appropriate field. In addition, students may be required to take a qualifying examination in the basic disciplines of the Wool and Pastoral Sciences BSc degree course, viz. General and Human Biology, Agronomy and/or Livestock Production. 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 programme 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 of two optional graduate level subjects to the extent of ten hours lecture and laboratory work per week for two sessions plus approved undergraduate subjects to the extent of eight hours 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.

Hours per week for 2 Sessions

	Lec.	Lab.
9.105G Advanced Livestock Production	4	0
9.503G Wool Study	2	4
9.711G Advanced Wool Technology	2	2
9.902G Techniques of Laboratory and Field Investigation	2	2
Approved undergraduate subjects	4	4

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.

Successful completion of the course leads to the award of a Graduate Diploma (GradDip).

DETAILS OF SUBJECTS

The following pages contain a list of most of the subjects offered for courses in the Faculty of Applied Science. In general, the list is arranged according to subject numbers and the School responsible for the subject.

Details of subjects available in Faculty of Applied Science courses but not included in this list may be obtained from the School responsible for the subject. Details of subjects in the Faculty of Arts which may be taken as Humanities subjects may be found in the current Arts Faculty Handbook.

Students are required to have their own copy of the prescribed Textbooks. Lists of Reference Books for additional reading, and of Textbooks, where not given here, will be issued by the Schools.

DEPARTMENT OF GENERAL STUDIES (HUMANITIES SUBJECTS)

Almost all undergraduate students in faculties other than Arts and Law and in the Bachelor of Science Economic Geography Course are required to study a number of General Studies subjects. Test and Reference Books for all General Studies subjects and outlines of the subjects appear in the *Department of General Studies Handbook*, which is available free of cost to all students.

SCHOOL OF PHYSICS

1.001 Physics I

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.

The application of wave and particle theories in physics. A review of the atomic theory of matter and the structure and properties of atomic nuclei. A molecular approach to energy transfer, kinetic theory, gas laws and calorimetry. 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. Interaction of radiation with matter, photoelectric effect, Compton effect, spectroscopy. Resolution of the wave, particle paradox by means of wave mechanics and the uncertainty principle.

TEXTBOOK

Bueche, F. *Introduction to Physics for Scientists and Engineers*, McGraw-Hill.

REFERENCE BOOKS

- Ference, M., Lemon, H., & Stephenson, R. J. *Analytical Experimental Physics*. Chicago U.P.
- Halliday, D., & Resnick, R. *Physics for Students of Science and Engineering*. Vols. I & II. Wiley.
- Wiedner, R. T. V., & Sells, R. L. *Elementary Classical Physics*. Vols. I and II. Allyn & Bacon.

1.011 Higher Physics I

Kinematics-Non-uniformly accelerated systems. Centripetal acceleration. Laws of motion. Momentum. Impulse. Potential and kinetic energy. Power. Conditions of equilibrium. Elasticity. Young's bulk and shear moduli. Poisson's ratio. Strain energy. Hydrodynamics. Bernoulli's equation. Motion in resistive medium. Moments of inertia. Rotational dynamics. Simple harmonic motion. Pendulums. Motion about free axis. Progressive and stationary waves. Energy current. Superposition of waves. Doppler effect. Resonance. Huygen's principle. Reflection, refraction, interference and diffraction of waves. Electromagnetic spectrum. Polarization.

Electrostatics, Gauss' theorem. Electric intensity. Capacitance. Electromagnetism. Biot-Savart and Ampere's circuital laws. Force on moving charge and on conductor. Torque on coil. D.C. instruments. Electromagnetic induction. Faraday's and Lenz's laws. Self and mutual inductance. D.C. circuits. Kirchhoff's rules and Thevenin's theorem. Growth and decay of current. A.C. circuits. Resonance. Diode. Triode. Amplifiers and oscillators. Electronic measuring instruments.

TEXTBOOKS

- Halliday, D., and Resnick, R. *Physics for Students of Science and Engineering*. Vols. I and II, or combined volume. Wiley, 1960.
- Russell, G. J., and Mann, K. *Alternating Current Circuit Theory*. N.S.W.U.P.
- Spiegel, M. R. *Theory and Problems of Theoretical Mechanics*, Schaum.

REFERENCE BOOKS

- Brophy, J. J. *Basic Electronics for Scientists*. McGraw Hill. Paperback.
- Feynman, R. P., Leighton, R. B. & Sands, M. *The Feynman Lectures on Physics*. Vols. I and II. Addison Wesley.
- Tombouliau, D. H. *Electric and Magnetic Fields*. Harcourt, Brace & World, N.Y., 1965.

1.112A Electromagnetism

Electrostatics and magnetostatics in vacuum and in dielectrics. Magnetic materials. Maxwell's equations and simple applications.

TEXTBOOK

- Reitz, J. R. and Milford, F. J. *Foundations of Electromagnetic Theory*. 2nd ed. Addison-Wesley.

1.112B Modern Physics

Special relativity. Quantum theory. Schrödinger wave equation and simple applications. Atomic and nuclear physics. Nuclear reactions.

TEXTBOOKS

- Beiser, A. *Perspectives of Modern Physics*. Rev. ed. McGraw-Hill, 1969
- Coster, H. G. L. *Experimental Physics*. N.S.W.U.P.

1.112C Waves in Continuous Media and Thermodynamics

Waves in continuous media: oscillations and forced vibrations, Fourier analysis, travelling waves and wave packets. *Thermodynamics:* First and second laws of thermodynamics. Thermodynamic functions and simple applications. Statistical foundations of thermodynamics. Kinetic theory of gases.

TEXTBOOKS

French, A. P. *Vibrations and Waves*. Nelson, 1971.

Mandl, F. *Statistical Physics*. Wiley, 1971.

1.113A Wave Mechanics and Spectroscopy

Concepts, harmonic oscillator, uncertainty principle, the free particle, barriers, the hydrogen atom, many electron atoms, removal of degeneracy, spectroscopy, molecules, periodic potentials, band structure, perturbations.

TEXTBOOK

Beiser, A. *Perspectives of Modern Physics*. Rev. ed. McGraw-Hill, 1969.

1.113B Electromagnetic Fields and Physical Optics

Wave equation; propagation in dielectrics and ionized media; reflection and transmission; guided waves, coherence of radiation; interaction of radiation with matter; stimulated emission; laser oscillators; properties of laser light; interferometry; diffraction; convolution theorem X-ray and neutron diffraction.

TEXTBOOK

Lipson, H., and Lipson, S. S. *Optical Physics*. C.U.P., 1969.

1.113C Statistical Mechanics and Solid State

Thermodynamic potentials, ensembles and partition functions, lattice vibrations, the grand canonical ensemble, Pauli exclusion principle, Bose-Einstein and Fermi-Dirac distributions.

Structure of crystals, imperfections, specific heat. Band theory of solids, semiconductors.

TEXTBOOKS

Blakemore, J. S. *Solid State Physics*. W. B. Saunders, 1969.

Jackson, E. A. *Equilibrium Statistical Mechanics*. Prentice-Hall, 1968.

1.122A Electromagnetism

Further electrostatics. Poisson's and Laplace's equations. Ferromagnetism. Maxwell's equations and application to waves in isotropic dielectrics. Poynting vector.

TEXTBOOKS

Corson, D. & Lorrain, P. *Introduction to Electromagnetic Fields and Waves*. Freeman, 1962.

1.122B Quantum Physics

Syllabus as for 1.112B but treated at a higher level and including some solid state physics.

TEXTBOOKS

Eisberg, R. M. *Fundamentals of Modern Physics*. Wiley, 1961.

1.122C Thermodynamics and Mechanics

Thermodynamics: as for 1.112C Thermodynamics but at higher level and with some additional topics. *Mechanics:* oscillations and forced vibrations, Lagrange's equation, variational principles, Hamilton's equations.

TEXTBOOKS

Reif, F. *Fundamentals of Statistical and Thermal Physics*. McGraw-Hill. 1965.

Symon, K. R. *Mechanics*. 2nd ed. Addison-Wesley. 1965.

1.123A Quantum Mechanics

Concepts, measurements, expectation values, wave mechanics, matrix mechanics, free particle and barrier problems, hydrogen atom spin, exclusion principle, stationary and time dependent perturbation methods, scattering. Born approximation and partial waves.

TEXTBOOK

Schiff, L. I. *Quantum Mechanics*. 2nd ed. McGraw-Hill.

1.123B Electromagnetic Theory and Statistical Mechanics

Metallic boundary conditions, eigenfunctions and eigenvalues, cavities, wave guides, scattering by a conductor wave equation for potentials, radiation fields, Hertz potential, dipole and multipole radiation, radiated energy and angular momentum.

Statistical mechanics: Kinetic theory, the Boltzmann equation, Maxwell-Boltzmann distribution, Boltzmann's H-theorem Classical statistical mechanics: postulates, equipartition, ensembles, difficulties; quantum statistical mechanics; postulates, ensembles, Fermi and Bose statistics.

TEXTBOOK

Corson, D., and Lorrain, P. *Introduction to Electromagnetic Fields and Waves*. Freeman.

REFERENCE BOOK

Knox, J. H. *Molecular Thermodynamics*. Wiley.

1.123C Solid State and Nuclear Physics

Crystallography, binding energy, phonons, lattice conduction, free electron gas, band theory.

Nuclear models, binding energy, nuclear forces, elementary particles, nuclear reactions, radioactive decay.

TEXTBOOKS

Burcham, W. E. *Nuclear Physics and Introduction*. Longmans, 1963.

Kittel, C. *Introduction to Solid State Physics*. 3rd ed. Wiley, 1967.

1.133A Electronics

A.C. circuit analysis, band theory of semiconductors, diode, field effect transistor, rectifier circuits, power supplies, single and multistage amplifiers, positive feedback, oscillators.

TEXTBOOKS

Delaney, C. F. G. *Electronics for the Physicist*. Penguin, 1969.

Transistor Manual. General Electric Co. 1972 or 1971.

Russell, G. J. & Mann, K. *Alternating Current Circuit Theory*. N.S.W.U.P.

1.212 Physics IIT**Unit B (Electronics)**

Vacuum tubes and applications. Conduction in solids; solid state diodes, transistors, amplifiers, feed back.

TEXTBOOK

Smith, R. J., *Circuits, Devices and Systems Theory*. 2nd ed. Wiley, 1972.

Unit C (Introduction to Physics of Solids)

Introductory quantum mechanics and atomic physics; crystal structure; point and line defects; introductory band theory; conductors, semi-conductor and insulators; energy level diagrams.

TEXTBOOK

Rudden, M. N. & Wilson, J. *A Simplified Approach to Solid State Physics*. Butterworths, 1971.

1.213 Physics III

For Textile Physics Students.

The lectures and tutorials of 1.113, Units A, B, C and 1.133, Unit A, together with 3 hours per week laboratory work.

1.223 Higher Physics III

For Textile Physics Students.

The lectures and tutorials of 1.123, Units A, B, C and 1.133, Unit A, together with 3 hours per week laboratory work.

SCHOOL OF CHEMISTRY

2.001 Chemistry I

Classification of matter and theories of the structure of matter. Atomic structure, the periodic table and chemical behaviour. Chemical bonds and molecular structure. Equilibrium and change in chemical systems. The structure, nomenclature and properties of organic compounds. Reactions of organic compounds.

TEXTBOOKS

Aylward, G. H., & Findlay, T. J. V. eds. *SI Chemical Data*. Wiley, 1971.
Chemistry I Laboratory Manual. N.S.W.U.P., 1974.

Kneen, W. R., Rogers, M. J. W., & Simpson, P. *Chemistry—Facts, Patterns and Principles*. Addison-Wesley, 1972.

Schaum Outline Series. *Theory and Problems of College Chemistry*. McGraw-Hill SI (metric) ed.

REFERENCE BOOKS

Barrow, G. M., Kenney, M. E., Lassila, J. D., Litle, R. L. & Thompson, W. E. *Understanding Chemistry*. Benjamin, 1969.

Brown, G. I. *A New Guide to Modern Valency Theory*. Longmans, 1967.

Eastwood, F. W., Swan, J. M. & Yonatt, J. B. *Organic Chemistry. A First University Course in Twelve Programs*. Science Press, 1967.

Gray, H. B. & Haight, G. P. *Basic Principles of Chemistry*. Benjamin, 1967.

Pauling, L. *College Chemistry*. 3rd ed. Freeman, 1964.

Runquist, O., Cresswell, C. J. & Head, J. T. *Chemical Principles. A Programmed Text*. Burgess, 1968.

Sisler, H. H., Van der Werf, C. A. & Davidson, A. W. *College Chemistry*. 3rd ed. Collier-Macmillan, 1967.

Vogel, A. I. *Macro and Semimicro Qualitative Analysis*. 4th ed. Longman, 1954.

2.002 Chemistry II

This course consists of three strands, 2.002A, B, C as follows:

2.002A Chemistry II (Physical Chemistry)

Quantum mechanics; molecular energy and thermodynamics; chemical application of thermodynamics; surface and colloid chemistry.

TEXTBOOKS

Aylward, G. H., & Findlay, T. J. V. eds *SI Chemical Data*. Wiley, 1971.

Barrow, G. M. *Physical Chemistry*. 3rd ed. McGraw Hill, 1973.

Shaw, D. J. *Introduction to Colloid and Surface Chemistry*. 2nd ed. Butterworths, 1970.

REFERENCE BOOKS

Adamson, A. W. *Textbook of Physical Chemistry*. Academic, 1973.

Alexander, A. E., & Johnson, P. *Colloid Science*. O.U.P., 1950.

Barrow, G. M. *Structure of Molecules*. Benjamin, 1963.

Daniels, F., & Alberty, R. A. *Physical Chemistry*. 3rd ed. Wiley, 1966.

Daniels, F. et. al. *Experimental Physical Chemistry*. 7th ed. McGraw-Hill, 1970.

Glasstone, S. *Textbook of Physical Chemistry*. 2nd ed. Van Nostrand, 1948.

Moore, W. J. *Physical Chemistry*. 4th or 5th ed. Longman, 1963 or 1972.
Shoemaker, D. P., & Garland, C. W. *Experiments in Physical Chemistry*.
2nd ed. McGraw-Hill, 1967.

2.002B Chemistry II (Organic Chemistry)

Chemistry of the more important functional groups: aliphatic hydrocarbons, monocyclic aromatic hydrocarbons, halides, alcohols, phenols, aldehydes, ketones, ethers, carboxylic acids and their derivatives, nitro compounds, amines, and sulphonic acids.

TEXTBOOKS

Morrison, R. T., & Boyd, R. N. *Organic Chemistry*. 3rd ed. Allyn & Bacon, 1973. Int. student ed.
Vogel, A. I. *Elementary Practical Organic Chemistry*. Pt. II. Qualitative Organic Analysis. Longman, 1957 (only if proceeding to 2.003B or 2.622).

2.002C Chemistry II (Inorganic/Analytical Chemistry)

Chemistry of non-metals; chemistry of typical metals; transition metals, lanthanides and actinides; introduction to nuclear chemistry. Quantitative inorganic analysis.

TEXTBOOKS

Fischer, R. B., & Peters, D. G. *Quantitative Chemical Analysis*. W. B. Saunders, 1968.
Jolly, W. L. *The Chemistry of the Non-Metals*. Prentice-Hall, 1966.
Quagliano, J. V., & Vallarino, L. M. *Coordination Chemistry*. Heath, 1969.

REFERENCE BOOKS

Basolo, F. & Johnson, R. *Coordination Chemistry*. Benjamin, 1964.
Carswell, D. J. *Introduction to Nuclear Chemistry*. Elsevier, 1967.
Cotton, F. A., & Wilkinson, G. *Advanced Inorganic Chemistry*. 2nd ed. Wiley, 1966.

2.003A Chemistry III (Physical Chemistry)

Physico-chemical aspects of spectroscopy — quantum mechanical approach; electronic and vibrational spectra; nuclear magnetic resonance and electron spin resonance spectroscopy. Chemical kinetics — transition state theory; theories of unimolecular reactions; chemistry of excited species.

TEXTBOOKS

Banwell, C. N. *Fundamentals of Molecular Spectroscopy*. 2nd ed. McGraw Hill, 1972.
Barrow, G. M. *Physical Chemistry*. 2nd ed. McGraw-Hill, 1966.
Dixon, R. N. *Spectroscopy and Structure*. Methuen, 1965.
Laidler, K. J. *Chemical Kinetics*. 2nd ed. McGraw-Hill, 1965.

REFERENCE BOOKS

Benson, S. W. *Thermochemical Kinetics*. Wiley, 1968.
Calvert, J. G., & Pitts, J. N. *Photochemistry*. Wiley, 1966.

- Carrington, A., & McLachlan, A. D. *Introduction to Magnetic Resonance*. Harper & Row, 1967.
- Daniels, F. et al. *Experimental Physical Chemistry*. 6th or 7th ed. McGraw Hill, 1970 or 1972.
- Gardiner, W. C. *Rates and Mechanisms of Chemical Reactions*. Benjamin, 1969.
- Glasstone, S., Laidler, K. J., & Eyring, H. *Theory of Rate Processes*. McGraw-Hill, 1941.
- King, G. W. *Spectroscopy and Molecular Structure*. Holt, Rinehart & Winston, 1964.
- Shoemaker, D. P., & Garland, C. W. *Experiments in Physical Chemistry*. 2nd ed. McGraw-Hill, 1967.
- Weston, R. E., & Schwarz, H. A. *Chemical Kinetics*. Prentice Hall, 1972.

2.003B Chemistry III (Organic Chemistry)

Stereochemistry of acyclic systems. *Alicyclic Chemistry*: The synthesis and properties of monocyclic systems, conformational aspects of cyclohexane and related systems, rearrangement reactions, and the chemistry of fused and bridged polycyclic compounds. *Heterocyclic Chemistry*: The chemistry of pyridine, quinoline, isoquinoline, and benzopyran and its derivatives. The chemistry of pyrrole, furan, and thiophene and their benzo derivatives. The chemistry of pyrimidine, imidazole, and pyrazole.

TEXTBOOKS

- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, 3rd ed. Allyn & Bacon, Int. student ed. or
- Roberts, J. D. & Caserio, M. C. *Basic Principles of Organic Chemistry*. Benjamin, 1964.
- Tedder, J. M., Nechvatal, A., Murray, A. W. & Carnduff, J. *Basic Organic Chemistry*. Pt. 3. Wiley, 1970.
- Vogel, A. I. *Elementary Practical Organic Chemistry*. Pt. II. Qualitative Organic Analysis. Longman, 1957.

REFERENCE BOOKS

- Acheson, R. M. *An Introduction to the Chemistry of Heterocyclic Compounds*. 2nd ed. Wiley Int. ed., 1967.
- Eliel, E. L. *Stereochemistry of Carbon Compounds*. McGraw-Hill, 1962.
- Eliel, E. L., Allinger, N. L., Angyal, S. J. & Morrison, G. A. *Conformational Analysis*. Interscience, 1965.
- Gould, E. S. *Mechanism and Structure in Organic Chemistry*. Holt, Rinehart & Winston, 1959.
- Hallas, G. *Organic Stereochemistry*. McGraw-Hill, 1965.
- March, J. *Advanced Organic Chemistry. Reactions, Mechanisms and Structure*. McGraw-Hill, 1968.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*. 3rd ed. Longman, 1971.
- Whitham, G. H. *Alicyclic Chemistry*. Oldbourne Press.

2.021 Chemistry IE

A terminating subject for students in the Aeronautical, Civil, Industrial and Mechanical Engineering, Naval Architecture, and Applied Geography courses.

Classification of matter and theories of the structure of matter. Atomic structure, the periodic table and chemical behaviour. Chemical bonding and the nature and properties of chemical substances. Equilibrium and change in chemical systems.

2.022 Chemistry IIM

Units 2.002A (Physical Chemistry) and 2.002C (Inorganic Analytical Chemistry) of 2.002 Chemistry II.

2.221 Chemistry and Enzymology of Foods

Similar to 2.261 Chemistry and Enzymology of Foods with reduction in scope and depth. Emphasis is continued on the integration of different areas of chemistry.

REFERENCE BOOKS

- Heftmann, E. *Chromatography*. 2nd ed. Reinhold, 1967.
Joslyn, M. A. *Methods in Food Analysis*. Academic, 1950.
Karrer, P., & Jucker, E. *Carotenoids*. Elsevier, 1950.
Markley, K. L. *The Fatty Acids*. 2nd ed. Interscience, 1960-67.
Neurath, H. *The Proteins*. Vols. I-IV. 2nd ed. Academic, 1963-68.
Pigman, W. *The Carbohydrates*. Academic, 1957.
Winton, A. L. & Winton, K. B. *Structure and Composition of Foods*. Wiley, 1932.

Subsidiary lists are supplied from the Department.

2.261 Chemistry and Enzymology of Foods

The chemistry of food constituents at an advanced level and the relationship between the chemistry and enzymology associated with the origin and post-harvest handling of the foodstuff; deteriorative changes in colour and texture occurring during processing and storage. Analytical procedures, chemical and physical.

General classification of constituents, role of moisture. Fixed oils and fats, rancidity of enzymic and autoxidative origin, antioxidants—natural and synthetic—theories on mechanisms of action, carbohydrates reactivity, role in browning processes, carbohydrate polymers, starch structure, enzymic susceptibility and mode of action, estimation, pectic substances and other gelling agents, gel structure. Proteins, sulphur chemistry of proteins, position in cereal chemistry, bleachers and improvers, theories on mode of action, redox and displacement reactions. Colour systems, origin, development and chemistry of natural food pigments, carotenoids, chlorophyll, etc. Stability and estimations, enzymic degradation and enzymic browning, vitamins, preservatives.

REFERENCE BOOKS

- As for 2.221 less books of Joslyn and the Wintons, plus:
Gunstone, F. D. *An Introduction to the Chemistry and Biochemistry of the Fatty Acids and their Glycerides*. Chapman & Hall, 1968.
Gunstone, F. D. *The Fatty Acids*. Chapman & Hall, 1968.
Reed, G. *Enzymes in Food Processing*. Academic, 1966.
Schultz, H. W. ed. *Carbohydrates and their Roles*. Avi Publishing Co., 1969.
Schwarz, J. C. P. *Physical Methods in Organic Chemistry*. Oliver & Boyd, 1964.
Scott, G. *Atmospheric Oxidation and Antioxidants*. Elsevier, 1965.
Walton, H. F. *Principles and Methods of Chemical Analysis*. 2nd ed. Prentice Hall, 1964.
Willard, H. H., Merritt, L. L., & Dean, J. A. *Instrumental Methods of Analysis*. 4th ed. Van Nostrand, 1965.

Subsidiary lists are supplied from the Department.

2.311 Physical Chemistry I

Quantum mechanics; molecular energy and thermodynamics; chemical statistics; chemical application of thermodynamics; surface and colloid chemistry.

TEXTBOOKS

Adamson, A. W. *Textbook of Physical Chemistry*. Academic, 1973.
Aylward, G. H., & Findlay, T. J. V. *SI Chemical Data*. Wiley, 1973.

REFERENCE BOOKS

Alexander, A. E., & Johnson, P. *Colloid Science*. O.U.P., 1950.
Barrow, G. M. *Structure of Molecules*. Benjamin, 1963.
Daniels, F., & Alberty, R. A. *Physical Chemistry*. 3rd ed. Wiley, 1966.
Daniels, F. et al *Experimental Physical Chemistry*. 7th ed. McGraw Hill, 1970.
Glasstone, S. *Textbook of Physical Chemistry*. 2nd ed. Van Nostrand, 1948.
Moore, W. J. *Physical Chemistry*. 4th or 5th ed. Longman, 1963 or 1972.
Shaw, D. J. *Introduction to Colloid and Surface Chemistry*. 2nd ed. Butterworths, 1970.
Shoemaker, D. P. & Garland, C. W. *Experiments in Physical Chemistry*. 2nd ed. McGraw-Hill, 1967.

2.322 Physical Chemistry II

Subject description, text and reference books as for 2.003A Chemistry III (Physical Chemistry).

2.411 Inorganic Chemistry I

Chemistry of the non-metals, including B,C,Si,N,P,S,Se,Te, halogens, and noble gases. Chemistry of the metals of groups IA,IIA, and A1. Typical ionic, giant-molecule and close packed structures. Transition metal chemistry, including variable oxidation states, paramagnetism, Werner's theory, isomerism of six- and four-coordinate complexes, chelation, stabilization of valency states. Physical methods of molecular structure determination. Chemistry of Fe,Co,Ni,Cu,Ag,Au.

TEXTBOOKS

1. Jolly, W. L. *The Chemistry of the Non-Metals*. Prentice-Hall, 1966.
Larsen, E. M. *Transitional Elements*. Benjamin, 1965.
Quagliano, J. V., and Vallarino, L. M. *Coordination Chemistry*. Heath, 1969.
or
2. Cotton, F. A. & Wilkinson, G. *Advanced Inorganic Chemistry*. 2nd ed. Wiley, 1966.

REFERENCE BOOKS

Bailar, J. C. *Chemistry of Coordination Compounds*. Reinhold, 1960.
Barnard, A. K. *Theoretical Basis of Inorganic Chemistry*. McGraw-Hill, 1965.
Basolo, F. & Johnson, R. *Introduction to Coordination Chemistry*. Benjamin, 1964.
Graddon, D. P. *An Introduction to Coordination Chemistry*. 2nd ed. Pergamon, 1968.
Jones, M. M. *Elementary Coordination Chemistry*. Prentice-Hall, 1964.
Vogel, A. *A Textbook of Macro and Semimicro Qualitative Inorganic Analysis*. Longmans Green.
Wells, A. F. *Structural Inorganic Chemistry*. 3rd ed. O.U.P., 1962.

2.511 Analytical Chemistry I

Sampling data evaluation; ionic equilibria in solution; electrochemical analysis, volumetric analysis; spectroscopy in analytical chemistry.

TEXTBOOKS

Ewing, G. W. *Instrumental Methods of Chemical Analysis*. McGraw-Hill, 1969.

Fischer, R. B., and Peters, D. G. *Quantitative Chemical Analysis*. W. B. Saunders, 1968.

2.611 Organic Chemistry I

Subject description and textbooks as for 2.002B Chemistry II (Organic Chemistry.)

2.622 Organic Chemistry II

Subject description, text and reference book lists as for 2.003B Chemistry III (Organic Chemistry).

2.271G Chemistry and Analysis of Foods

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.

Subject matter 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.

SCHOOL OF CHEMICAL ENGINEERING

GENERAL

In addition to drawing instruments, set squares, protractor and scale-rules, which will be obtained as specified for 5.010 Engineering A and 5.030 Engineering C, each student should possess a *Slide Rule* of a type which incorporates at least *three* cycles of *each* of the exponential scales and reciprocal exponential scales. (These usually are designated on the rules as LL1, LL2, LL3 and LL01, LL02, LL03 respectively.) Suitable slide rules are: Aristo 0968, Aristo 0969, Aristo 0970, Castell 2/82, Castell 2/83, Hemmi 259D. Undoubtedly there are others equally satisfactory, but these are suggested as a guide.

3.111 Chemical Engineering Principles I

(a) *Fluid Mechanics*. Introduction and units. Definition and properties. Statics: pressure distribution and pressure measurements. Dynamics: Euler and Bernoulli equations, momentum equation; laminar and turbulent flow, steady flow in pipes and equipment, pressure losses. Flow metering. Elementary boundary layer theory.

(b) *Fluid Pumping*—Piping, fittings and valves. Blow cases, air lift pumps, reciprocating pumps, centrifugal pumps and gear pumps. Gas blowers.

(c) *Heat Transfer*—Simple conduction, series and parallel. Resistance concept in solids and fluid films. Heat flow in walls and pipes. Lagging and insulation—critical lagging thickness—economic lagging thickness. Simple convection—natural and forced. Nusselt equation and its implications. Logarithmic temperature difference. Scaling and fouling of surfaces. Heat transfer to boiling liquids. Simple radiation—absorptivity and emissivity. Kirchhoff's laws—black body concepts—radiation from simple and complex surfaces. Luminous and non-luminous flames.

(d) *Elementary Boundary Layer Theory*—Boundary layer concepts, velocity profiles and boundary layer thickness in laminar and turbulent flow on plates and in pipes. Shear stresses in boundary layers. Heat and momentum analogies—Reynolds, Prandtl-Taylor, Chilton and Colburn.

(e) *Dimensional Analysis Scale-up and Theory of Models*—Dimensions—dimensionless numbers—dimensional analysis—static and dynamical similarity—Regime concepts—Use of models for scale-up. Pilot plants.

TEXTBOOKS

- Coulson, J. M., & Richardson, J. *Chemical Engineering*. Vol. 1. Pergamon.
McCabe, W. L., & Smith, J. C. *Unit Operations of Chemical Engineering*.
2nd ed. McGraw-Hill.
Massey, B. S. *Mechanics of Fluids*. 2nd ed. Van Nostrand-Reinhold, 1971.
Perry, J. H. *Chemical Engineers' Handbook*. 4th ed. McGraw-Hill, 1963.

REFERENCE BOOKS

- Allcock, H., Jones, J. & Michel, J. *The Nomogram*. Pitman.
Badger, W. & Banchero, J. *Introduction to Chemical Engineering*. McGraw-Hill.
Corcoran, W. & Lacey, N. *Introduction to Chemical Engineering Problems*.

- Davies, O. *Statistical Methods in Research and Production*.
Eckert, E. & Drake, R. *Heat and Mass Transfer*.
Haslam, R. & Russell, R. *Fuels and their Combustion*. McGraw-Hill.
Hougen, O., Watson, K. & Ragatz, R. *Chemical Process Principles*. Vol. 1. Wiley.
Johnson, L. H. *Nomography and Empirical Equations*.
Johnstone, R. & Thring, H. *Pilot Plant Models and Scale-up Methods in Chemical Engineering*. McGraw-Hill.
Knudson, D. J. & Katz, D. *Fluid Dynamics and Heat Transfer*.
Kreith, F. *Principles of Heat Transfer*. International Text Book.
Langhaar, H. *Dimensional Analysis and the Theory of Models*.
Lewis, W., Radasch, A. & Lewis, H. *Industrial Stoichiometry*. McGraw-Hill.
Lipka, J. *Graphical and Mechanical Computations*. Wiley.
Mickley, H. Sherwood, T. & Reed, C. *Applied Mathematics in Chemical Engineering*. McGraw-Hill.
Schmidt, A. & List, M. *Material and Energy Balances*. Prentice Hall.
Worthing, A. & Geffner, J. *Treatment of Experimental Data*.

3.112 Chemical Engineering Material Balances and Thermodynamics

Material balances. Basic thermodynamic principles leading to Phase Rule. P-v-T relationships. Energy balances. Further thermodynamic principles leading to phase and reaction equilibrium.

TEXTBOOKS

- Perry, J. H., ed. *Chemical Engineers' Handbook*. 4th Ed. McGraw-Hill, 1963.
Wales, C. E. *Programmed Thermodynamics*. Vols. I and II. McGraw-Hill, 1970.

REFERENCE BOOKS

- Braun, E. & Wait, E. T. *Programmed Problems in Thermodynamics*. McGraw-Hill, 1967.
Himmelblau, D. M. *Basic Principles and Calculations in Chemical Engineering*. 2nd ed. Prentice Hall, 1967.
Hougen, O., Watson, K. & Ragatz, R. *Chemical Process Principles. Part II, Thermodynamics*. 2nd ed. 1962.
Smith, J. M., & Van Ness, H. C. *Introduction to Chemical Engineering Thermodynamics*. 2nd ed. McGraw-Hill, 1959.

3.121 Chemical Engineering Principles II

Mass Transfer—Mechanism of mass transfer, diffusivity, characteristics of phase contactors. Stage and transfer unit calculations applied to solid-liquid, gas-liquid, liquid-liquid, solid-gas and vapour-liquid operations. Penetration and surface renewal theories. Simultaneous heat and mass transfer, phase equilibria based on humidity—temperature relationships, psychrometric charts. Vaporization and condensation processes. Heat mass and momentum analogies.

Heat Transfer—Evaporation and crystallization processes. Convective heat transfer rates, boiling and condensing heat transfer coefficients. Unsteady state conduction and convection.

Flow of Fluid-Solid Systems—Flow of solids in fluids—sedimentation. Flow of fluids in solids—packed beds—single and two phase flow. Fluidisation. Pneumatic conveying.

Digital and Analogue Computations—A short introduction to digital and analogue computers and their uses.

TEXTBOOKS

- Blatt, J. M. *Introduction to Fortran IV Programming*. Prentice-Hall.
 Coulson, J. M., & Richardson, J. F. *Chemical Engineering*. Vol. 2. Pergamon.
 Holman, J. P. *Heat Transfer*. 3rd ed. McGraw-Hill, Int. Student ed. 1972.
 Perry, J. H. *Chemical Engineers' Handbook*. 4th ed. McGraw-Hill, 1963.
 Peterson, G. R. *Basic Analog Computation*. Collier Macmillan, 1967.

REFERENCE BOOKS

- Bennett, C. O. & Myers, J. E. *Momentum, Heat and Mass Transfer*, McGraw-Hill.
 Carslaw, H. S., & Jaeger, J. C. *Conduction of Heat in Solids*. O.U.P., 1947.
 Foust, A. S. et al. *Principles of Unit Operations*. Wiley.
 Kern, D. Q. *Process Heat Transfer*. McGraw-Hill, 1950.
 Kreith, F. *Principles of Heat Transfer*. International Text Book Co.
 Larian, M. G. *Fundamentals of Chemical Engineering Operations*. Constable.
 Levenspiel, O. *Chemical Reaction Engineering*. Wiley, 1962.
 McAdams, W. H. *Heat Transmission*. 3rd ed. McGraw-Hill, 1954.
 Purchas, D. B. *Industrial Filtration of Liquids*. Leonard Hill, 1967.
 Scheidegger, A. E. *The Physics of Flow Through Porous Media*. Univ. of Toronto Press, 1957.

3.122 Chemical Engineering Thermodynamics and Reaction Engineering

Thermodynamics—The application of basic material from 3.112 to selected processes and operations. Sources of data, methods of estimating, determining consistency of, and methods of presenting data. Applications of thermodynamics to specific systems, i.e. vapour-liquid, non-electrolyte solutions, aqueous electrolyte solutions and gas-solid systems. Thermodynamic analysis of processes. Irreversible thermodynamics, statistical thermodynamics and thermodynamics of adsorption and desorption.

Reaction Engineering—Homogeneous reactions: (a) interpretation of batch reactor data and testing of mechanisms; (b) isothermal ideal reactor design (i) single reactions (ii) multiple reactions: (c) adiabatic ideal reactor design—single and multiple reactions—optimization. Heterogeneous reactions including (a) flow models—dispersion—mixing residence time distribution (b) reactor design in non-catalytic fluid/solid reactions, catalytic fluid/solid reactions and fluid/fluid reactions. A selection of topics from (a) mass transfer with chemical reaction (b) reactor stability (c) optimal reactor design (d) analysis of reactor/reactions.

TEXTBOOKS

- Dasent, W. E. *Inorganic Energetics*. Penguin, 1970.
 Hougen, O., Watson, K., & Ragatz, R. *Chemical Process Principles. Part II Thermodynamics*. 2nd ed. Wiley.
 Levenspiel, O. *Chemical Reaction Engineering*. 2nd ed. Wiley, 1973.

REFERENCE BOOKS

- Denbigh, K. G., and Turner, J. C. R. *Chemical Reactor Theory. An Introduction*. 2nd ed. C.U.P., 1971.
 King, M. B. *Phase Equilibria in Mixtures*. Pergamon, 1969.
 Pourbaix, M. J. N. *Atlas of Electrochemical Equilibria in Aqueous Solutions*. Pergamon.
 Smith, J. M. *Chemical Engineering Kinetics*. 2nd ed. McGraw-Hill, 1970.

- Smith, J. M., and Van Ness, M. C. *Introduction to Chemical Engineering Thermodynamics*. 2nd ed. McGraw-Hill, 1959.
- Van Zeggeren, F., and Storey, S. H. *The Computation of Chemical Equilibria*. C.U.P.

3.123 Chemical Engineering Design IA and IB

Process Vessels—Mechanical design and fabrication of pressure vessels. Code and legal requirements. Design of supports for vertical and horizontal vessels.

Heat Exchangers—Types of heat exchangers, evaporators and crystallizers. Service fluids for heating and cooling at various temperature levels. Construction and design of shell and tube, concentric tube and plate exchangers for liquids, gases, condensing vapours and boiling liquids.

Mass Transfer Equipment—Construction and design of sieve and other type trays for plate towers. Design and construction of packed towers; selection of packing; performance characteristics of packed and plate towers.

Plant Layout; Reticulation and Fluid Transfer Systems—Arrangement of equipment, fluid prime movers, valves and piping for process and service fluids. Overhead and underground piping. Commercial pipes and tubes; components, flanges and couplings. Construction, shop and field fabrication. Characteristics of common valve types, their sizing and selection. Sizing of pipes. Characteristics of fluid prime movers and associated piping systems.

Process Engineering—Block diagrams, process flowsheets, presentation of material properties, mass and energy flows at various points. Engineering flowsheets. Process engineering (or performance) specifications for equipment items. Storage and safety considerations. The design report.

Chemical Engineering Economics—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, capitalised cost, optimisation. Depreciation and taxation and their effect on economic analyses. Economic design.

Process Measurements and Control—The principles of operation and use of the basic industrial measuring instruments. Fundamentals of feedback control, leading to the analysis and synthesis of single-loop linear systems.

Corrosion and Materials—A short course covering the theory of corrosion and materials of construction.

TEXTBOOKS

- Coughanowr, D. R., and Koppel, L. B. *Process Systems Analysis and Control*. McGraw-Hill, 1965.
- Holman, J. P. *Experimental Methods for Engineers*. 2nd ed. I.S.E.
- Kern, D. Q. *Process Heat Transfer*. McGraw-Hill, 1950.
- Mott, L. C. *Engineering Materials for M.E.T.* Part 2, O.U.P. 1970.
- Perry, J. H. ed. *Chemical Engineers' Handbook*. 4th ed. McGraw-Hill. 1963.
- Peters, M. S. & Timmerhaus, K. D. *Plant Design and Economics for Chemical Engineers*. 2nd ed. McGraw-Hill.
- Rase, H. F. *Piping Design for Process Plants*. Wiley.
- Treybal, R. E. *Mass Transfer Operations*. 2nd ed. McGraw-Hill, 1968.

Uhlig, H. H. *Corrosion and Corrosion Control*. Wiley, 1963.
 A.S. 1210-1972. *Unfired Pressure Vessels*. Standards Association of Australia.

REFERENCE BOOKS

- Bickell, M. B. & Ruiz, C. *Pressure Vessel Design and Analysis*. Macmillan, 1967.
 Brownell, L. E. & Young, E. H. *Process Equipment Design*. Wiley.
 Buchanan, R. H. & Sinclair, C. G. *Costs and Economics of the Australian Process Industries*. West.
 Fontana, M. G. & Greene, N. D. *Corrosion Engineering*. Wiley, 1970.
 Johns, V. B. *Introduction to Engineering Materials*. Macmillan, 1972.
 Nelson, W. L. *Petroleum Refinery Engineering*. 4th ed. McGraw-Hill. Int. Student ed. 1958.
 Rabald, E. *Corrosion Guide*. Elsevier, 1970.
 Speller, F. *Corrosion — Causes and Prevention*. McGraw-Hill, 1969.
 Stewart, D. & Tullock, D. S. *Principles of Corrosion and Protection*. Macmillan, 1968.
 B.S. 1500 and B.S. 1515 *Fusion Welded Pressure Vessels*. British Standard Institution.
 B.S. 3274:1960 *Tubular Heat Exchangers*. British Standards Institution.

3.124 Chemical Engineering Design and Practice

Design Report. The basis of this subject is a design report which will be a test of knowledge of principles and design as applied to a possible industrial situation. The report should take the form of a set of iterative calculations and specifications for the components of a simple processing battery and is usually limited in size to a battery consisting of two principal unit operations in series (e.g. extractor and fractionator, reactor and separator, etc.). Particular attention is paid to operating instructions, hazards and safety, economic evaluation, use of standards and general presentation.

Industrial Process Report. The Industrial Process Report is an exercise in which the student collects up-to-date information regarding a process which is in current use in Australia. He must report on its history, present state and future with particular respect to the scale, raw materials, alternative and competing end products, and processes. The final report is a compilation of material copied directly from the literature.

3.131 Chemical Engineering Principles III

Combined Heat Mass and Momentum Transfer: an advanced theoretical treatment of situations where the various forms of interfacial transport occur simultaneously; fundamental consideration of units such as cooling towers and spray driers; modification to usual transport equations under high flux conditions. *Transport Phenomena*: the equations of conservation (mass, energy, momentum) and their solution in simple applications; the transport coefficients; the energy mass and momentum analogy. *Optimization*: a treatment with examples of such topics as: single and multiple dimension search techniques including Simplex EVOP, linear programming, dynamic programming, introduction to other optimization techniques. *Computer Methods and Modelling*: brief review of Fortran programming, and an introduction to computer operating systems, disc storage, efficient programming methods; numerical methods for roots of equations, solution of linear algebraic equations, ordinary differential equations and partial differential equations; error propagation; search methods, sorting, table-

look-up; analogue simulation, and the use of specialized computer programmes such as CSMP; introduction to other high-level programmes and PLI.

TEXTBOOKS

Beveridge, G. S., & Schechter, R. S. *Optimization Theory and Practice*. McGraw-Hill, 1970.

Bird, R. B., Stewart, W. E., & Lightfoot, E. N. *Transport Phenomena*. Wiley, 1962.

Pennington, R. H. *Introductory Computer Methods and Numerical Analysis*. Macmillan, London, 1970.

REFERENCE BOOKS

Germaine, C. *Programming the I.B.M. 1620*. 2nd ed. Prentice-Hall, 1965.

Himmelblau, D. M. *Process Analysis by Statistical Methods*. Wiley, 1970.

Wilde, D. J. & Beightler, C. S. *Foundations of Optimization*. Prentice-Hall, 1967.

3.132 Chemical Engineering Process Dynamics and Control

Problem formulation for lumped- and distributed-parameter dynamic systems, and their mathematical description. Linear dynamic behaviour, stability criteria. Analysis of non-linear systems by linearization and numerical methods. Experimental characterisation of systems. Comparison of methods of analysis and synthesis of feedback systems. Multi-loop linear systems. State-space methods. Laboratory.

TEXTBOOK

Coughanowr, D. R. & Koppell, L. B. *Process Systems Analysis and Control*. McGraw-Hill, 1965.

REFERENCE BOOKS

Campbell, D. P. *Process Dynamics*. Wiley, 1958.

Perlmutter, D. D. *Introduction to Chemical Process Control*. Wiley, 1965.

3.133 Chemical Engineering Design II

(a) *Process Engineering Strategy*—The creation and screening of alternative processes. The structure of process systems. The treatment of uncertainties in data. Failure tolerance. Engineering around variations. Case studies. Practical and flexural aspects of plant layout and piping arrangements. (b) *Chemical Reactor Design*—Models for non-ideal homogeneous and heterogeneous systems. Non-ideal homogeneous reactors. Non-catalytic fluid-solid reactors. Solid-catalyzed fluid reactors, reactor instabilities. (c) *Economic Selection Criteria*—Methods based on discounted cash flows. Comparison of methods, applications and taxation effects. New ventures, replacements, lease and purchase studies. Cost of capital, investment types, evaluation of risk, simulation, ranking of investments, sizing for future developments, case studies.

TEXTBOOKS

Levenspiel, O. *Chemical Reaction Engineering*. 2nd ed. Wiley, 1973.

Peters, M. S. & Timmerhaus, K. D. *Plant Design and Economics for Chemical Engineers*. 2nd ed. McGraw-Hill, 1968.

Rudd, D. F. & Watson, C. C. *Strategy of Process Engineering*. Wiley, 1968.

REFERENCE BOOKS

- Astarita, G. *Mass Transfer with Chemical Reaction*. Elsevier, 1967.
- Buchanan, R. H., & Sinclair, C. C. eds. *Costs and Economics of the Australian Process Industries*. West, 1964.
- Industrial Ventilation*. Amer. Soc. of Govt. Indus. Hygienists. Washington, 1966.
- Danckwerts, P. V. *Gas-Liquid Reactions*. McGraw-Hill, 1970.
- Jelen, F. C. ed. *Cost and Optimization in Engineering*. McGraw-Hill, 1970.
- Ludwig, E. E. *Applied Process Design for Chemical and Petrochemical Plants*. Vols. I, II, III. Gulf Pub. Co., 1964-5.
- Pilborough, L. *Inspection of Chemical Plant*. CRC Press, 1971.
- Act. No. 43, 1962 *Factory, Shops and Industries Act*. As amended by Act No. 58, 1964. Government Printer.
- AS C25-1952 *General Principles for Safe Working in Industry*, Standards Association of Australia.

3.134 Advanced Chemical Engineering Principles

Advanced Stagewise Operations: brief review of conventional graphical calculation methods of Ponchon-Savarit and McCabe-Thiele type; phase equilibrium relationships for liquid-vapour and liquid-liquid systems; experimental methods, correlating equations, prediction methods (the case where more than two phases exist will be treated descriptively); graphical treatment of ternary distillation systems; multi-component separations; methods of Lewis-Matheson and Thiele-Geddes; detailed discussion of more modern computational methods; processes separation of binary azeotropes; heat economization; azeotropic and extractive distillation. *Advanced Fluid and Particle Mechanics*: selected topics in fluid mechanics with relevance to chemical engineering, e.g., flow patterns in processing equipment, jets; wakes, dispersion, mixing; two-phase systems; gas-liquid in pipes and packed beds; bubbles, drops, sprays, surface effects. Particles, sedimentation, hydraulic and pneumatic transport, fluidization; natural convection. *Advanced Diffusion and Separation*. *Advanced Heat Transfer*. Associated experimental laboratory studies.

TEXTBOOKS

- Bird, R. B., Stewart, W. E., & Lightfoot, E. N. *Transport Phenomena*. Wiley, 1962.
- Massey, B. S. *Mechanics of Fluids*. 2nd ed. Van Nostrand-Reinhold, 1971.

3.135 Chemical Engineering Practice

Specialized measurement techniques, experimental techniques, planning of experiments and analysis of engineering data. The use of the literature; information retrieval. The ethical, legal and social obligations of the engineer. Safety; pollution control. Integration of multi-unit complexes; seminar assignment, involving the presenting and discussion of recent chemical engineering papers. Analytical optimization of processes. Associated experimental laboratory studies.

3.136 Oil and Gas Engineering

Effects of temperature and pressure on the properties, thermodynamics and hydrodynamics of hydrocarbon materials. Design applications in the transport, storage and processing of oil and gas products.

3.140 Chemical Engineering Design Project

The design of plant for the production of chemicals and the estimation of product costs.

3.150 Chemical Engineering Experimental Project

An experimental investigation of some aspects of chemical engineering.

CHEMICAL ENGINEERING GRADUATE SUBJECTS**3.162G Urban Planning**

Priorities in urban planning: topography, community services, industry; selective zoning and decentralization; relationships to regional planning. Cost of pollution and control measures: legal aspects; planned development; architectural aspects; density distribution. Case histories.

3.163G Industrial Use and Re-Use of Water

Water sources, surface waters, ground waters — water quality, removal of gaseous, solid, solute and odorous contaminants. Physical and chemical treatments, softening plant, demineralization, plant design. Water collection and distribution, corrosion and its prevention, industrial contaminants and their removal, water-re-use in plant. Clean up before release, legal requirements. Costs and economics of supply and disposal.

3.164G Medical and Legislative Aspects

Aspects of medicine bearing upon physiological consequences of pollutants. Synergism and antagonism; 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. 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.

3.165G Process Optimization

Statistical evaluation of process parameters including significance and effect on objective. Experimental optimization techniques for dealing with stochastic processes. The application of selected programming techniques for determination of optimum process conditions for deterministic processes.

3.170G Process Principles

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

3.171G Corrosion Technology I

Theory of Corrosion—Principles: Thermodynamics, electrode kinetics. Applications: Predicting corrosion behaviour, corrosion prevention, corrosion rate measurements. *Industrial Corrosion*: Definitions—what it is. Terms used, units of measurement, corrosion research, corrosion technology, importance of corrosion (loss of product, downtime, safety, etc.). Extent—where it occurs. Cost. Economics. How it is prevented—materials selection, coatings, design, cathodic prevention, inhibitors.

Types of Corrosion: Direct chemical, galvanic, crevice, pitting, intergranular, phase attack, erosion—cavitation, stress, fatigue, hydrogen, fretting, atmospheric oxidation, high temperature oxidation. *Materials—non-metallic*: Plastics: thermoplastic—cellulose, acrylics, nylons, polyethylenes, vinyls, polypropylene, polystyrenes, fluorocarbons, chlorinated polyether. Thermosetting—phenolics, epoxies, polyesters, silicones, ureas, laminates. Laminates: reinforced plastics—fibreglass. Foamed Plastics. Rubbers: natural, synthetic—butyl, buna-S, neoprene, nitrile, ABS, silicone. Glasses: bulk—borosilicate, fused silica, glass linings. *Ceramics*: acid resisting bricks, stoneware, porcelain, concrete. *Carbon and graphite*. *Woods*.

Principles of Design for Corrosion Prevention. *Environmental Factors*: galvanic effects—potential differences, concentration cells, anode/cathode/areas operating anodic and cathodic reactions polarization, passivity ionic conducting electrolyte. Oxygen, velocity, temperature, atmospheric contaminants, partial immersion, geometry of design, fabrication and erection. *Intrinsic Factors*: Material structure, heat treatment, surface finish. *Corrosion Testing*: aims, specimens, surface preparation, measurements, exposure techniques, duration, aeration, temperature, expression of results—units, interpretation of results, standard tests.

3.172G Corrosion Laboratory

A number of laboratory assignments to illustrate and measure the mechanism of corrosion. Electroplating/anodising experiments.

3.173G Corrosion Materials

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.

3.174G Corrosion Technology II

Corrosion in: *special equipment and structures*, piping, tanks, heat exchangers. *Special Environments*—corrosion by sea water, soils, fresh-water, steam, atmosphere, lubricants and packings, mineral acids, organic acids, alkalis, petroleum industry, biological means, liquid metals. *Surface Preparation and Coatings*. General Theory—surface preparation—acid cleaners, alkali cleaners, solvent cleaners, mechanical cleaning, equipment.

Coatings—types, properties and applications, pre-treatments, primers based on acrylics, alkyd, bitumen, epoxy, chlorinated rubber, metals, phenolic polyurethane, vinyls. Temporary corrosion—preventive. Heat resistant, electroplated metal sprayed. Wrappings.

3.175G Corrosion Seminar

Joint University/industry colloquia on theory and practice of corrosion technology.

Students will present material arising from literature and/or laboratory assignments and industrialists will be invited to contribute papers and/or participate in the colloquia.

3.176G Corrosion Literature Review

Students will be expected to consult and read the wide literature on corrosion and to produce a comprehensive and detailed report on a selected topic, e.g. aspects of corrosion in the acid industry; marine corrosion; corrosion problems in the food industry; underground corrosion of pipelines.

3.177G Testing Laboratory

Candidates will undertake a project involving the design/evaluation of corrosion testing equipment/techniques. A comprehensive report will be submitted.

3.181G 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. *Nonlinear Systems:* Selected nonlinear systems, e.g. chemical reactors, flow systems, radiant heat transfer. Numerical solutions. Phase plane analysis. Limit cycles.

3.182G Process Optimization

Aspects of analytical optimization. The calculus of variations. The discrete and continuous maximum principles. Approach to complex systems: dynamic programming and decomposition techniques. Examples of the use of optimization methods in the chemical process industries.

3.183G Thermodynamics, Kinetics and Mechanism

Thermodynamics, kinetics and mechanism of proton transfer and electron transfer reactions, particularly with reference to selected industrial processes.

Chemical kinetic theories and empirical analysis of reaction rates. Particular emphasis is given to mechanistic analysis in terms of kinetics and the equilibrium state and steady-state approximation methods. Experimental techniques and treatment of data.

3.184G System Simulation and Control

Topics to be dealt with will be selected from the following areas: Numerical methods for digital simulation and computation; Programming languages for system modelling; Unsteady-state distributed parameter systems; Advanced analogue computer methods; Digital computers in data-logging and control; Digital logic and instrumentation; Advanced control systems: e.g. system identification, multiloop systems, non-linear systems, sampled-data systems.

3.185G Interphase Mass Transfer

Advanced theories of mass transfer. The effect of interfacial instability and methods for predicting its presence. Gas absorption with chemical reaction. Mass transfer into froths and foams. Multicomponent mass transfer.

3.186G 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 reactors. 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.

3.187G Design of Process Envelopes

Theoretical treatments concerning stress analyses with time and temperature as variables, stresses at discontinuities and transitions in vessel geometry. Theories and modes of material behaviour, gas solubility effect, design of insulation, reinforcement, etc. Analyses of stresses and reactions in piping subject to large temperature changes. Code requirements. Practical aspects will include a treatment of high pressure components, e.g. valves, fittings, pumps, safety devices. Economic aspects.

3.188G Advanced Process Engineering Economics

Cost Evaluation: Capital and operating cost estimation, venture profitability, feasibility studies, and the effect of gearing, size and capacity factor on the DCF return. *Project Optimization:* Minimizing costs in the conception, design, tendering, construction, start-up and operational stages with emphasis on methods engineering, critical-path scheduling and good practice in business organization and management. *Australian Process Industry Economics:* The tariff, gross national product, balance of payments, productivity, population and industrial growth plus detailed economic analysis of Australia's chemical and metallurgical industries.

3.189G Graduate Colloquia

Joint University/industry colloquia on research developments in Chemical Engineering. Students are required to participate actively in the colloquia, give at least one dissertation based on their own investigations, and complete a number of assignments on topics related to research skills. These last will cover such areas as statistical planning of experiments, modelling and the use of optimization techniques in the evaluation of experimental data.

3.190G Specialist Lectures

3.191G Thermodynamics

Equilibrium: liquid-liquid, liquid-solid and liquid-vapour phase equilibria for (i) high pressure; (ii) multicomponent systems. Chemical reaction equilibrium for complex systems.

Molecular theory and statistical thermodynamics: partition functions, monatomic and diatomic gases; Chapman-Enskog theory, evaluation of (i) thermodynamic potentials; (ii) virial coefficients.

Compressible flow: flow of compressible fluids in ducts including (i) supersonic flow; (ii) shock waves; (iii) stagnation properties.

3.192G Computer-aided Design

A workshop type of course with considerable time devoted to discussion, seminars, writing and running of programmes.

Programming. Methods, conventions, and standards. Programme 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.

DEPARTMENT OF FOOD TECHNOLOGY

REFERENCE BOOKS

Please consult Department.

3.201 Food Technology I

Introduction to food technology. Domestication, breeding and propagation of cultivated plants. Morphology, physiology and biochemistry of plants, horticultural factors, maturity assessment, harvesting, postharvest handling and storage, storage disorders of fruit and vegetables.

TEXTBOOK

Janick, J. *Horticultural Science*. 2nd ed. Freeman, 1972 or Janick, J., Schery, R. W., Woods, F. W. & Ruttan, V. W. *Plant Science*. Freeman, 1969.

3.211 Food Technology II

Introduction to food microbiology. Principles of food preservation. Thermal processing, process evaluation. Technology of frozen and dehydrated foods. Preservation by the use of salt, sugar, acid and chemical preservatives. Juices, concentrates, non-alcoholic fermentations. Use of ionizing radiations.

TEXTBOOKS

- Duckworth, R. B. *Fruit and Vegetables*. Pergamon, 1966.
 Earle, R. L. *Unit Operations in Food Processing*. Pergamon, 1966.
 Frazier, W. C. *Food Microbiology*. 2nd ed. McGraw-Hill, 1967.
 Hersom, A. C., & Hulland, E. D. *Canned Foods: an Introduction to their Microbiology*. Churchill, 1969.
 Nickerson, J. T., & Sinskey, A. J. *Microbiology of Foods and Food Processing*. Elsevier, N.Y., 1972.
 Nickerson, J. T., and Sinskey, A. J. *Microbiology of Foods and Food Processing*. Elsevier, N.Y., 1972.
 Williams, M. B. L. *Fundamentals of Thermal Bacteriology in Food Processing*. Record 7. Research and Productivity Council. Frederickton, 1969.

3.212 Food Technology III

The science and technology of meat, fish, eggs, milk, fats and oils, cereals, sugars; their derived products, with particular reference to sources, structure and composition, microbiological and biochemical aspects, their reactions and modifications during processing and storage. Food package requirements. Food spoilage, its diagnosis and control.

TEXTBOOKS

- Frazier, W. C. *Food Microbiology*. 2nd ed. McGraw-Hill, 1967.
 Kent, N. L. *Technology of Cereals*. Pergamon, 1966.
 Knight, J. W. *The Starch Industry*. Pergamon, 1966.
 Lawrie, R. A. *Meat Science*. Pergamon, 1966.

3.221 Food Technology IV

The characteristics of food quality. Colour, texture, flavour, their subjective and objective assessment. Food additives and toxicology, product development, quality control and factory management. Public health, food hygiene and food legislation. Utilization and disposal of food process wastes. Enology. Principles of nutrition.

3.231 Food Engineering I

An introduction to fluid mechanics, heat transfer, mass transfer with applications relevant to the food industry.

TEXTBOOKS

- Brennan, J. G., Butters, J. R., Cowell, N. D. and Lilly, A. E. V. *Food Engineering Operations*. Elsevier, 1969.
 Earle, R. L. *Unit Operations in Food Processing*. Pergamon, 1966.
 Kay, J. M. *An Introduction to Fluid Mechanics and Heat Transfer*. 2nd ed. C.U.P., 1963.

3.232 Food Engineering II

Fundamental and applied aspects of engineering in selected food processing operations. Food plant and machinery. Process control of food plant. Introduction to engineering economics. Plant experimentation. Design aspects of equipment for effluent treatment.

3.233 Food Technology (Chemical Engineering)

The science and technology of foods of plant and animal origin—fruit and vegetables, meat, fish, eggs, milk, fats and oils, cereals, sugars; their derived products with particular reference to microbiological aspects, their modification during processing and storage. Principles of food preservation with particular reference to unit processes and limiting parameters. Food spoilage, its diagnosis and control, foods in relation to disease. Food additives, food packaging. Quality characteristics of foods. Elements of human nutrition. Food regulations. Utilization and disposal of food process wastes.

3.240 Food Technology Project (Chemical Engineering)

Project in Food Technology for students in Chemical Engineering.

3.250 Food Technology Project

The student will undertake 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.

FOOD TECHNOLOGY GRADUATE SUBJECTS

3.213G Food Process Laboratory

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

3.241G Food Technology

Introduction to food technology. Principles of food preservation. The science and technology of foods of plant and animal origin, their derived products, with reference to biochemical and microbiological aspects. Food spoilage, foods in relation to disease, food additives, food packaging. Waste disposal.

3.242G Treatment and Utilization of Biological Effluents

Parameters of water pollution, ecology of waste disposal. Treatment and use of water in food processing. Composition and treatment of sewage. Origin, composition, treatment, disposal and utilization of wastes from food and other biological industries. Legal and economic aspects. Plant and field inspections.

3.243G Graduate Seminar

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.

3.244G Dairy Technology

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 on the use and development of new technologies in the broad areas of dairy product processing.

3.245G Food Quality Assessment

The characteristics of food quality. Colour, its subjective and objective assessment, standards and grades in food products. Flavour, the physiology of flavour perception, theories of taste and odour perception, the characterization of food volatiles. Texture and consistency of foods, their subjective and objective assessment. The use of taste panels and evaluation of results. Principles of consumer testing.

3.246G Food Additives and Toxicology

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.

3.247G Enology

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.

3.248G Public Health and Legislative Aspects of Foods

Sanitation in food processing, distribution and handling. Water supplies, utilisation and disposal, insect and rodent control. Cleaning, disinfection, sanitation programmes. Food poisoning and food-borne infections of chemical, plant, animal and microbiological origin. Food hygiene with particular reference to food service operations. Food Legislation, State and Codex standards and regulations, Pure Foods Act, Public Health Act.

3.249G Technology of Cereal Products

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.

3.251G Marine Products

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.

DEPARTMENT OF FUEL TECHNOLOGY

3.311 Fuel Engineering I

1. *Fuels and Energy—Sources and Properties*—Fossil fuels: coal, oil, gas—origin, geology, occurrence in Australia; storage, sampling and analysis; properties and their significance; classification.

2. *Energy Conversion*—An introduction to the combustion of gaseous, liquid and solid fuels; design principles and types of steam-raising plant.

3. *Fuel Processing*—Crude oil, refinery flow patterns, general methods of gas making, carbonisation and the production of metallurgical coke.

4. *Steam, Power and Work Cycles*—Heat engines, thermodynamic properties of working fluids.

TEXTBOOKS

Macrae, J. C. *An Introduction to the Study of Fuel*. Elsevier.

Mayhew, Y. R., & Rogers, G. F. C. *Thermodynamic Properties of Fluids and Other Data*. Basil & Blackwell, Oxford, 1966.

Hickson, D. C. & Taylor, F. R. *Enthalpy-Entropy Diagram for Steam*. Basil & Blackwell, Oxford.

REFERENCE BOOKS

Ministry of Power (U.K.). *The Efficient Use of Fuel*. H.M.S.O. Inst. of Petroleum. *Modern Petroleum Technology*.

Dept. of Nat. Development. *Energy in Australia*. Standards Assoc. of Aust. Various standards on Sampling, Analysis and Classification of Fuels, and Glossary of Terms.

3.321 Fuel Engineering II

1. *Combustion of Gaseous Fuels*—Basic principles, kinetics, chemical, physical and aerodynamic considerations; an introduction to flames.

2. *Combustion of Liquid and Solid Fuels*—Heterogeneous combustion reactions; combustion in fuel beds, particles in suspension and of 'atomized' fuels. Mineral impurities; deposits and corrosion.

3. *Principles of Gasification*—Thermodynamics of basic reactions and calculations of equilibrium compositions. The production of fuel and synthesis gases, controlled furnace atmospheres; gas purification.

4. *Fuel Plant Technology*—Introduction to furnaces, ovens, kilns and steam generators. Thermodynamics of heating processes; recoverable and returnable heat in fuel systems. Industrial water.

TEXTBOOKS

Spiers, H. *Technical Data on Fuel*. W.P.C., London.

Thring, M. *The Science of Flames and Furnaces*. Chapman & Hall.

REFERENCE BOOKS

Field, M. A., et al. *Combustion of Pulverised Coal*. B.C.U.R.A.

Smith, M., & Stinson, K. *Fuels and Combustion*. McGraw-Hill.

Gaydon, A., & Wolfhard, H. *Flames*. Chapman & Hall.

Johnson, H. R., & Littler, D. J. *The Mechanism of Corrosion by Fuel Impurities*. Butterworth.

Gumz, W. *Gas Producers and Blast Furnaces*. Wiley.

Lyle, O. *Efficient Use of Steam*. H.M.S.O., London.

3.331 Fuel Engineering III

Fuel Plant Design: Furnace design for continuous and intermittent operations. Recuperator, regenerator and waste heat boiler design. Process heat transfer. Steam:—condensers, evaporators. *Thermal Engineering*: Advanced heat transfer engineering, including numerical and analogue methods of problem solution with applications directed towards the design and performance of combustion appliances and furnaces. Gas and flame behaviour in combustion systems — the use of similarity criteria and models as computation aids.

TEXTBOOKS

Holman, J. P. *Heat Transfer*, 3rd ed., McGraw-Hill.

Kern, D. Q. *Process Heat Transfer*. McGraw-Hill, 1950.

McAdams, W. H. *Heat Transmission*. McGraw-Hill.

Trinks, W. *Industrial Furnaces*. Vols. 1 and 2. Wiley.

REFERENCE BOOKS

Etherington, H. G. *Modern Furnace Technology*. 3rd ed. Griffin.

Schack, A. *Industrial Heat Transfer*. Chapman & Hall.

Lyle, O., *Efficient Use of Steam*. H.M.S.O., London.

Field, M. A., et. al. *Combustion of Pulverised Coal*. B.C.U.R.A.

Lowry, H. H., *Chemistry of Coal Utilization*. Wiley, 1963.

3.332 Fuel Engineering IV

Flames: Carbon formation, radiation, temperature calculation and measurement; characteristics of industrial flames. *Secondary Fuels and Refractories*: Carbonization — evaluation of coals, blending, additives; liquid fuels — evaluation, physical properties, specifications; refractories — raw materials, types, thermal, mechanical and chemical properties. *Atmospheric Pollution*: Nature of pollutants, sources, sampling, measurement, physiological effects; plume dispersal — effect of meteorological conditions; industrial gas cleaning, air quality standards and Clean Air Legislation. *Fundamental Constitution of Fuels*: Constitution and classification of mineral oils; coal petrology — techniques and application; physical and chemical fine structure of coal.

TEXTBOOKS

Gaydon, A. & Wolfhard, H. *Flames*. Chapman & Hall.

Krevelen, D. W. van. *Coal, Typology, Chemistry, Physics and Constitution*. Elsevier.

REFERENCE BOOKS

Lowry, H. H. *Chemistry of Coal Utilization—Supplementary Vol.* Wiley.
Van Ness, K. & Van Weston, K. *Aspects of the Constitution of Mineral Oils*. Elsevier.

Wilson, P. J. & Wells, J. H. *Coal, Coke and Coal Chemicals*. McGraw-Hill.
Drinker, P. & Hatch, T. *Industrial Dusts*. McGraw-Hill.

Spalding, D. B. *Some Fundamentals of Combustion*. Butterworths.

Nelson, W. *Petroleum Refinery Engineering*. McGraw-Hill.

Strauss, W. *Industrial Gas Cleaning*. Pergamon.

Norton, F. H. *Refractories*. McGraw-Hill.

Fristrom, R. M., & Westenberg, A. A. *Flame Structure*. McGraw-Hill.

3.340 Fuel Engineering Project

Projects will be selected involving the design of fuel plant or aspects of fuel science and/or fuel processing and utilization. This will usually involve some experimental work.

No books are recommended. Students are supplied with reading lists appropriate to individual requirements.

FUEL TECHNOLOGY GRADUATE SUBJECTS**3.381 Principles of Fuel Engineering**

An expanded version of the course 3.311 Fuel Engineering I, including appropriate laboratory work.

Textbooks are as for 3.311 Fuel Engineering I.

3.382 Combustion Engineering

Similar to 3.321 Fuel Engineering II offered in the post-graduate diploma.

Textbooks as for 3.321 Fuel Engineering II.

3.383 Fuel Plant: Evaluation and Assignments

Designed to meet the needs of individual students in the graduate diploma course, with an emphasis on the practical aspects of combustion engineering and the efficiency of operation of fuel plant. Also included is a bridge course of lectures in heat transfer, fluid mechanics, and chemical and engineering thermodynamics, which is designed to bring students from the varied backgrounds of their first degrees to a common level to facilitate further study of these subjects in the graduate diploma course.

Students are supplied with reading lists appropriate to individual requirements.

3.390G Postgraduate Fuel Seminar

This is intended to assist students in assessing technical problems, in the collection of information and presentation of data, including technical report writing and critical evaluation of available information.

3.391G Atmospheric Pollution and Control

Causes, measurement and control of atmospheric pollutants with special reference to fuel-using plant. Clean air legislation.

3.392G Fuel Science

The nature of solid and liquid fuels, their physical and chemical properties and fundamental structure. The constitution of the coal matrix and coal petrography. The influence of the physical and chemical constitution of fuels and petrographic composition of coal and technological utilization.

TEXTBOOKS

As for 3.332.

3.393G Fuel Engineering Plant Design

Extends some of the subject-matter of 3.331.

TEXTBOOKS

As for 3.331.

3.394G Thermal Engineering and Fuel Processing

Advanced heat transfer with applications to flames and fuel utilization. The aerodynamics of fuel and combustion plant; dimensional analysis and models; flame temperature.

Coal carbonization and by-product recovery. Petroleum processing and properties of liquid fuel products; thermodynamics of gasification reactions; controlled atmospheres.

TEXTBOOKS

Inst. of Petroleum. *Modern Petroleum Technology*.

Holman, J. P. *Heat Transfer*. 3rd ed. McGraw-Hill.

McAdams, W. *Heat Transmission*. McGraw-Hill.

3.395G Research Techniques and Extension Methods

Designed to provide a critical approach to research activities. The topics are selected from the following:

(a) Advanced analytical techniques (e.g. spectroscopy, X-ray diffraction, chromatography, mass spectroscopy, N.M.R., other optical and instrumental methods. (b) Mathematical methods in the design and interpretation of experiments, e.g., formulation and solution of equations; statistical evaluation of results; empirical equations and nomographs; analogue simulation; an introduction to programming and use of digital computers.

Students to be supplied with reading lists appropriate to individual requirements.

3.396G Unit Operations in Waste Management

The unit operations and processes associated with modern waste management practices, i.e. 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. Legal aspects; case histories.

TEXTBOOK

1971 Waste Disposal Conference. Dept. of Fuel Technology, Univ. of N.S.W.

REFERENCE BOOKS

First Aust. Refuse Disposal Conference Proceedings. Dept. of Fuel, Univ. of N.S.W., 1967.

Corey, R. C. *Principles and Practices of Incineration.* Wiley, Interscience. *The Incineration of Municipal and Industrial Wastes.* Proceedings of Conference, Inst. of Fuel, 1969.

U.S. Dept. of Health, Education and Welfare. *The Role of Packaging in Solid Waste Management 1966 to 1976.* 1969.

DEPARTMENT OF BIOLOGICAL PROCESS ENGINEERING

3.411 Biological Process Engineering

3.440 Biological Process Engineering Project

Project in Biological Process Engineering for students in Chemical Engineering.

BIOLOGICAL PROCESS ENGINEERING GRADUATE SUBJECTS

3.461G Physical Transport Processes

Viscosity, thermal conductivity, diffusivity. Velocity, temperature, concentration distributions with more than one independent variable. Equations of change. Turbulent flow. Interphase transport in isothermal and non-isothermal systems. Multicomponent systems. Transient and oscillatory behaviour. Stability. General problem of transport in non-Newtonian fluids. Non-ideal mixing—models and dynamics. Application to multiphase systems.

3.462G Microbial Energetics

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.

3.463G Theory of Rate Processes and Microbial Dynamics

Phenomenological characterization of reacting systems, mathematical and experimental characterization of complex kinetic systems. Kinetic behaviour of non-stationary state systems. Feedback mechanisms. Application to microbial systems. Control of metabolite and enzyme balance. Models of cell growth, e.g., monod model; variable yield model; unstructured and structured models; feedback models.

3.464G Theory and Design of Microbial Culture Processes

Basic theory of chemical engineering kinetics. Batch culture. Semi-batch culture. Basic theory of continuous culture. Multi-stage continuous culture. Application to continuous culture; (i) research tool; (ii) industrial fermentations; (iii) effluent treatment; (iv) microbial oxidation of minerals. Biochemical unit operations. Special problems of design, materials and control introduced by aseptic requirements. Engineering problems associated with continuous biological processes.

3.471G Chemical Engineering in Medicine

An introduction to general physiology, particularly emphasising renal and respiratory physiology. The design and operation of artificial kidneys and membrane oxygenators. Application of chemical engineering principles to design of artificial organs. Criteria of optimal therapy. Objective functions for future development.

3.481G Heat, Mass and Momentum Transfer

Revision of fluid dynamics, heat and mass transfer, boundary layer theory; applications to stagewise processes and two-phase flow, lift and drag co-efficients, non-Newtonian flow. Unsteady state heat transfer by conduction, convection and radiation.

3.482G Thermodynamics of Biological Systems

Review of fundamental principles. First and Second Laws. Applications to biological systems, energy in important processes. Rates of reaction, activation, energy, free energy, and metabolism, activated complexes, redox potential and irreversible electrode potentials.

3.483G Process Dynamics and Biochemical Engineering Design

Process dynamics and control. Principles of process dynamics and the mathematical techniques employed. Dynamics of batch and flow processes with living organisms. Unstable systems.

Engineering design and operating characteristics of plant and processes normally used, e.g., 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.

3.900G Master of Applied Science Major Project**3.901G Master of Applied Science Minor Project**

SCHOOL OF METALLURGY

4.011 Metallurgy I

(a) *General Introduction to Metallurgy.*

(b) *Physical Metallurgy*—The crystalline structure and physical properties of solids. Structure sensitive and structure insensitive properties. Specific heat of solids. Phase equilibrium in alloy systems. Thermodynamical and physical aspects of binary systems. Mechanism of phase transformations. Departures from equilibrium and principles of heat treatment. Generation of microstructure. Metallography of iron-carbon and non-ferrous alloys.

(c) *Chemical and Extraction Metallurgy*—Principles underlying the unit processes by which metals are extracted from ores and raw materials. The extraction metallurgy of iron and steel, copper, aluminium, lead, and zinc, together with the less common metals. An introduction to the principles of fluid flow, metallurgical stoichiometry, energy and mass balances, heat transfer.

(d) *Mechanical Metallurgy*—Mechanical testing. The mechanical behaviour of solids—elastic and inelastic behaviour. The effects of stress state, temperature and strain rate. Creep, fatigue and brittle fracture. Metal shaping processes.

TEXTBOOKS

Cottrell, A. H. *An Introduction to Metallurgy.* Arnold.

Dennis, W. H. *Extractive Metallurgy.* Pitman.

Reed-Hill, R. E. *Physical Metallurgy Principles.* Van Nostrand.

Hume-Rothery, W. & Raynor, G. V. *The Structure of Metals and Alloys.* The Institute of Metals, London.

Themelis, N. & Szekely, J. *Rate Phenomena in Process Metallurgy.* Wiley.

REFERENCE BOOKS

Bennett, C. O. & Myers, J. E. *Momentum, Heat and Mass Transfer.* McGraw-Hill.

Boas, W. *Introduction to the Physics of Metals and Alloys.* M.U.P.

Darken, L. S. & Gurry, R. W. *Physical Chemistry of Metals and Alloys.* McGraw-Hill.

Dennis, W. H. *Metallurgy of the Ferrous Metals.* Pitman.

Dennis, W. H. *Metallurgy of the Non-Ferrous Metals.* Pitman.

Dieter, G. E. *Mechanical Metallurgy.* McGraw-Hill.

Gensamer, M. *Strength of Materials under Combined Stress.* A.S.M.

Gilchrist, J. D. *Fuels and Refractories.* Pergamon.

Hollomon, J. H. & Jaffe, L. D. *Ferrous Metallurgical Design.* Wiley.

Kehl, G. L. *Principles of Metallographic Laboratory Practice.* 3rd ed. McGraw-Hill.

McGannon, H. E. *The Making, Shaping and Treating of Steel.* 8th ed. U.S. Steel.

Perry, J. H. *Chemical Engineers Handbook.* McGraw-Hill.

Rhines, F. N. *Phase Diagrams in Metallurgy.* McGraw-Hill.

Woodcock, J. T. ed. *Eighth Commonwealth Mining and Metallurgical Congress.* Vol. 3. Aus. I.M.M.

4.012 Metallurgy II

(a) *Metallurgical Thermodynamics*—An introduction to the thermodynamics of metallurgical systems including a study of equilibria involving liquid metals, slags, gases and the solid state.

(b) *Chemical and Extraction Metallurgy*—The application of physico-chemical principles to the study of metallurgical processes. Electrochemistry and the related topics of corrosion and hydrometallurgy. The engineering basis of extraction metallurgy; heat and mass transfer, high temperature technology.

(c) *Physical Metallurgy*—Theories of diffusion, phase equilibrium and transformation, and their application to alloying, heat treatment, and other metallurgical processes.

(d) *Mechanical Metallurgy*—Analysis and effects of complex stress states in relation to flow and fracture. Stress concentration. Residual stresses. Creep, fatigue and brittle fracture—metallurgical and engineering aspects.

(e) *Mineral Processing*—The principles and practice associated with liberation, beneficiation, froth flotation, hydrometallurgy, materials handling and process engineering.

(f) *Theory of Plastic Deformation*—Geometry of slip in metal crystals. Polycrystalline materials; preferred orientation. Introduction to dislocation theory; application of this theory to yielding, strain ageing, work- and solution-hardening.

(g) *X-ray Diffraction and Theory of the Metallic State*—X-ray diffraction and its application to metallurgy. Development of the modern theory of solids based on the zone theory.

(h) *Special Topics*—Further development of topics from the above sections.

TEXTBOOKS

As for 4.011 Metallurgy I, plus:

Barrett, C. S. *Structure of Metals*. 3rd ed. McGraw-Hill.

Bodsworth, C. & Appleton, A. S. *Problems in Applied Thermodynamics*. Longman.

Cottrell, A. H. *The Mechanical Properties of Matter*. W.I.E.

Darken, L. S., and Gurry, R. W. *Physical Chemistry of Metals*. McGraw-Hill.

Hull, D. *Introduction to Dislocations*. Pergamon.

Mann, J. Y. *Fatigue of Materials*. M.U.P., 1967.

Swalin, R. A. *Thermodynamics of Solids*. Wiley.

West, J. M. *Electrodeposition and Corrosion Processes*. Van Nostrand.

For the Mineral Processing section see under 7.023 (Part 2) Mining and Mineral Process Engineering (School of Mining Engineering).

REFERENCE BOOKS

As for 4.011 Metallurgy I, together with—

Bain, E. C. & Paxton, H. W. *Alloying Elements in Steel*. 2nd ed. A.S.M. Birchenall, C. *Physical Metallurgy*. McGraw-Hill.

Bockris, J. O'M., White, J. L. & Mackenzie, J. D. *Physicochemical Measurements at High Temperatures*. Butterworths.

Burkin, A. R. *Chemistry of Hydrometallurgical Processes*. Spon.

Campbell, I. E. *High Temperature Technology*. Wiley.

Clark, D. S. & Varney, W. R. *Physical Metallurgy for Engineers*. Van Nostrand.

Cottrell, A. H. *Dislocations and Plastic Flow in Crystals*. McGraw-Hill.

Cullity, B. D. *Elements of X-ray Diffraction*. Addison-Wesley.

Grossman, M. A. *Elements of Hardenability*. A.S.M.

Hutchison, T. S. & Baird, D. C. *Physics of Engineering Solids*. 2nd ed. Wiley.

Hume-Rothery, W. *Atomic Theory for Students of Metallurgy*. Inst. of Metals, London.

- Kreith, F. *Principles of Heat Transfer*. Int. Textbook.
Kubaschewski, O., Evans, E. L. L., & Alcock, C. B. *Metallurgical Thermochemistry*. 4th ed. Pergamon.
Levenspiel, O. *Chemical Reaction Engineering*. Wiley.
Read, W. T. *Dislocations in Crystals*. McGraw-Hill.
Schuhmann, R. *Metallurgical Engineering*. Vol. 1. Addison-Wesley.
Scully, J. C. *Fundamentals of Corrosion*. Pergamon.
Shewman, P. G. *Diffusion in Solids*. McGraw-Hill.
Shewman, P. G. *Transformations in Metals*. McGraw-Hill.
Shreir, L. L. ed. *Corrosion*. Vols. 1 and 2. Newnes.
Smallman, R. E. *Modern Physical Metallurgy*. Butterworths.
Stewart, D. & Tulloch, D. S. *Principles of Corrosion and Protection*. Macmillan.
Tetelmann, A. S. & McElivry, A. J. *The Fracture of Structural Materials*. Wiley.
Wagner, C. *Thermodynamics of Alloys*. Addison-Wesley.
Zener, C. ed. *Thermodynamics of Physical Metallurgy*. A.S.M.

4.0121 Metallurgy IIA

Comprises sections (a), (b) (part only), (c) and (e) of 4.012 Metallurgy II, together with appropriate laboratory work.

4.0122 Metallurgy IIB

Comprises section (b) (part only), (d), (f) and (g) of 4.012 Metallurgy II, together with:

(i) *Industrial Metallurgy*—A course of lectures on the application of metallurgical principles to industrial practice.

(j) *Metallurgy Seminar*—As specified in 4.013 Metallurgy III.

The section on "Mineral Processing" in 4.012 and 4.0121 is given by the School of Mining Engineering in 7.023 (Part 2). For Textbooks see under 7.023.

TEXTBOOKS for 4.0121 and 4.0122.

As for 4.012 Metallurgy II.

REFERENCE BOOKS

As for 4.011 Metallurgy I, together with—

Hinsley, J. F. *Non-Destructive Testing*. Macdonald and Evans.

Kondic, V. *Metallurgical Principles of Founding*. Arnold.

Seferian, O. *The Metallurgy of Welding*. Wiley.

Udin, H., Funk, E. R. & Wulff, J. *Welding for Engineers*. Wiley.

4.0123 Metallurgy IIC

Principally industrial metallurgy, and substantially as for section (i) in 4.0122.

4.0124 Metallurgy Report

A literature survey of approximately 10,000 words on a topic of relevance to the student's employment. The proposed topic must be submitted to the Head of School for approval before the end of the third week of Session 1

and the report submitted not later than the end of the seventh week of Session 2.

The section on "Mineral Processing" in 4.012 and 4.0121 is given by the School of Mining Engineering in 7.023 (Part 2). For Textbooks see under 7.023.

4.013 Metallurgy III

(a) Development and application of metallurgical principles relating to the thermodynamics and kinetics of metallurgical processes; structural chemistry; the extraction and refining of the rarer metals; crystal imperfections, with reference to deformation, work hardening, annealing and radiation damage; X-ray and neutron diffraction; phase transformations; fracture mechanisms; and the design of engineering materials.

(b) The application of metallurgical principles to industrial practice, with particular reference to welding, foundry practice, metal shaping, metal finishing, materials selection and non-destructive testing.

(c) Seminar.

TEXTBOOKS

As for 4.011 Metallurgy I and 4.012 Metallurgy II.

REFERENCE BOOKS

As for 4.011 Metallurgy I and 4.012 Metallurgy II, plus

Bloom, H. *The Chemistry of Molten Salts*. Benjamin.

Christian, J. W. *Theory of Transformations in Metals and Alloys*. Pergamon.

Denbigh, K. G. *The Thermodynamics of the Steady State*. Methuen.

de Groot, S. R. *Thermodynamics of Irreversible Processes*. North Holland.

Greenwood, N. N. *Ionic Crystals, Lattice Defects and Non Stoichiometry*. Butterworths.

Hills, A. W. D. ed. *Heat and Mass Transfer in Process Metallurgy*. I.M.M., London.

Hills, A. W. D. ed *Advances in Extractive Metallurgy*. I.M.M., London.

Hinsley, J. F. *Non-Destructive Testing*. Macdonald & Evans.

Kofstad, P. P. *Non Stoichiometry, Diffusion and Electrical Conductivity in Binary Metal Oxides*. Wiley Interscience.

Kondic, V. *Metallurgical Principles of Founding*. Arnold.

Seferian, O. *The Metallurgy of Welding*. Wiley.

Udin, H., Funk, E. R. & Wulff, J. *Welding for Engineers*. Wiley.

4.021 Metallurgy Project

An experimental investigation of some aspect of metallurgy.

4.031 Physics of Metals

(a) *Statistical Mechanics*: Specification of systems and ensemble; quantised system. Distribution law for localised elements; microscopic states; Stirling's approximation; partition function; Bose-Einstein distribution; Fermi-Dirac distribution; Maxwell-Boltzmann distribution. Interpretation of classical thermodynamic variables; Monte Carlo methods.

(b) *Electron Theory*: Introduction. Dual nature of light and electrons. Wave equation; time-dependent, time-independent; tunnelling. Bonding. Mention of hydrogen atom; hydrogen molecule; ionic structure. Metallic

bond; Drude-Lorentz theory, Sommerfeld theory; interaction with lattice; Kronig-Penny model. Suitable wave functions in metals; Bloch waves. Zone representations in k space; Fermi surface; experimental methods of determining Fermi surface. Fermi surface in liquids and alloys.

(c) *Interaction of Radiation with Matter*: Properties of electrons; photons, neutrons. Mass; charge; spin; energy. Energy transfers in collisions with free and bound particles. Absorption; true absorption; scattering. Importance of absorption mechanisms at different energies. Coherently scattered radiation; interference; Bragg's law; reference to dynamical theory and effects; determination of lattice parameters.

4.041 Mathematical Methods

Part 1. *10.351 Statistics SM* (see University Calendar).

Part 2. *Numerical Methods*—Roots of equations. Finite differences, numerical differentiation and integration. Solution of ordinary differential equations; series and finite difference methods. Solution of partial differential equations; finite difference and iterative methods. Systems of linear equations; least squares analysis.

4.121 Principles of Metal Extraction

The fundamental principles of metal extraction. Oxidation and reduction, roasting, slag reactions, distillation, leaching precipitation and electrolysis.

4.131 Principles of Physical and Mechanical Metallurgy

A condensed treatment of physical and mechanical metallurgy.

4.141 Experimental Techniques in Physical Metallurgy

A condensed course of instruction in metallographic, crystallographic and X-ray diffraction techniques.

4.901 Materials

An introductory course on the production, structure and properties of the main types of engineering materials, with a brief introduction to the process used in shaping and fabricating them. This course forms part of the subject 5,010 Engineering A.

REFERENCE BOOKS

Aitchison, L. *A History of Metals*. Vols. I and II. MacDonald & Evans.

Dennis, W. H. *Extractive Metallurgy*. McGraw-Hill.

Gilchrist, J. D. *Extraction Metallurgy*. Pergamon.

Guy, A. C. *Physical Metallurgy for Engineers*. Addison-Wesley.

Newton, J. *Extractive Metallurgy*. Wiley.

Street, A. *Metals in the Service of Man*. Penguin.

Timoshenko, S. *History of the Strength of Materials*. Van Nostrand.

4.911 Materials Science

The atomic structure of metals. The grain structure of metals; origin; modification. Structure of alloys—theory. Structure, properties and heat

treatment of commercially important alloys based on aluminium, copper and iron in particular. Corrosion. Control of structure and properties, commercial alloys, materials selection.

TEXTBOOK

Wulff, J. ed. *Structure and Properties of Materials*. Vols. I & III. Wiley.

REFERENCE BOOK

Guy, A. G. *Elements of Physical Metallurgy*. Addison-Wesley.

4.913 Materials Science

The structure and properties of crystalline substances. Crystal structures, crystal planes and directions. Examination of crystals by X-ray, electron and neutron diffraction techniques. 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.

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.

4.921 Materials Science

(For students in Electrical Engineering). This subject forms part of 8.111 Civil Engineering.

The atomic structure of metals. The crystalline nature of metals and its significance. The solidification of metals. Plastic deformation of crystalline materials and its effect on properties. Phase equilibria in metallic alloys. The heat treatment of some ferrous and non-ferrous alloys. Corrosion. The electron theory of metals. Conductors, semi-conductors and insulators. Magnetic materials—structure and properties.

TEXTBOOKS

As for 4.911 Materials Science, together with—
Wulff, J. ed. *Structure and Properties of Materials*. Vol. IV. Wiley.

REFERENCE BOOKS

Azaroff, L. V. & Brophy, J. J. *Electronic Processes in Materials*. McGraw-Hill.

Guy, A. G. *Elements of Physical Metallurgy*. Addison-Wesley.

Pfann, W. G. *Zone Melting*. Wiley.

4.931 Metallurgy

For students of Civil Engineering. Part of 8.280 Civil Engineering Materials I.

The atomic structure of metals. The grain structure of metals; origin; effects of manufacturing processes. Structure of alloys—theory. Structure, properties and heat treatment of commercially important alloys. The selection and properties of structural steels. Corrosion.

TEXTBOOKS

Guy, A. G. *Elements of Physical Metallurgy*. Addison-Wesley.

Wulff, J. ed. *Structure and Properties of Materials*. Vols. I and III. Wiley

4.941 Metallurgy for Engineers

The structure and properties of solids, with special reference to metals and metallic alloys which are of use to the engineer.

TEXTBOOKS

Guy, A. G. *Elements of Physical Metallurgy*. Addison-Wesley or

Hanks, R. W. *Materials Engineering Science*. Harcourt, Brace & World.

4.951 Materials Technology

Materials selection, based on structure and properties. Equilibrium and kinetics in metallic systems. The structure of ceramics with particular reference to silicates. Structural changes. Electroplating processes considered from a theoretical and practical standpoint. Structure and testing of electro-deposits; electrochemical protection.

The structure, properties and technology of wood.

METALLURGY GRADUATE COURSE SUBJECTS**4.211G Metallurgical Practice**

Detailed studies relating to one or more specialized areas of metallurgical practice, such as founding, welding, mineral treatment.

4.221G Advanced Metallurgical Techniques

Lectures and laboratory instruction in advanced techniques including the following: (a) X-ray metallography; (b) electron microscopy; (c) electron probe microanalysis; (d) quantitative metallography; (e) stress and strain analysis; (f) fracture toughness testing; (g) metal melting and casting; (h) mechanical testing; (i) electrochemical technique; (j) research techniques—physical; (k) research techniques—chemical; and (l) mineral investigation techniques.

4.231G Specialist Lectures in Advanced Theoretical Metallurgy

Advanced courses covering a wide range of theoretical topics drawn from physical metallurgy, chemical and extractive metallurgy, mineral chemistry, physics of metals and mechanical metallurgy.

4.241G Graduate Metallurgy Project

An experimental or technical investigation or design related to a branch of metallurgy.

4.251G Advanced Materials Technology

Principles of materials selection. Selection of materials based on engineering design criteria. Service performance. Modes of failure. Selection based on service performance criteria. Principles of the design of materials. Materials specifications. Acceptance testing. Principles and methods of non-destructive testing. Selection of test methods. N.D.T. laboratory procedure. Service performance analysis. Service failure investigations.

SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING

5.010 Engineering A

Prerequisite: None.

Engineering Mechanics I: Two and three dimensional force systems, composition and resolution of forces, laws of equilibrium. Statics of rigid bars, pin-jointed frames. Shear force, axial force, bending moment. Simple states of stress. Kinematics of the plane motion of a particle. Kinetics of the plane motion of a particle; equations of motion, dynamic equilibrium, work and energy.

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.

Materials: For subject description and reference books see under 4.901.

TEXTBOOKS

Svensson, N. L. *Introduction to Engineering Design*. N.S.W.U.P.

Waldron, K. J. *Engineering Mechanics*. Wiley.

Walshaw, A. C. *SI Units in Worked Examples*. Longman.

REFERENCE BOOKS

Beakley, G. C. & Chilton, E. G. *Introduction to Engineering Design and Graphics*. Macmillan.

Beer, F. P. & Johnston, E. R. *Statics and Dynamics*. Vector ed. McGraw-Hill.

Harrisberger, L. *Engineersmanship*. Wadsworth.

Higdon, A. & Stiles, W. B. *Engineering Mechanics*. Vector ed. Prentice Hall.

Krick, E. V. *Introduction to Engineering and Engineering Design*. Wiley.

McCormick, E. J. *Human Engineering*. McGraw-Hill.

Meriam, J. L. *Statics and Dynamics*. Wiley.

5.020 Engineering B

Engineering Mechanics II: Further development of Mechanics I together with: Virtual work. Cables and catenaries. Geometric properties of plane figures. Kinetics of systems of particles; impulse and momentum. Rotation of a rigid body about a fixed axis.

Introduction to Systems and Computers: Introduction to computers to follow the computer work in Mathematics I. Develops familiarity with algorithms and the use of procedure-oriented languages, and introduces computing equipment.

Systems — Introduction and Concepts: Some of the concepts used in engineering, the relationship of these concepts to phenomena within students' experience, and the illustration of the concepts by case histories and engineering examples. Quantities. Concepts. Components. Systems.

TEXTBOOKS

Waldron, K. J. *Engineering Mechanics*. Wiley.

Walshaw, A. C. *SI Units in Worked Examples*. Longman.

Karbowiak, A. E. & Huey, R. M. eds. *Information Computers, Machines and Humans*. N.S.W.U.P.

REFERENCE BOOKS

- Beer, F. P. & Johnston, E. R. *Statics and Dynamics*. Vector ed. McGraw-Hill.
- French, A. P. *Newtonian Mechanics*. Nelson
- Higdon, A. & Stiles, W. B. *Engineering Mechanics*. Vector ed. Prentice-Hall.
- Meriam, J. L. *Statics and Dynamics*. Wiley.

5.030 Engineering C

Engineering Drawing: Fundamental concepts of descriptive geometry, including reference systems, representation of point, line and plane; fundamental problems of position and measurement. Application of descriptive geometry to certain problems arising in engineering practice. Special emphasis on ability to visualize problems and processes involved in their solution. Instruction in the correct use of drawing instruments and the application of drawing standards. Measurements and dimensioning. Orthographic and isometric projections.

and either

Introduction to Systems and Computers: Introduction to computers to follow the computer work in Mathematics I. Develops familiarity with algorithms and the use of procedure-oriented languages, and introduces computing equipment.

Systems — Introduction and Concepts: Some of the concepts used in engineering, the relationship of these concepts to phenomena within students' experience, and the illustration of the concepts by case histories and engineering examples. Quantities. Concepts. Components. Systems.

TEXTBOOKS

- Robertson, R. G. *Descriptive Geometry*. Pitman.
- Thomson, R. *Exercises in Graphic Communication*. Nelson.
- *Karbowski, A. E. & Huey, R. M. eds. *Information, Computers, Machines and Man*. Wiley.

* For Introduction to Systems and Computers.

or

Introduction to Chemical Engineering (Compulsory for Chemical Engineering students): Routes to and end uses of industrial chemicals. Likely new industrial chemicals. A survey of several Australian chemical industries for the point of view of their historical and economic importance. Examination of the unit operations involved in the industry and the raw materials, equipment and services used. Environmental aspects of the chemical industry.

5.071 Engineering Analysis

Prerequisite: 10.022.

Digital Computer Programming: Numerical Methods — Roots of non-linear equations. Systems of linear equations. Finite differences; numerical differentiation and integration. Solution of ordinary differential equations — series and stepwise methods. Solution of partial differential equations — finite difference and iterative methods. Emphasis to be placed on the use of digital computers. *Statistics* — An introduction to probability theory. Random variables and distribution functions; the binomial, Poisson and

normal distributions in particular. Standard sampling distributions, including those of χ^2 , t and F . Estimation by moments and maximum likelihood: Confidence interval estimation. The standard tests of significance based on the above distributions, with a discussion of power where appropriate. An introduction to linear regression.

TEXTBOOKS

Freund, J. E. *Mathematical Statistics*. Prentice-Hall.

Southworth, R. W. & De Leeuw, S. L. *Digital Computation and Numerical Methods*. McGraw-Hill.

Statistical Tables.

REFERENCE BOOKS

Derman, C. & Klein, M. *Probability and Statistical Inference for Engineers*. O.U.P.

Freeman, H. *Introduction to Statistical Inferences*. Addison-Wesley.

Hald, A. *Statistical Theory with Engineering Applications*. Wiley.

Martin, H. C. & Carey, G. F. *Introduction to Finite Element Analysis*. McGraw-Hill.

Nielsen, K. L. *Methods in Numerical Analysis*. Macmillan.

Plumb, S. C. *Introduction to Fortran Programming*. McGraw-Hill.

Salvadori, M. G. & Baron, M. L. *Numerical Methods in Engineering*. Prentice-Hall.

5.111 Mechanical Engineering Design I

Prerequisite: 5.010. Co- or prerequisites: 5.311, 5.611, 8.151, 8.259.

Introductory lectures illustrating the interdependence of design and technology. Mechanical technology. Interpretation of engineering drawing practice. Philosophy and technique of design. Simple creative design assignments. Basic engineering elements.

TEXTBOOKS

Australian Standard Engineering Drawing Practice. I.E. Aust., 1973.

Grant, H. E. *Engineering Drawing with Creative Design*. McGraw-Hill.

Shigley, J. E. *Mechanical Engineering Design*. 2nd ed. McGraw-Hill.

5.311 Engineering Mechanics

Prerequisites: 1.001, 5.010, 5.020. Co- or prerequisite: 10.001.

Kinematics and kinetics of the plane motion of rigid bodies. Absolute motion, relative translational motion and relative angular motion; dynamic equilibrium; work and energy; impulse and momentum.

TEXTBOOK

Meriam, J. L. *Dynamics*. Wiley.

5.331 Dynamics of Machines I

Prerequisites 5.311, 10.022.

Dynamics of Planar Mechanisms: Analytical and graphical methods for the analysis of velocities, accelerations and forces in planar mechanisms. Kinematics of gear tooth profiles. Static and dynamic rotor balancing.

Mechanical Vibrations: Simple harmonic motion. One degree of freedom systems, free and forced vibrations, transmissibility and motion isolation. Whirling of shafts. Laplace transform methods and transfer functions.

TEXTBOOKS

Hirschhorn, J. *Dynamics of Machinery*, Nelson.

Morrison, J. L. M. & Crossland, B. *Mechanics of Machines*. Longman.

5.611 Fluid Mechanics/Thermodynamics I

Prerequisites: 1.001, 5.010, 10.001. Co- or prerequisites: 5.311, 10.022.

Dimensional systems, units, dimensional analysis, properties of substances. Statics of Fluids. One dimensional flow. Mass, energy and momentum equations. Laminar and turbulent motion. Flow in pipes. Elementary boundary layer theory Drag. Fluid measurements. Angular momentum equation. Turbomachines. Concepts and conservation principles of thermodynamics. First and second laws of thermodynamics. Properties of ideal gases, liquids and vapours. Non-flow and flow processes. Ideal cycles. Factors limiting performance of real cycles.

TEXTBOOKS

Streeter, V. L. *Fluid Mechanics*. 4th ed. McGraw-Hill or

Massey, B. S. *Mechanics of Fluids*. Van Nostrand.

Wark, K. *Thermodynamics*. 2nd ed. McGraw-Hill, 1971, or

Lee, J. F., & Sears, F. W. *Thermodynamics*. 2nd ed. Addison-Wesley.

Reynolds, W. *Thermodynamics*. 2nd ed. McGraw-Hill, 1968.

5.711 Thermodynamics

Prerequisites: 1.001, 5.010, 10.001.

The system; work and heat interactions. Properties of pure substances. First law of thermodynamics. Steady flow processes. Second law of thermodynamics. Power and refrigeration cycles; air standard cycles.

TEXTBOOK

Van Wylen, G. J. *Thermodynamics*. SI Unit ed. Wiley.

SCHOOL OF ELECTRICAL ENGINEERING

6.801 Electrical Engineering

A course for those not envisaging electrical engineering as their profession. Presentation of principles of circuit theory and elementary electronics, transformers, electrical machines and instrumentation.

TEXTBOOK

Smith, R. J. *Circuits Devices and Systems*. 2nd ed. Wiley.

REFERENCE BOOKS

Del Toro, V. *Electrical Engineering Fundamentals*. Prentice-Hall.

Earlier version published as:

Del Toro, V. *Principles of Electrical Engineering*. Prentice-Hall.

Hammond, S. B., & Gehmlich, D. K. *Electrical Engineering*. 2nd ed. McGraw-Hill.

Hayt, G. & Hughes, W. *Introduction to Electrical Engineering*. McGraw-Hill.

SCHOOL OF MINING ENGINEERING

PRELIMINARY BACKGROUND READING

- (Selected reading from this book list for First and Second Year Students.)
- Blainey, G. *Mines in the Spinifex*. 1960.
Blainey, G. *The Peaks of Lyell*. A. & R.
Com. of Aus. *The Australian Mineral Industry Review*. Bur. of Min. Res.
Farwell, G. M. *Down Argent Street*. Johnson.
Fox, A. F. *The World of Oil*. Pergamon.
Hoover, H. C. *The Memoirs of Herbert Hoover, 1874-1920 Years of Adventure*. Macmillan.
Lowering, T. S. *Minerals in World Affairs*. Prentice-Hall.
McLeod, I. R. *Australian Mineral Industry: The Mineral Deposits*. Bur. of Min. Res.
Morrell, W. P. *The Gold Rushes*. A. & C. Black.
Woodward, O. H. *A Review of the Broken Hill Lead, Silver & Zinc Industry*.

7.012 and 7.012R Mineral Resources

Part 1: Historical & economic introduction, definitions. Geological time scale. Principles of mining. Unions, industrial tactics. Salient data on the mineral industry, fuels, metals, industrial minerals. Mining law, government assistances and controls. Tutorial exercises.

Part 2: Investment, employment, wages, basic mining costs. International developments, pattern of mineral trade. Environmental requirements, conservation. Tutorial exercises.

TEXTBOOKS

- Brown, D. A., Campbell, K. S. W. & Crook, K. A. W. *The Geological Evolution of Australia and New Zealand*. Pergamon.
Com. of Aust. *The Australian Mineral Industry Annual Review*. Bur. of Min. Res.
Fullard, H. *Atlas of the World*. E.U.P.
Lang, A. G. ed. *Manual of Australian Mining Laws*. Butterworth.
Thomas, L. J. *An Introduction to Mining*. Hicks Smith.

7.023 and 7.023R Mining and Mineral Process Engineering

1. Mining Engineering: a technical introduction to mining engineering. Prospecting. Types of mineral deposits. Classification of mining methods, applications to coal, non-metallic and metalliferous deposits, petroleum production engineering and sea floor mining. Tutorial exercises, demonstrations or visits to plants.

2. Mineral Process Engineering: a technical introduction to mineral process engineering. Liberation. Theories of comminution, crushing and grinding. Particle size analysis, screening and classification. Principles of methods of concentration including froth flotation. Product disposal. Flowsheets, materials balance calculations. Sampling. Tutorial exercises, demonstrations and laboratory work.

TEXTBOOKS

- Gaudin, A. M. *Principles of Mineral Dressing*. McGraw-Hill.
Lewis, R. S. & Clark, G. B. *Elements of Mining*. Wiley.
Thomas, L. J. *An Introduction to Mining*. Hicks Smith.

7.033 Mineralogical Assessment

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. Quantitative analysis by microscope; chemical; use of heavy liquids; or magnetic and conductive processes.

TEXTBOOK

Jones, M. P. & Fleming, M. G. *Identification of Mineral Grains*. Elsevier.

7.113 and 7.113R Mining Engineering I

Two parts will be taught in each session.

Part 1. Development patterns and techniques for mineral deposits. Explosives, their classification, characteristics and properties. Ammonium nitrate based explosives. Blasting fundamentals, rock fragmentation. Drilling equipment and techniques. Deep boring. Shaft sinking, preliminary considerations, planning layout and equipment, methods. Tunnelling, planning, lay-out, excavation methods and equipment. Underground power stations and storages.

Part 2. Advanced mining systems, elements of mine design as influenced by the system. Orebody types and classification, selection of mining method. Surface methods, metallic and non-metallic, open cuts, dredging, strip mining. Underground coal mining, horizon, bord and pillar, longwall. Underground metal mining, open stoping, supported stoping, caving. Integrated mining methods, pillar recovery. Parameters for applicability and efficiency of mining methods. Mining waste disposal.

Part 3. Non entry mining methods. Hydrocarbon accumulation, porosity and permeability of reservoir rocks. Flow through porous media. Darcy's Laws. Permeability of beds in series and parallel. Gas solubility. Reservoir engineering, volumetric and radial flow calculations. Secondary recovery. In situ mining of sulphur, salt and potash. Underground leaching, retorting of oil shale, gasification of coal. Marine deposits, off-shore mining methods.

Part 4. Mechanical properties of rocks and soils. Failure theories. Analysis of existing structures and openings. Criteria for prediction of failure. Post failure analysis. Structures under compression.

TEXTBOOKS

Calhoun, J. C. *Fundamentals of Reservoir Engineering*. Univ. Oklahoma Press, 1957.

Pfleider, E. P. & Eugen, D. *Surface Mining*. A.I.M.E.

Lewis, R. S. & Clark, G. B. *Elements of Mining*. Wiley, or

Sinclair, J. *Winning Coal*. Pitman.

Thomas, L. J. *An Introduction to Mining*. Hicks Smith.

Woodruff, S. D. *Methods of Working Coal and Metal Mines*. 3 vols., Pergamon.

REFERENCE BOOKS

STATISTICS

Arkin, H. & Colton, R. R. *Statistical Methods*. Barnes & Noble.

Bross, I. D. J. *Design for Decision*. Macmillan.

Deming, W. E. *Some Theory of Sampling*. Wiley.

Moroney, M. J. *Facts from Figures*. Penguin.

Weatherburn, C. E. *A First Course in Mathematical Statistics*. C.U.P.

DRILLING

Brantly, J. E. *Rotary Drilling Handbook*. Palmer Publications.
Cumming, J. D. *Diamond Drill Handbook*. Smith.

GEOPHYSICS

Dobrin, M. R. *Introduction to Geophysical Prospecting*. McGraw-Hill.
Howell, B. F. *Introduction to Geophysics*. McGraw-Hill.

ECONOMICS

Truscott, S. J. *Mine Economics*. Min. Pub. Ltd.

EXPLOSIVES & BLASTING

Atlas Copco Ltd. *Manual of Rock Blasting*.
Dupont de Nemours E. I. & Co. Inc. *Blasters' Handbook*.
Gregory, C. E. *Explosives for Engineers*. Queensland U.P.
Langefors, U. & Kohlstrom, B. *Rock Blasting*. 2nd ed. Wiley.
McAdam, R. & Westwater, R. *Mining Explosives*. Oliver & Boyd.

MINE EQUIPMENT

Bryson, T. *Mining Machinery*. Pitman.
Compressed Air & Gas Institute, N.Y. *Compressed Air Handbook*.

MINING PRACTICE

Beringer, B. *Underground Practice in Mining*. Min. Pub. Ltd.
Eaton, L. *Practical Mine Development and Equipment*. McGraw-Hill.
Fritzsche, G. H. & Potts, E. L. J. *Horizon Mining*. Allen & Unwin.
Higham, S. *An Introduction to Metalliferous Mining*. Griffin.
Jackson, C. F. & Hedges, J. H. *Metal Mining Practice*. U.S. Bur. of Mines
Bull. No. 419.
Morrison, R. G. R. *A Philosophy of Ground Control*. Ontario Dept. of
Mines, 1970.
Shevyakov, L. *Mining of Mineral Deposits*. Peace Publishers.
Statham, I. C. F. *Coal Mining*. E.U.P.
Stoces, B. *Atlas of Mining Methods*. 2 vols. Pergamon.
Whitaker, J. W. & Willet, H. L. *Colliery Explosion and Recovery Work*.
Pitman.
5th Empire Mining and Metallurgical Congress. *Coal in Australia*.
A.I.M.M., 1953.
5th Empire Mining and Metallurgical Congress. *Mining Methods in Aus-
tralia and Adjacent Territories*. A.I.M.M., 1953.
8th Commonwealth Mining and Metallurgical Congress. *The Australian
Mining, Metallurgical and Mineral Industry*. A.I.M.M., 1965.

TUNNELLING

Howett, B. H. M. & Johannesson, S. *Shield and Compressed Air Tunnelling*.
McGraw-Hill.
Inst. of Min. Met. London. *Symposium on Shaft Sinking and Tunnelling*,
1959.
Proctor, R. V. & White, T. L. *Rock Tunnelling with Steel Supports*.
Commercial Shearing and Stamping Company.
Sandstrom, G. E. *The History of Tunnelling*. Barrie & Rockliff.

ALLUVIAL MINING

Griffith, S. V. *Alluvial Prospecting and Mining*. *Symposium of Open Cast
Mining, Quarrying and Alluvial Mining, London, 1964*. Min. Pub. Ltd.
Harrison, H. L. M. *Examination, Boring and Valuation of Alluvial
Deposits*. Min. Pub. Ltd.

OIL AND NATURAL GAS

- Amyx, J. W., Bass, D. M. & Whiting, R. L. *Petroleum Reservoir Engineering*. Vols I & II. McGraw-Hill.
- Craft, B. C. & Hawkins, M. F. *Applied Petroleum Reservoir Engineering*. Prentice-Hall, 1959.
- Katz, J. *Handbook of Natural Gas Engineering*. McGraw-Hill, 1959.
- Pirson, S. J. *Elements of Oil Reservoir Engineering*. McGraw-Hill.
- Uren, L. C. *Petroleum Production Engineering*. Vol. I *Oil Field Exploitation*. Vol. II *Development*. Vol. III *Economics*. McGraw-Hill.

7.124 Mining Engineering II

1. Mine atmospheres, gases, dust. Spontaneous combustion, fires, rescue, recovery. Mine ventilation, flow of air in mines, friction factors, shock losses. Psychometry. Mine fans, fan laws, introductory thermodynamics. Natural ventilation. Bulk materials handling underground, hoisting, conveyors, tracked and trackless transport, wire ropes, oil and slurry pipe lines. Natural state of stress in rock masses, stress concentration around underground openings.

2. Support at the face, in roadways and in the waste. Requirements of Mines Inspection Acts with respect to electrical power distribution, power supply and transmission. Mine drainage, pumps, pump station, flooding and de-watering. Mine safety, health, metallic poisons, hygiene, diseases, forensic investigations. Noise control in mining operations. Mine lighting. Compressed air generation and reticulation.

7.124R Mining Engineering II

For students in BSc(Eng) based on topics principally selected from the syllabi of 7.124, 7.224 and 7.234. To a lesser degree some topics from 7.134 and 7.144 may also be included or recommended for additional reading.

PRELIMINARY BACKGROUND READING for 7.124 and 7.124R

(selected reading from this book list for third and fourth year students).

- Blainey, G. *The Tyranny of Distance*. Sun, 1966.
- Blainey, G. *Mines in the Spinifex*. A. & R., 1960.
- Hoover, H. C. *Principles of Mining*. McGraw-Hill, 1909.
- Jenkin, A. K. H. *The Cornish Miner*. Allen & Unwin.
- Rickard, T. A. *Man and Metals*. Vols I & II. McGraw-Hill.
- Rickard, T. A. *Technical Writing*. Wiley, 1931.
- Spalding, J. *Deep Mining*. Min. Pub. Ltd.

REFERENCE BOOKS**STATISTICS**

- Arkin, H. & Colton, R. R. *Statistical Methods*. Barnes & Noble.
- Schaifer, R. *Probability and Statistics for Business Decisions*. McGraw-Hill.
- Walker, M. W. & Lev, J. *Statistical Inference*. Constable & Holt.

HOISTING

- Inst. of Min. & Met. *Wire Ropes in Mines*.
- Broughton, H. H. *Electric Winders*. Sun.
- Price, A. G. *Winding Calculations for the Mining Engineer*. The Gen. Elec. Co.

MINE VENTILATION

Buffalo Forge Co. *Fan Engineering*.

Bulletin 385 U.S. Bur. of Mines. *Engineering Factors in the Ventilation of Metal Mines*.

BSS 848. *Testing of Fans*.

Hartman, H. L. *Mine Ventilation and Air Conditioning*. Ronald Press.

Penman, D. & Penman, J. S. *Principles and Practice of Mine Ventilation*. Griffin.

Rayner, H. E. R. *A Guide to Mine Ventilation Calculations*. Mine Ventilation Soc. of South Africa.

Transvaal Chamber of Mines. *Quality of Mine Air*.

Weeks, W. S. *Ventilation of Mines*. McGraw-Hill.

ECONOMICS

Brech, E. F. L. *Management, its Nature and Significance*. 3rd ed. Pitman, 1953.

Chambers, R. J. *Financial Management*. Law Book Co.

Court, H. P. *Budgetary Control*. Sweet & Maxwell.

Dobb, M. *Wages*. Nisbet & C.U.P.

Donovan, F. P., Rymer, B. P. & Sinclair, D. A. *Signed Sealed and Delivered*. 4th ed. Cheshire, 1967.

Hoover, T. J. *The Economics of Mining*. Stanford U.P. & O.U.P.

Myer, J. N. *Financial Statement Analysis*. Prentice-Hall.

Wilcox, F. *Mine Accounting and Financial Administration*. Pitman.

MINING LAW

Ely, N. *Summary of Mining and Petroleum Laws of the World*. U.S. Bur. of Mines.

Mining Acts. N.S.W., W.A., Tas., Q'land, Vic. & S.A.

SAFETY, HEALTH

Davies, C. N. *Dust is Dangerous*. Faber & Faber.

Davies, R. N. *Breathing and Irrespirable Atmospheres*. St. Catherine Press.

Drinker, P. & Hatch, T. *Industrial Dust*. McGraw-Hill.

Gill, G. H. *Dust, Its Effects on the Respiratory System*. Lewis.

Inst. of Mining Engineers & Inst. of Mining & Metallurgy. *Silicosis, Pneumoconiosis and Dust Suppression in Mines*, 1947.

Jenkins, J. D. & Waltham, J. W. *Coal Mines Rescue and Fire Fighting*. Griffin.

McAdam, R. & Davidson, D. *Mine Rescue Work*. Oliver & Boyd.

Transvaal Chamber of Mines. *Safety Code*.

MINING PRACTICE

Jeppe, C. B. *Gold Mining on the Witwatersrand*. Transvaal Chamber of Mines.

Mitke, C. A. *Mining Methods*. McGraw-Hill.

Peele, R. *Mining Engineers Handbook*. Wiley.

Spruth, Fritz. *Face Supports in Steel and Light Metal*. Colliery Guardian.

Statham, I. C. F. ed. *Coal Mining Practice*. 4 vols. Caxton Pub. Co.

Tillson, B. F. *Mine Plant*. A.I.M.E.

ROCK MECHANICS

Farmer, I. W. *Engineering Properties of Rocks*. Spon, 1968.

Jaeger, J. C. & Cook, N. G. W. *Fundamentals of Rock Mechanics*. Methuen, 1969.

Jaeger, J. C. *Elasticity, Fracture and Flow*. Science Paperback, 1971.

Subsidence Engineer's Handbook. N.C.B. Prod. Dept. London.

GENERAL

Nelson, J. R. *Writing the Technical Report*. McGraw-Hill.

7.134 Mining Engineering III

Rock fragmentation and excavation, nuclear blasting applied to mining. Reservoir mechanics, formation pressures and temperatures, phase behaviour. Bottom hole pressures. Free flowing and pumping for oil wells. Secondary recovery applications. Off-shore mining, sea-floor excavation, transport systems, support platforms. Computer applications to mining methods and transport.

TEXTBOOKS

Obert, L. & Duvall, W. I. *Rock Mechanics and the Design of Structures in Rocks*. Wiley.

Woodruff, S. D. *Methods of Working Coal and Metal Mines*. Vols. 1 and 2, Pergamon, 1966.

7.144 Mining Engineering IV

Advanced mine ventilation, network analysis, mine thermodynamics, air flow in naturally and fan ventilated mines. Booster and auxiliary fans. Mine climate, air contaminants and noxious gases, comfort, air cooling power, heat stress, problems in hot, deep mines. Air conditioning in mines. Design of open pit excavations and underground structures in rock. Mechanics of mining subsidence. Exercises in mine design and layout.

TEXTBOOKS

Jaeger, J. C. & Cook, N. G. W. *Fundamentals of Rock Mechanics*. Methuen, 1969.

Mero, M. *Mineral Resources of the Sea*. Pergamon.

7.213 Mine Surveying and Control Engineering

Surveying methods in the development and exploitation of mineral resources and the assessment of mineral properties. Tunnel surveys, azimuth transfers, borehole surveys, stope and ore reserve surveys. Mine survey office organization. Production and development scheduling, use of networks, integrated networks, resource restrained networks. Production control, grade control. Demonstrations of equipment.

7.213R Mine Surveying and Control Engineering

For students in the BSc(Eng) course; based on the syllabus of 7.213.

TEXTBOOKS FOR 7.213 and 7.213R

Staley, W. W. *Introduction to Mine Surveying*. 2nd ed. Stanford U.P., 1964.
or

Winiberg, F. *Metalliferous Mine Surveying*. 5th ed. Min. Pub. Ltd., 1966.
or

Metcalf, J. E. *A Mining Engineer's Survey Manual*. Electrical Press, London.

Chamber's Seven-Figure Mathematical Tables.

7.224 Mine Valuation

Administration. Sampling Theory applied to projection of boreholes, ore bodies and milling. Valuation of mineral properties. Resource allocation, finance, labour, equipment. Infrastructure and taxation. Size and scope of mining company operations.

TEXTBOOK

Baxter, C. H. & Parks, R. D. *Examination and Valuation of a Mineral Property*. Addison-Wesley.

7.234 Mineral Economics

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.

TEXTBOOK

C'wealth of Aust. *The Australian Mineral Industry Review*. Annual and Quarterly. Bureau of Min. Res.

7.314 Mineral Processing I

Applied mineralogy, assessment of physical and chemical properties, liberation. Theory of particle breakage, comminution, technology of crushing and grinding, particle size distribution and analysis. Gravity concentration and other physical methods of separation. Froth flotation. Chemical processing and extraction. In situ recovery processes. Coal preparation technology. Fluid mechanics of mineral pulps, free, hindered and zone settling, thickening, classification, dewatering. Materials handling. Process design.

7.314R Mineral Processing I

For students in the BSc(Tech) course. Based on the syllabus of 7.314.

7.315R Mineral Processing for Mining Engineers

An abridged course for students in the BSc(Eng) course based on the syllabus of 7.314.

BOOK LIST for 7.314, 7.314R and 7.315R.

TEXTBOOK

Taggart, A. F. *Handbook of Mineral Dressing*. Wiley.

REFERENCE BOOKS

Cameron, E. N. *Ore Microscopy*. Wiley.

Edwards, A. B. *Texture of Ore Minerals*. A.I.M.M.

Gaudin, A. M. *Flotation*. 2nd ed. McGraw-Hill.

Gaudin, A. M. *Principles of Mineral Dressing*. McGraw-Hill.

Glembotskii, V. A. *Flotation*. Primary Sources. N.Y.

Herdan, G. *Small Particle Statistics*. Butterworths.

Leonard, J. W. & Mitchell, D. R. *Coal Preparation*. A.I.M.E.

Sutherland, K. L. & Wark, I. W. *Principles of Flotation*. A.I.M.M.

Taggart, A. F. *Elements of Ore Dressing*. Wiley.

7.316R Mineral Processing II

Physical and chemical properties of minerals. Applied mineragraphy. Selection of beneficiation processes. Gravity separation processes and physical separation processes. Surface chemistry and froth flotation. Chemical processing and extraction, bacterial leaching. Process engineering, flowsheet and plant design. Market preparation.

TEXTBOOKS

Cameron, E. N. *Ore Microscopy*. Wiley.

Gaudin, A. M. *Flotation*. 2nd ed. McGraw-Hill.

Taggart, A. F. *Handbook of Mineral Dressing*. Wiley.

7.324 Mineral Processing II

Surface chemistry, adsorption, electrical double layers, stabilization and dispersion of mineral particles. Flocculation and froth flotation.

TEXTBOOK

Gaudin, A. M. *Flotation*. 2nd ed. McGraw-Hill.

7.326R Mineral Industry Processes

Principles underlying extraction of some common metals, pyrometallurgy, hydrometallurgy, electro-metallurgy, chemical extraction, agglomeration, sintering, mineral processing as a bridge between mining and metallurgical industries.

TEXT AND REFERENCE BOOKS

Students should obtain list from Broken Hill.

7.334 Mineral Processing III

Integration of mineral processing techniques with metallurgical operations. Process engineering. Laboratory and pilot plant testing, project evaluation. Preparation of flowsheets, equipment selection and plant design.

TEXTBOOKS

Denver Equip. Co. *Modern Mineral Processing Flowsheets*.

Leonard, J. W. & Mitchell, D. R. *Coal Preparation*. A.I.M.E.

REFERENCE BOOKS

Brown, G. G. *Unit Operations*. Wiley.

Herdan, G. *Small Particle Statistics*. Butterworths.

Jones, M. P. & Fleming, M. G. *Identification of Mineral Grains*. Elsevier.

McLeod, I. R. *Australian Mineral Industry. The Mineral Deposits*. Dept. Nat. Dev.

Rabone, P. *Flotation Plant Practice*. Min. Pub. Ltd.

Short, M. W. *Microscopic Determination of Ore Minerals*. U.S. Dept. Int.

7.411R Fluid Mechanics

Statics of fluids. One dimensional flow. Mass, energy and momentum equations. Laminar and turbulent motion. Flow in pipes. Elementary boundary layer theory. Drag. Fluid measurements. Angular momentum equation. Turbomachines.

TEXT AND REFERENCE BOOKS

Students should obtain list from Broken Hill.

7.414 Mineral Industry Elective Project

The elective project may be selected from one of the following options, and consists of Part 1: Literature survey, and Part 2: Thesis.

1. *Mathematical Models for Mining Methods*

Presenting a rapid technique for the examination and analysis of mining methods, indicating modifications to a basic mining system which makes for better adaptation to a particular ore body. Computer control of production and rapid re-assessment of the ore production capacity of a mine in relation to quantity and grade control.

2. *Advanced Mine Design*

Review of mining methods. Transport considerations. Level interval determinants. Location of mine shafts. Design of shaft systems. Factors influencing stope design. Services openings. Computer applications in design. Design for emergency conditions. Mine design exercises.

3. *Explosives Engineering*

Characteristics of high explosive, classification of explosive compounds and mixtures; ammonium nitrate based explosive mixtures. Theories of detonation; rock fragmentation, theories of blasting, calculation of charge, general case, bench blasting, short delay blasting, smoothwall blasting, submarine blasting. Ground vibration.

4. *Mechanics of Bulk Materials Handling*

Appraisal of available methods. Belt conveyors, chain conveyors, bucket elevators, screw conveyors and elevators, shaking and vibratory conveyors, fluid transport, rope haulage, monorails, aerial ropeways, locomotive haulage. Mine hoisting systems.

5. *Marine Mining*

Basic oceanography, physical resources of the ocean, marine deposits and characteristics, marine physiology. Sampling techniques, hydrographic surveying, navigation. Mining systems, excavation, transport, support platforms, treatment and tailings disposal. Marine environment, air-sea interface, water zones, sea-floor and sub-bottom.

6. *Natural Gas Technology*

Properties of natural gas and reservoir fluids. Single and two phase flow in wells. Theory and practice of gas reservoir engineering. Pipelining and distribution of natural gas. Conservation and storage of natural gas.

7. *Mine Organization and Methods*

Mine organization charts, mine operation and cost control. Human relations in mining. Detailed production and development scheduling and networking. Modern mining methods: Mechanized cut and fill, sub-level caving, block caving, sub-level open stoping. Open cut, strip mining, longwall. Quantitative analysis of conservation of resources and environment.

8. *Mine Filling*

Support and mining roles of fill. Fill emplacement, cost analyses, mining methods employing fill. Hydraulic fill: compressibility, permeability, size grading effects. Cemented fill: properties, production, specialist application and requirements. Rock fill and cemented rock fill. Attrition in passes, rill classification, placement of mixed fills.

9. *Advanced Rock Mechanics*

Methods of stress and strain analysis. Theories of rock failure. Photoelasticity. Finite element methods. Laboratory use of strain measuring equipment. Rock stress determination techniques. Deformation measuring equipment. Elements of elastic wave theory. Theories of blasting. Theory of shock propagation. Calculation of explosive pressure. Rock bursts. Hydraulic fracturing. Workability of coal and other minerals. Design of tailing dams. Recent developments in rock mechanics.

10. *Computer Methods*

Advanced use of Fortran IV. Linear programming. Monte-Carlo method. Simulation techniques. Ore reserves calculations. Critical path analysis. Transport system analysis. Use of computers in surveying. Geological data processing. Mining system analysis. Open pit design. Production planning.

11. *Comminution*

Comminution and Sizing: rock properties, methods of fracture and breakage, size distribution and size control, sampling granular materials.

12. *Flotation*

Flotation theory: sulphide minerals, oxidized and oxide minerals, salt minerals, calcium minerals.

13. *Coal Preparation*

Coal constitution, bore core evaluation, non-destructive testing, interpretation of analyses for selective preparation, blending for utilization.

14. *Mineralogical Assessment for Leaching*

Analysis of physical and chemical properties of mineral assemblages for process design, selection of solvents, methods of dissolution, solvent extraction, precipitation, cementation, refining.

15. *Flowsheet Planning*

Assessment of mineral properties; extraction processes and environmental conditions for the basis of process design. Selection of technology to be adopted; assemblage, selection and location of equipment. Fluid-solids flows; design of auxiliary units. Development and presentation of flowsheets and material balances.

16. *Advanced Mine Ventilation*

The energy equation applied to mine ventilation, sources of heat in mines, geothermal gradients, mine thermodynamics, pressure volume diagrams. Fan design, installation and testing. Psychrometry, air conditioning, ventilation planning, surveys and network analysis. Computer applications.

7.414R Mineral Industry Elective Project

For students in the BSc(Eng) and BSc(Tech) courses, based on the syllabus for 7.414. Part 1: Literature Survey. Part 2: Thesis.

MINING AND MINERAL ENGINEERING GRADUATE SUBJECTS

7.111G Mining Engineering

1. Surveying methods in the development and exploitation of mineral resources. Mine development, drilling equipment and techniques. Explosives,

their characteristics and properties. 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. Introductory rock mechanics, mechanical behaviour of rocks. The Mining Acts.

7.122G Mining Engineering Technology

1. Mine ventilation, mine atmospheres, quality and properties of mine air, contaminants, toxicity of mineral particles and gases, thermodynamics of mine air, network analyses, air conditioning in mines. Mine safety, health, mine hygiene, noise control.

2. Mine lighting, electrical power distribution, generation and reticulation of compressed air. Materials handling, fundamental concepts. Surface and underground haulage systems, design of conveyors and locomotives, mine hoisting, design criteria. Mine drainage.

3. Feasibility studies. Mine design and layout, separation of functions for maximum efficiency; application of analogue and digital computers. Production control, grade control. Mine valuation, administration. Sampling. Valuation of mineral properties. Resources allocation, finance, labour, equipment. Size and scope of mining company operations.

4. Mine support. Mining methods employing fill. Hydraulic fill, compressibility. Rock fill and cemented rock fill. Placement of mixed fills.

5. Rock mechanics. Stress and strain analysis. Theories of failure. 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 exercises in sampling and valuation, mine support, temporary or long term; mine design and plant related to extraction areas 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

Natural state of stress in rock masses. Stress distribution around underground excavations. Effects of geological structures on the stability of mine working. Stresses and rock mass movements induced by mining operations. Design of underground excavations in competent and incompetent rock. Design of mining systems and layout of workings based upon rock mechanics and functional considerations.

Principles and design of natural and artificial support systems. Interrelation of temporary, stabilizing and long term support. Support of permanent mining and civil engineering openings. Support at the face and in the waste. Control of ground in the vicinity of production excavations; mine filling, its source, characteristics and application.

Design and construction aspects of open pit slopes and tailing dams.

Rock-breaking and drilling method; penetrability and workability of rocks. Hydraulic fracturing. Nature, occurrence and prediction of rock-bursts. Mechanics of mining 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 prior to mining, 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 mine ventilation, sources of heat in mines, geothermal gradients, mine 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, air conditioning, ventilation planning, surveys, and network analysis. Computer applications. Selected laboratory experiments and network designs.

7.154G Rock Excavation and Transportation

Methods of rock fragmentation drilling, explosives, 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. Selection procedures, cost analysis.

7.311G Mineral Beneficiation

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 technology, energy requirements. Processes of agglomeration. Physical separation methods, electronic sorting, electrostatic and magnetic separation.

7.322G Mineral Beneficiation Technology

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, assessment of mineral properties, extraction processes and environmental conditions. Selection and location of equipment, fluid-solids flow, design of auxiliary units, development and presentation of flowsheets. 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. Management.

7.332G Mineral Engineering Laboratory

Laboratory investigations may be selected from the following classifications according to availability and specialization: metalliferous ore concentration; coal preparation; beneficiation of non-metallics; processing of mineral fluids.

7.351G Mineral Beneficiation

Process design based upon assessment of mineral properties; extraction processes and environmental conditions. Selection of technology to be adopted. Basis of feasibility studies. Special considerations for coal preparation and treatment of industrial minerals. Flowsheet planning, solid and fluid flows, auxiliary units, materials handling, product disposal. Experimental techniques used in testing. Scale up procedures. Plant control, automation, use of computers. Management of mineral processing operations.

7.442G Mineral Industry Analysis

This subject involves advanced work in the technical and economic analysis of mining and mineral processing operations carried out on mine leases. Cases are selected for examination and analysis, and a critical review must be written of the operations analysed.

TEXTBOOKS for all Mining and Mineral Engineering Graduate Subjects.

Arbiter, N. *Milling Methods in the Americas*. Gordon & Breach Sci. Pub.
Baxter, C. H. & Parks, R. D. *Examination and Valuation of a Mineral Property*. Addison-Wesley.

Cameron, E. N. *Ore Microscopy*. Wiley.

Commonwealth of Australia. *The Australian Mineral Industry Review*.
Annual and Quarterly. Bureau of Min. Res.

Fox, A. F. *The World of Oil*. Pergamon.

Gaudin, A. M. *Flotation*. 2nd ed. McGraw-Hill.

Jaeger, J. C. *Elasticity, Fracture and Flow*. Science Paperback, 1971.

Jaeger, J. C. & Cook, N. G. W. *Fundamentals of Rock Mechanics*.
Methuen, 1969.

Lewis, R. S. & Clark, G. B. *Elements of Mining*. Wiley.

Obert, L. & Duvall, W. I. *Rock Mechanics and the Design of Structures in Rocks*. Wiley.

Peele, R. *Mining Engineers Handbook*. 3rd ed. Vols I and II. Wiley.

Pfleider, E. P. & Eugen, D. *Surface Mining*. A.I.M.E.

Rose, H. E. & Sullivan, R. M. *Ball Tube and Rod Mills*. Constable.

Staley, W. W. *Introduction to Mine Surveying*. 2nd edition. Stanford U.P.,
1964.

Taggart, A. F. *Handbook of Mineral Dressing*. Wiley.

Woodruff, S. D. *Methods of Working Coal and Metal Mines*. 3 vols.
Pergamon.

SCHOOL OF CIVIL ENGINEERING

8.112 Materials and Structures

Theory of Structures—Moduli of elasticity, simple stress and strain. Compound bars, temperature stresses. Thin shells. Stress at a point. Strain at a point. Principal stresses and strains. Relationship between load, shear force and bending moment. Moments of inertia, principal moments of inertia. Stresses due to axial force, bending moment shear force, and torsion. Differential equations of simple beam theory. Deflection of beams. Statically indeterminate beams. Strain energy. Deflections at a single load. Shock loads. Theory of centrally loaded column and eccentrically loaded columns.

Properties of Materials—Mechanical behaviour of materials; response to static and dynamic loads. Laboratory techniques. Analysis and presentation of experimental results. Use of material properties in analysis and design.

8.151 Mechanics of Solids

Statics of bars. Geometrical properties of plane figures. Stress and strain; uniaxial stress. Stresses and deformations due to bending, shear and torsion. Stress and strain at a point; combined stresses. Assemblages of bars and beams. Structural instability. Dynamic loading.

TEXTBOOK

Hall, A. S. *An Introduction to Mechanics of Solids*. SI ed. Wiley, 1973.

8.241 Geomechanics

Introductory mechanics of solids and properties of materials. Stress and strain. Elasticity and plasticity. Mohr's Circle concepts. Materials testing. Brief review of theories of yield and failure. Engineering behaviour of natural materials. Soil/rock classification. Role of water and effective stress. Consolidation characteristics and shear strength of soils. Active and passive pressure states. Brief treatment of stability of foundations, slopes and earth/rock fill dams. Failure in rock structures. Preferred failure plane orientations. Design of rock bolting grids. Laboratory/tutorial. Engineering tests of soil and rock. Use of testing data to check designs of road pavements, foundations and earth/rock fill dams.

TEXTBOOKS

Farmer, I. W. *Engineering Properties of Rocks*. Spon., 1968.

Terzaghi, K. & Peck, R. B. *Soil Mechanics in Engineering Practice*. 2nd ed., Wiley, 1967.

8.250 Properties of Materials

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.

TEXTBOOK

Polakowski, N. H. & Ripling, E. J. *Strength and Structure of Engineering Materials*. Prentice-Hall, 1966.

8.259 Properties of Materials

8.250—Properties of Materials, *plus* the structure and properties of binary alloys; control of structure and properties, commercial alloys, materials selection.

8.510 Hydraulics

Fluid properties; hydrostatics, stability of floating bodies; fluid acceleration; flow patterns, continuity; Euler, Bernoulli, energy and momentum equations. Laboratory experiments.

TEXTBOOKS

Giles, R. V. *Fluid Mechanics and Hydraulics*. Schaum's Outline Series.
Vennard, J. K. *Elementary Fluid Mechanics*. 4th ed. Wiley, 1961.

CIVIL ENGINEERING GRADUATE SUBJECTS**8.757G Foundation Engineering**

Bearing capacity and settlement of cohesive and cohesionless soils, shallow and deep foundations, pile and raft foundation interaction, vibration of foundations, accelerated consolidation.

8.842G Groundwater Hydrology

Confined and unconfined aquifers, analogue and digital models of aquifer systems, water movement in the unsaturated zone, recharge, groundwater quality, sea water intrusion.

SCHOOL OF WOOL AND PASTORAL SCIENCES

9.121 Livestock Production I

The sheep and beef cattle industries and their place in the economic life of Australia; levels of production and trends. The interrelationships of each of these classes of livestock and the natural, artificial and economic conditions determining the stratification of types. Sheep producing zones. Sheep breeds, their uses and economic relationships. Crossbreeding, prime lamb production.

Sheep management; and principal sources of wastage.

TEXTBOOKS

Alexander, G. & Williams, O. B. *The Pastoral Industries of Australia*. Sydney U.P.

Belschner, H. G. *Sheep Management and Diseases*. 8th ed. A. & R.

Cole, V. G. *Sheep Management for Wool Production*. Grazcos.

James, B. J. F. ed. *Animal Reproduction*. Cheshire.

REFERENCE BOOKS

Anderson, R. *On the Sheep's Back*. Sun.

Austen, H. B. *The Merino. Past, Present and Probable*. A. & R.

Barnard, A. ed. *The Simple Fleece*. M.U.P.

Dun, R. B. & Eastoe, R. D. *Science and the Merino Breeder*. N.S.W. Govt. Printer.

Ensminger, M. E. *Animal Science*. 6th ed. Interstate Printers.

Frandsen, R. D. *Anatomy and Physiology of Farm Animals*. Lea & Febiger.

Hafez, E. S. E. ed. *Reproduction in Farm Animals*. 2nd ed. Lea & Febiger.

Hafez, E. S. E. ed. *Adaptation of Domestic Animals*. Lea & Febiger.

Hafez, E. S. E. ed. *Behaviour of Domestic Animals*. Lea & Febiger.

Hammond, J. J., Mason, I. L. & Robinson, T. J. *Hammond's Farm Animals*. Arnold.

Le Couteur, G. S. *Wool, Modern Myths, New Horizons*. Cheshire.

Mason, I. L. *A Dictionary of Livestock Breeds*. C'wlth. Agric. Bureau, Buckinghamshire.

May, N. D. S. *Anatomy of the Sheep*. Q'ld. U.P.

Moore, R. M. ed. *Australian Grasslands*, A.N.U.P.

Pryor, W. *Husbandry of Sheep in Queensland*. 2nd ed. Q'ld. U.P.

Spedding, C. R. W. *Sheep Production and Grazing Management*. Bailliere, Tindal & Cox.

Spedding, C. R. W. *Grassland Ecology*. Clarendon.

Tribe, D. E. & Coles, G. J. R. *Prime Lamb Production*. Cheshire.

Williams, D. B. ed. *Agriculture in the Australian Economy*. Sydney U.P.

Yeates, N. T. M. *Modern Aspects of Livestock Production*. Butterworths.

9.122 Livestock Production II

Statistics on beef production, home consumption and export markets. Breeds of beef cattle, cross breeding and dairy-beef production.

Selection of breeding stock, factors affecting reproduction and performance recording. The effect of climate on beef cattle performance, applied and physiological aspects.

Carcass appraisal, methods of grading and quality aspects of meat. Artificial breeding and feedlotting of beef cattle. Management practices.

TEXTBOOKS

Alexander, G. & Williams, O. B. *The Pastoral Industries of Australia*. Sydney U.P.

Cole, V. G. *Beef Cattle (Production) Guide*. Grazcos.

REFERENCE BOOKS

- Barton, R. A. *Quality Beef Production*. Massey Agricultural College.
 Beattie, W. A. *Beef Cattle Industry of Australia*. C.S.I.R.O.
 Campbell, A. G. ed. *New Zealand Beef. Production, Processing and Marketing*. N.Z. Inst. Agric. Sci.
 Ensminger, M. E. *Beef Cattle Science*. Interstate Printers.
 Fraser, A. *Beef Cattle Husbandry*. Crosby Lockwood.
 Neuman, A. L. & Snapp, R. R. *Beef Cattle*. 6th ed. Wiley.
 Payne, W. J. A. *Cattle Production in the Tropics*. 2 vols. Longman.
 Phillips, R. W. *Breeding Animals Suited to Unfavourable Environments*. F.A.O.
 Yeates, N. T. M. *Modern Aspects of Livestock Production*. Butterworths.

9.123 Livestock Production III

The dairying and pig industries of Australia; patterns and trends. Principal breeds and their uses. Production of milk and milk by-products, and of pigmeats. Quality concepts of the various products.

Management of the dairy cow; selection and management of the dairy sire.

Selection of breeding pigs. Pig housing, management and feeding. Wastage and disease.

TEXTBOOKS

- Downey, L. A. *Pig Raising*. 2nd ed. A. & R.
 Lamond, D. R. & Campbell, A. *Dairy Cattle Husbandry*. 2nd ed. A. & R.

REFERENCE BOOKS

- Belschner, H. G. *Pig Diseases*. A. & R.
 Krider, J. L. & Carroll, W. E. *Swine Production*. McGraw-Hill.
 Roy, J. H. B. *The Calf. Vol. 1. Management and Feeding*. Butterworths.
 Roy, J. H. B. *The Calf. Vol. 2. Nutrition and Health*. Butterworths.

9.124 Livestock Production IV

Principles of livestock production and their application in optimizing animal production; reproduction and fertility; applied milk secretion; growth and development. The meat industry; slaughter, meat inspection and preservation; utilization of by-products.

Carcass conformation and composition and measurement techniques for predicting same. Meat quality.

TEXTBOOKS

- James, B. J. F. ed. *Animal Reproduction*. Cheshire.
 Sadleir, R. M. *Ecology of Reproduction in Domestic Animals*. Methuen.
 Tribe, D. E. ed. *Carcass Composition and Appraisal of Meat Animals*. C.S.I.R.O.

REFERENCE BOOKS

- American Meat Inst. Foundation. *Science of Meat and Meat Products*. 2nd ed. Freeman.
 Barnard, C. S., Halley, R. J. & Scott, A. H. *Milk Production*. Butterworths.
 Barton, R. A. *Quality Beef*.
 Butterfield, R. M. & May, N. D. S. *Muscles of the Ox*. Q'ld. U.P.
 Falconer, I. R. *Lactation*. Butterworths.
 Fraser, A. F. *Reproductive Behaviour in Ungulates*. Academic.

- Fraser, A. F. *Animal Reproduction. Tabulated Data*. Balliere Tindall & Box.
 Gerrard, F. *Meat Technology*. Leonard Hill.
 Hafez, E. S. E. *Reproduction in Farm Animals*. 2nd ed. Lea & Febiger.
 Hafez, E. S. E. *Behaviour of Domestic Animals*. Lea & Febiger.
 Hafez, E. S. E. & Dyer, I. A. *Animal Growth and Nutrition*. Lea & Febiger.
 Lodge, G. A. & Lamming, G. E. *Growth and Development of Mammals*.
 Butterworths.
 McMeekan, C. P. *Principles of Animal Production*. Whitcombe & Tombs.
 Rheingold, H. L. ed. *Maternal Behaviour in Mammals*. Wiley.
 Rhodes, D. N. ed. *Meat Production from Entire Male Animals*. Churchill.

9.131 Animal Health and Preventive Medicine I

Causes of disease. Symptomatology and recognition of the abnormal state; Nutritional conditions and digestive disorders; Deficiencies; excesses, diseases initiated by starvation. Avitaminosis, sheath rot. Diseases causing intestinal dysfunction including effect of parasites on production. Diseases of the feet and bone structures. Diseases causing locomotive dysfunction and abnormal behaviour. Diseases affecting the wool and skin, including external parasites. Management and disease, including conditions initiated by injury, shearing, dipping, lamb marking, lambing. Plant and mineral poisoning. Economics of disease and production. Jurisprudence.

9.132 Animal Health and Preventive Medicine II

Immunology and vaccination. Diseases causing sudden death or an acute state of disease. Diseases of the eye. Diseases of the mouth and nose, cattle and sheep. Diseases of the udder. Diseases of the reproductive organs and of new born lambs. Kidney dysfunction and urinary calculi. Diseases of the lungs. Diseases causing anaemia. Other diseases of economic importance. Internal parasites: life cycles and climatic factors, major parasites, abomasum, small intestine, large intestine, lungs, liver. Development of control programmes. Management and parasites (parasites on pasture). Treatment and control. Parasite identification. Cattle diseases.

9.221 Agronomy

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.

9.231 Pastoral Agronomy

Pasture ecology. Establishment, management and utilization of pastures and fodder crops. Vegetation management in arid and semi-arid areas. Pasture research techniques.

TEXTBOOKS for 9.221 and 9.231

- Barnard, C. *Grasses and Grassland*. Macmillan.
 Black, J. M. *Flora of South Australia*. (Parts I-IV). S. Aust. Govt. Printer.
 Burbidge, N. T. *Australian Grasses*. Vols. I, II & III. A. & R.
 CSIRO. *The Australian Environment*. M.U.P.
 Donahue, R. L. *Soils*. Prentice-Hall.
 Leeper, C. W. *Introduction to Soil Science*. M.U.P.

Molnar, I. ed. *Manual of Australian Agriculture*. 2nd ed. Heinemann.
Spedding, C. R. *Grassland Ecology*. O.U.P.
Whittet, J. N. *Weeds*. N.S.W. Dept. of Agriculture.
Wilson, B. *Pasture Improvement in Australia*. Murray.

9.232 Crop Agronomy

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

9.311 Agricultural Economics I

The nature and development of agricultural economics and farm management. Theory and practical applications of production economics principles and the analysis of production functions.

Theory, construction and analysis of cost curves. Economies of size and the problem of optimum farm size.

Introduction to price theory. The nature and derivation of supply and demand relationships, and of factors which affect these relationships. Illustration of the role of price theory in the analysis of agricultural policies. Problems in the empirical estimation of supply and demand.

TEXTBOOKS

Bishop, C. E. & Toussaint, W. D. *Introduction to Agricultural Economic Analysis*. Wiley, N.Y. 1958.
Heady, E. O. *Economics of Agricultural Production and Resource Use*. Prentice-Hall, N.J. 1952.
Samuelson, P. A., Hancock, K., & Wallace, R. *Economics: Australian Edition*. McGraw-Hill, Sydney, 1970.

REFERENCE BOOK

Hardaker, J. B., Lewis, J. N. & McFarlane, G. C. *Farm Management and Agricultural Economics*. A. & R., 1970.

9.312 Agricultural Economics II

The structure and functions of agricultural marketing systems and institutions. Use of price theory in the examination of problems and policies affecting marketing systems. Effects on agricultural markets of subsidies, taxation, population growth and economic development.

Introduction to the theory of international trade and international monetary mechanisms. Interrelationships between trade policies and agricultural policies.

Review of current issues in agricultural policy: the small farm problem and declining industries; rural credit policies.

TEXTBOOKS as for 9.311, plus:

Williams, D. B. ed. *Agriculture in the Australian Economy*. Sydney U.P., 1967.

9.313 Farm Management I

Farm management planning methods: gross margins analysis; simplified programming; partial budgeting; parametric budgeting; whole-farm budgeting; development budgeting and cash flow budgeting. Discounting methods, taxation provisions and rural credit facilities affecting evaluation of rural investments.

Principles and practice of methods of valuation of rural assets. Land tenure and systems of title.

Financial and production records and accounts. Co-ordination of managerial accounts with taxation requirements. Current developments in managerial accounting for rural industries. Use of farm records as indicators of economic efficiency and as sources of information for normal farm planning methods.

TEXTBOOKS

Castle, E. N. & Becker, M. H. *Farm Business Management*. Macmillan, N.Y. 1962.

Joint Committee on Standardisation of Farm Management Accounting. *Accounting and Planning for Farm Management*. Dept. Primary Industries, Brisbane. 1966.

Meredith, G. G., Rickards, P. A. & Pearse, R. A. *Farm Management Accounting: A Commentary*.

Professional Farm Management Guidebook, No. 4, 2nd ed. U.N.E., Armidale. 1969.

Rickards, P. A. & McConnell, D. J. *Budgeting, Gross Margins & Programming for Farm Planning*. Professional Farm Management Guidebook No. 3, U.N.E., Armidale. 1967.

9.314 Farm Management II

Mathematical programming applications in agricultural industries: linear programming in static and development situations; parametric linear programming; Monte Carlo programming approaches; dynamic programming. Game theory, inventory analysis and other approaches to planning in uncertain or risky situations.

TEXTBOOKS

Dent, J. B. & Casey, H. *Linear Programming and Animal Nutrition*. Crosby Lockwood, 1967.

Heady, E. O. & Candler, W. *Linear Programming Methods*. Iowa State U.P., 1958.

Throsby, C. D. *Elementary Linear Programming*. Random House, 1970.

9.315 Farm Management III

Economic aspects of technical agricultural research, with emphasis on the evaluation and interpretation of research results at the farm level. Design and analysis of research projects for estimation of response relationships between rural resources and products. Problems in interpretation and application of these estimates.

Simulation of farm management systems and data requirements for simulation.

TEXTBOOKS

Dent, J. B., & Anderson, J. R. *Systems Analysis in Agriculture*. Wiley, 1971.

Dillon, J. L. *The Analysis of Response in Crop & Livestock Production*. Pergamon, 1968.

Heady, E. O. & Dillon, J. L. *Agricultural Production Functions*. Iowa State U.P., 1961.

REFERENCE BOOKS

Baum, E. L., Heady, E. O. & Blackmore, J. eds. *Methodological Procedures in the Economic Analysis of Fertiliser Use Data*. Iowa State U.P., 1956.

- Heady, E. O., Johnson, G. L. & Hardin, L. S. eds. *Resource Productivity, Returns to Scale and Farm Size*. Iowa State U.P., 1956.
- Naylor, T. H., Balintfy, J. L., Burdick, D. S. & Chu, K. *Computer Simulation Techniques*. Wiley, 1966.

9.316 Analysis of Rural Development Projects

Justifications for public investment in rural development. Australian developments in Federal-State financial relationships affecting the planning and evaluation of public development projects.

Evolution of cost-benefit analysis techniques. Theory of cost benefit analysis, and problems in its application, illustrated by case studies.

Input-output models and measurement of the impact of development projects on regional and national economies.

TEXTBOOKS

- American Economic Association & Royal Economic Society. *Surveys of Economic Theory*. Vol. I, 1967 and Vol. III, 1966, Macmillan.
- Commonwealth of Australia. *Investment Analysis—Supplement to the Treasury Information Bulletin*. Govt. Printing Office, Canberra, 1966.
- Davidson, B. R. *The Northern Myth*. M.U.P., 1965.
- Eckstein, O. *Water Resources Development*. Harv. U.P., 1958.
- Hinrichs, H. H. & Taylor, G. M. *Program Budgeting and Benefit Cost Analysis*. Goodyear, 1969.
- International Engineering Service Consortium. *An Economic Study of Keepit Dam*. Dept. of Conservation, Syd., 1970.
- McKean, R. N. *Efficiency in Government Through Systems Analysis*. Wiley, 1958.
- Mishaw, E. J. *Cost Benefit Analysis*. Allen & Unwin, 1971.
- Patterson, R. A. *The Economic Justification of the Ord River Project*. 38th Cong., ANZAAS, 1965.
- Subcommittee on Benefits and Costs. *Proposed Practices for Economic Analysis of River Basin Projects*. Report to the United States Federal Inter-Agency River Basin Committee. U.S. Govt. Printer, 1950.

9.411 Agricultural Chemistry I

An integrated course in various aspects of chemistry directed to the special interests of pastoral science. Experimental techniques, preparative and analytical, built around biological interest. Correlations of theoretical chemistry with biological processes.

Treatment of separation techniques, theory and design of chromatographic and distillation processes. Reaction principles, functional groups, analytical chemistry and roles in biological processes. Colorimetric and spectrophotometric control. Oxidation reactions and electron transfer. Separations and reactions of proteins, fats and carbohydrates, chemical and physical properties, cyanogenetic glycosides. Isomerizations and transesterification. Colloids and gel structures. Introductory heterocyclic chemistry, poisonous plants and alkaloid detection. Trace metals and soil analysis.

9.412 Agricultural Chemistry II

Proximate analysis of feeding stuffs, calorimetry, further work on fats, carbohydrates and proteins. Autoxidation and relationship to loss of animal nutritional factors. Antioxidants, natural and synthetic; correlations of *in vitro* and *in vivo* action to tocopherols and organo-sulphur and

selenium compounds. Protein homogeneity, enzyme separation and assay. Sulphur reactions of proteins; thiolation and grafting. Free radical and ionic reactions of disulphides. Sulphydryl-disulphide interchange and displacement reactions. Partial oxidations.

Animal milks, analysis and heat treatment changes and detection. Roles of trace metals in biological processes, metal complexes with proteins and metal catalysis.

Anthelmintics; oxidation products and possible origin. Insecticides, fungicides and herbicides, formulation and survey of commercial materials. Analysis and trace residue detection. Vitamins, enzymes and hormones. Photochemistry, energy transducers. Isotope techniques.

9.421 Animal Nutrition

Composition and classification of foodstuffs and pastures. Physiology of ruminant digestion. Digestion, absorption and metabolism of carbohydrates, proteins, fats, minerals 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 will be given to nutritional requirements of sheep, those of other farm livestock will be dealt with in this section.

TEXTBOOKS

Crampton, E. W. *Applied Animal Nutrition*. Freeman, 1956.

Dougherty, R. W. et al. *Physiology of Digestion in the Ruminant*. Butterworths, 1965.

Maynard, L. A. *Animal Nutrition*. McGraw-Hill, 1947.

9.531 Wool Technology I

Wool Study: The physical attributes of wool which in combination determine its manufacturing use and commercial value. Wool defects, wool in relation to district, breedtype and environment. Principles of wool classing. Wool marketing and procedures, broking, buying and central classing. Carbonising and fellmongering.

Wool Biology: Structure and function of skin. Follicle and fibre structure. Initiation and maturation of follicle and fibre populations. Wool growth. Significance of wool characteristics and their assessment.

Wool Textile Manufacture: Lectures and laboratory demonstrations cover the principles and practices involved in the conversion of raw materials to yarn. Weaving and finishing of fabrics.

TEXTBOOK

Henderson, A. E. *Growing Better Wool*. A. H. & A. W. Reed.

REFERENCE BOOK

Ryder, M. L. & Stephenson, S. K. *Wool Growth*. Academic.

9.532 Wool Technology II

Practical wool sorting, wool classing and appraisal. Modified classing in relation to presale testing and sale by sample. The physical handling and composition of the Australian clip.

TEXTBOOK

Dawes, K. *Objective Measurement of Wool*. N.S.W.U.P.

9.533 Wool Technology III

Wool Metrology: Theories of sampling and measurement of wool characteristics. Laboratory procedures. Chemical and physical testing of raw wool. Estimation of wool damage.

TEXTBOOK

Aust. Wool Board. *Objective Measurement of Wool in Australia, Parts I, II and III*.

REFERENCE BOOK

Onions, W. J. *Wool: an Introduction to its Properties, Varieties, Uses and Production*. Benn, 1962.

9.534 Wool Technology IV

Raw Materials: Fibres other than wool; their properties, uses and identification.

9.535 Wool Technology V

Wool Study: Relationships between subjective appraisal and objective measurement. Sampling and testing of baled bulks from Field Stations and commercial clips. Developments in wool marketing.

TEXTBOOK

Dawes, K. *Objective Measurement of Wool*. N.S.W.U.P.

9.536 Wool Technology VI

Wool Science: Fine structure of the fibre, chemical composition, wool fibre physics, chemical reactivity, mechanical properties and developments in wool technology.

TEXTBOOK

Onions, W. J. *Wool*. Benn, 1961.

REFERENCE BOOK

Alexander, P. & Hudson, R. F. *Wool: its Chemistry and Physics*. 2nd ed. Chapman & Hall.

9.601 Animal Physiology I

Physiological 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.

TEXTBOOKS

- Frye, B. E. *Hormonal Control in Vertebrates*. Macmillan.
 Perry, J. S. *The Ovarian Cycle of Mammals*. Oliver & Boyd.
 Sampson Wright. *Applied Physiology*. 10th ed. O.U.P.

REFERENCE BOOKS

- Austin, C. R. & Short, R. V. eds. *Reproduction in Mammals. Vol. 1. Germ Cells and Fertilisation. Vol. 2. Embryonic and Fetal Development. Vol. 3. Hormones in Reproduction. Vol. 4. Reproductive Patterns*. C.U.P.
 Benzie, D. & Phillipson, A. *The Alimentary Tract of the Ruminant*. Oliver & Boyd.
 Breazile, J. E. *Textbook of Veterinary Physiology*. Lea & Febiger.
 Best, C. H. & Taylor, L. B. *Physiological Basis of Medical Practice*.
 Catt, K. J. *An A.B.C. of Endocrinology*. The Lancet.
 Fulton, J. F. *Textbook of Physiology*. Saunders.
 Turner, C. D. & Bagnara, J. T. *General Endocrinology*. Saunders.

9.602 Animal Physiology II

Major aspects of mammalian physiology relevant to animal production, behavioural physiology, reproduction in the female and lactation, semen physiology. Introductory courses on environmental physiology, lower gut physiology, respiratory gas transport, renal function, the physiology of gene action, ageing and the problem of chemical residues will be given.

REFERENCE BOOKS

- Blandau, R. J. ed. *The Biology of the Blastocyst*. Chicago U.P.
 CIBA Foundation Symp. on Lactogenic Hormones. Churchill.
 Cowie, A. T. & Tindal, J. S. *The Physiology of Lactation*. Arnold.
 Eckstein, P. & Knowles, F. *Techniques in Endocrine Research*. Academic.
 Eik-Nes, K. B. ed. *The Androgens of the Testis*. Marcel Dekker.
 Ganong, W. F. & Martini, L. eds. *Frontiers in Neuroendocrinology*. O.U.P.
 Gold, J. J. ed. *Textbook of Gynecologic Endocrinology*. Harper & Row.
 Hafez, E. S. E. & Blandau, R. J. eds. *The Mammalian Oviduct*. Chicago U.P.
 Hall, P. F. *The Functions of the Endocrine Glands*. Horowitz.
 Harris, G. W. & Donovan, B. T. eds. *The Pituitary Gland*. 3 vols. Butterworths.
 Haymaker, W. *The Hypothalamus*. C. C. Thomas.
 Johnson, A. D., Gomes, W. R. & Vandemark, N. L. *The Testis*. Academic.
 McKerns, K. W. ed. *The Gonads*. North Holland.
 Martini, L., Motta, M. & Fraschini, F. eds. *The Hypothalamus*. Academic.
 Martini, L. & Ganong, W. F. eds. *Neuroendocrinology*. 2 vols. Academic.
 Martini, L. & Ganong, W. E. eds. *Frontiers in Neuroendocrinology*. O.U.P.
 Pitt-Rivers, R. & Trotter, W. R. *The Thyroid Gland*. 2 vols. Butterworths.
 Spector, H. *Handbook of Biological Data*. Saunders.
 Stear, E. B. & Kadish, A. H. eds. *Hormonal Control Systems. Supplement 1. Mathematical Biosciences*. Elsevier.
 Sulman, F. G. *Hypothalamic Control of Lactation*. Heinemann.

9.603 Animal Physiology III

Mammalian physiology directed towards domestic livestock production and homeostatic mechanics. Emphasis will be placed upon techniques.

Active transport and allied membrane phenomena. Co-ordinator systems (neural, humoral), reproduction and lactation. Development physiology. General metabolism and its regulation: the physiology and metabolism of

specific organs—heart, muscle, liver, kidney. The physiology of the mammalian digestive tract. Environmental physiology; adaptive mechanisms, especially in the newborn, and in heat tolerance, the immune reaction. Electrolyte physiology; acid-base equilibrium of the organism; use of clearance values in measuring renal and liver activity; respiration; techniques of gas analysis and respirometry. Circulation, cardiac output and distribution (experimental techniques), special vascular circuits (pulmonary, cerebral, hepatic, splenic, renal, testicular). Physiology of the skin.

TEXTBOOKS

Cole, H. H., and Cupps, P. T. eds. *Reproduction in Domestic Animals*. 2nd ed. Academic, 1969.

Donovan, B. T. *Mammalian Neuroendocrinology*. McGraw-Hill.

Sampson Wright. *Applied Physiology*. 10th ed. O.U.P., 1961.

REFERENCE BOOKS

As for 9.602.

9.801 Genetics I

Applied genetics in relation to sheep and other farm livestock. Mendelian inheritance. Chromosomes, linkage and the physical basis of heredity. Gene action in physiology, development and sex determination. Mutation. Principles of statistical genetics, strength of inheritance, selection, inter-relationships, genetics and livestock improvement.

TEXTBOOKS

Falconer, D. S. *Introduction to Quantitative Genetics*. Oliver & Boyd, 1960.

Fraser, A. S. *Heredity, Genes and Chromosomes*. McGraw-Hill, 1966.

REFERENCE BOOKS

Allard, R. A. *Principles of Plant Breeding*. Wiley.

Bogart, R. A. *Improvement of Livestock*. Macmillan.

Brink, R. A. ed. *Heritage from Mendel*. Wisconsin U.P.

Crow, J. F. & Kimura, M. *Introduction to Population Genetics Theory*. Harper & Row.

Dolling, C. H. S. *Breeding Merinos*. Rigby.

Dun, R. B. & Eastoe, R. D. *Science and the Merino Breeder*. N.S.W. Govt. Printer.

Kempthorne, O. *Introduction to Genetic Statistics*. Wiley.

Lerner, I. M. *Genetic Basis of Selection*. Wiley.

Lerner, I. M. *Population Genetics and Animal Improvement*. C.U.P.

Lerner, I. M. & Donald, H. P. *Modern Developments in Animal Breeding*. Academic.

Li, C. C. *Population Genetics*. Chicago U.P.

Lush, J. L. *Animal Breeding Plans*. 3rd ed. Iowa State U.P.

Pirchner, F. *Population Genetics in Animal Breeding*. Freeman.

Snedecor, G. W. & Cochran, W. G. *Statistical Methods*. 6th ed. Iowa State U.P.

Srb, A. M., Owen, R. D. & Edgar, L. S. *General Genetics*. 2nd ed. Freeman.

Turner, H. N. & Young, S. S. Y. *Quantitative Genetics in Sheep Breeding*. Macmillan.

9.802 Genetics II

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 to selective progress.

TEXT AND REFERENCE BOOKS

As for 9.801.

9.811 Biostatistics

Random sampling. Estimation and tests of significance. Comparison of means. Regression and correlation. Analysis of variance and covariance. Factorial experiments. Multiple and curvilinear regression. Treatment of non-orthogonal data. Analysis of enumeration data. Distribution-free methods. Planning of experiments and surveys.

TEXTBOOK

Snedecor, G. W. and Cochran, W. G. *Statistical Methods*. 6th ed. Iowa State U.P.

REFERENCE BOOKS

Cochran, W. G. & Cox, G. M. *Experimental Designs*. 2nd ed. Wiley.

Cox, D. R. *Planning of Experiments*. Wiley.

Pearce, S. C. *Biological Statistics*. McGraw-Hill.

Sokal, R. R. & Rohlf, F. J. *Biometry*. Freeman.

Steel, R. G. D. & Torrie, J. H. *Principles and Procedures of Statistics*. McGraw-Hill.

9.901 Rural Extension

Objective and agencies. Research-extension relationships. Educational, psychological and sociological aspects and principles. Programme planning involving analysis of the situation, determination of objectives, establishment of priorities and assessment of rural-socio-economic factors. Presentation of programmes including aims, educational procedures in presentation, channels and techniques. Evaluation of extension.

TEXTBOOK

Rogers, E. M. *Diffusion of Innovations*. Collier Macmillan, 1962.

REFERENCE BOOKS

Emery, F. M. & Oeser, O. A. *Information Decision and Action*. M.U.P.

Bettinghaus, E. P. *Persuasive Communication*. Holt, Rinehart & Winston.

Lionberger, H. F. *Adoption of New Ideas and Practices*. Iowa State U.P.

WOOL TECHNOLOGY GRADUATE SUBJECTS

9.105G Advanced Livestock Production

Advanced aspects of the principles of animal production with particular emphasis on physiology and endocrinology. Biostatistics and population genetics. Parasites. Management to maximize economic return.

9.503G Wool Study

Place of wool in world trade and the economic life of Australia. Wool quality, fleece defects. Principles of wool processing in relation to the preparation of the clip. Wool areas of the Commonwealth.

Wool terms. Types, yield. Wool classing. Wool scouring and carbonizing. Vegetable fault. Methodology of wool commerce. Australian Wool Board types and valuation.

9.711G Advanced Wool Technology

Biology of fibre growth—histology, fibre arrangement, morphology and fleece genetics. Modern concepts of fibre growth and structure. Advances in fibre physics and fibre chemistry. Wool metrology and conditioning house procedures. Principles of conversion of raw wool to finished goods. Impact of recent developments.

REFERENCE BOOK

Onions, W. J. *Wool: an Introduction to its Properties, Varieties, Uses and Production*. Benn, 1962.

9.902G Techniques of Laboratory and Field Investigation

Experimental method. Design of experiments. The survey approach. Co-operative farm trials. Experiment station investigations. Controlled environmental work in the laboratory. Agronomic studies; plant ecology, plant improvement, field plots, fertilizer trials. Animal studies. Genetic investigations. Fertilization, growth and development. Conversion efficiency for wool, meat and milk. Quality concepts. Special techniques and instrumentation. Small animal techniques. Plant-animal relationships. Grazing management. Economic investigations. Statistical interpretations.

SCHOOL OF MATHEMATICS

10.001 Mathematics I

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

PRELIMINARY READING LIST

Allendoerfer, C. B. & Oakley, C. O. *Principles of Mathematics*. McGraw-Hill.

Bell, E. T. *Men of Mathematics*. 2 vols. Pelican.

Courant, R. & Robbins, H. *What is Mathematics?* O.U.P.

Polya, G. *How to Solve It*. Doubleday Anchor.

Sawyer, W. W. *A Concrete Approach to Abstract Algebra*. Freeman.

Sawyer, W. W. *Prelude to Mathematics*. Pelican.

TEXTBOOKS

Blatt, J. M. *Introduction to Fortran IV Programming*. Prentice-Hall.

Shields, P. C. *Elementary Linear Algebra*. Worth.

Thomas, G. B. *Calculus and Analytic Geometry*. 4th ed. Addison-Wesley.

REFERENCE BOOKS

Blatt, J. M. *Basic Fortran IV Programming (IBM/360 Version)*. Computer Systems (Aust.).

Campbell, H. F. *Matrices with Applications*. Appleton-Century-Crofts.

Kaplan, W. & Lewis, D. J. *Calculus and Linear Algebra*. Vols 1 & 2. Wiley.

Kelly, G. M. *Introduction to Linear Algebra and Vector Geometry*. Reed Education, 1971.

Lange, I. H. *Elementary Linear Algebra*. Wiley.

Pedoe, D. *A Geometric Introduction to Linear Algebra*. Wiley.

Purcell, E. J. *Calculus With Analytic Geometry*. Appleton-Century-Crofts.

Smith, W. K. *Limits and Continuity*. Collier-Macmillan.

Spivak, M. *Calculus*. Benjamin.

Tetra, B. C. *Basic Linear Algebra*. Harper & Row.

Zelinsky, D. *A First Course in Linear Algebra*. Academic.

10.011 Higher Mathematics I

Calculus, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

PRELIMINARY READING TEST

As for 10.001 plus:

Arnold, B. H. *Intuitive Concepts in Elementary Topology*. Prentice-Hall.

David, F. N. *Games, Gods and Gambling*. Griffin.

Felix, L. *The Modern Aspect of Mathematics*. Science.

Huff, D. *How to Lie with Statistics*. Gollancz.

Reid, C. *From Zero to Infinity*. Routledge.

TEXTBOOKS

Blatt, J. M. *Introduction to Fortran IV Programming*. Prentice-Hall.

Fagg, S. V. *Differential Equations*. E.U.P.

Shields, P. C. *Elementary Linear Algebra*. Worth.

Spivak, M. *Calculus*. Benjamin.

REFERENCE BOOKS

As for 10.001 plus:

Abraham, R. *Linear and Multilinear Algebra*. Benjamin.

Brauer, F. & Nohel, J. *Ordinary Differential Equations*. Benjamin.

Burkhill, J. C. *A First Course in Mathematical Analysis*. C.U.P.

Crowell, R. H. & Williamson, R. E. *Calculus of Vector Functions*. Prentice-Hall.

Hochstadt, H. *Differential Equations*. Holt, Rinehart & Winston.

Lang, S. *Linear Algebra*. Addison-Wesley.

Murdoch, D. C. *Linear Algebra for Undergraduates*. Wiley.

Spivak, M. *Calculus on Manifolds*. Benjamin.

10.021 Mathematics II

Calculus, analysis, analytic geometry, algebra, probability theory, elementary computing.

TEXTBOOKS

Blatt, J. M. *Introduction to Fortran IV Programming*. Prentice-Hall.

Greening, M. G. *First Year General Mathematics*. N.S.W.U.P.

Youse, B. K. & Stalnaker, A. W. *Calculus for the Social and Natural Sciences*. International Textbook Co.

REFERENCE BOOKS

Allendoerfer, C. B. & Oakley, C. O. *Fundamentals of College Algebra*. McGraw-Hill.

Bates, G. E. *Probability*. Addison-Wesley.

Burford, R. L. *Introduction to Finite Probability*. Merrill.

Christian, R. C. *Logic and Sets*. Blaisdell.

Fine, N. J. *Introduction to Modern Mathematics*. Rand McNally & Co.

Hoyt, J. P. *A Brief Introduction to Probability Theory*. International Text Book Co.

Johnson, W. G. & Zaccaro, L. N. *Modern Introductory Mathematics*. McGraw-Hill.

10.022 Engineering Mathematics II

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, eigen values and their numerical evaluation; vector algebra and solid geometry; multiple integrals; introduction to vector field theory.

TEXTBOOK

Keane, A. & Senior, S. A. *Mathematical Methods*. Science.

REFERENCE BOOKS

Hildebrand, F. B. *Advanced Calculus for Applications*. Prentice-Hall.

Kreyszig, E. *Advanced Engineering Mathematics*. Wiley.

Pipes, L. A. & Harvill, L. R. *Applied Mathematics for Engineers and Physicists*. 3rd ed. McGraw-Hill.

Spiegel, M. R. *Advanced Mathematics for Engineers and Scientists*. McGraw-Hill.

10.031 Mathematics

Differential equations, use of Laplace transforms, solutions by series; partial differential equations and their solution for selected physical problems, use of Fourier series; multiple integrals, matrices and their application to theory of linear equations, eigen values; introduction to numerical methods.

TEXTBOOK

Keane, A. & Senior, S. A. *Mathematical Methods*. Science.

REFERENCE BOOKS

Grove, W. E. *Brief Numerical Methods*. Prentice-Hall.

Hildebrand, F. B. *Advanced Calculus for Applications*. Prentice-Hall.

Pipes, L. A. & Harvill, L. R. *Applied Mathematics for Engineers and Physicists*. 3rd ed. McGraw-Hill.

Spiegel, M. R. *Advanced Mathematics for Engineers and Scientists*. McGraw-Hill.

Wylie, C. R. *Advanced Engineering Mathematics*. 3rd ed. McGraw-Hill.

10.032 Mathematics

Vector calculus; special functions; Convolution theorem and applications; complex variable theory; Fourier integrals; Laplace transforms with application to ordinary and partial differential equations.

TEXTBOOK

Kreyszig, E. *Advanced Engineering Mathematics*. Wiley.

REFERENCE BOOKS

Grove, W. E. *Brief Numerical Methods*. Prentice-Hall.

Hildebrand, F. B. *Advanced Calculus for Applications*. Prentice-Hall.

Jeffreys, G. V. & Jenson, V. G. *Mathematical Methods in Chemical Engineering*. Academic.

Keane, A. & Senior, S. A. *Mathematical Methods*. Science.

10.111A Pure Mathematics II—Linear Algebra

Vector Spaces: inner products, linear operators, spectral theory, quadratic forms. Linear Programming: convex sets and polyhedra, feasible solutions, optimality, duality.

TEXTBOOKS**SESSION 1**

Tropper, A. M. *Linear Algebra*. Nelson. Paperback.

SESSION 2

Gass, H. *Linear Programming*. I.S.E. McGraw-Hill.

REFERENCE BOOKS

Hoffman, K. & Kunze, R. *Linear Algebra*. Prentice-Hall.

Lang, S. *Linear Algebra*. Addison-Wesley.

10.111B Pure Mathematics II—Analysis

Complex variables: analytic functions, elementary functions, Taylor and Laurent series, integrals, Cauchy's theorem, residues, evaluation of certain

real integrals, maximum modulus principles. Linear differential equations of the second order: equations with constant coefficients, power series solutions, Laplace transforms, Bessel functions.

TEXTBOOKS

SESSION 1

Kolman, B. & Trench, W. F. *Elementary Multivariable Calculus*. Academic.

SESSION 2

Churchill, R. V. *Complex Variables and Applications*. I.S.E. McGraw-Hill.

REFERENCE BOOKS

Hilton, P. J. *Partial Derivatives*. Routledge.

Thomas, G. B. *Calculus and Analytic Geometry*. 4th ed. Addison-Wesley.

10.121A Higher Pure Mathematics II—Algebra

Linear Algebra: vector spaces, commutative rings, polynomials, modules, linear transformations, eigenvectors, invariant subspaces, canonical forms, linear functions, bilinear and multi-linear algebra. Group Theory: subgroups, quotient groups, isomorphisms, Lagrange's theorem, Sylow's theorem.

TEXTBOOKS

Clark, A. *Elements of Abstract Algebra*. Wadsworth, 1971.

Hoffman, K. & Kunze, R. *Linear Algebra*. Prentice-Hall.

REFERENCE BOOKS

Green, J. A. *Sets and Groups*. Macmillan.

Hartley, B. & Hawkes, T. O. *Rings, Modules and Linear Algebra*. Chapman & Hall.

Hall, M. *The Theory of Groups*. Macmillan.

Herstein, I. M. *Topics in Algebra*. Blaisdell.

Lang, S. *Linear Algebra*. W.S.S. Addison-Wesley.

Ledermann, W. *The Theory of Finite Groups*. Oliver & Boyd.

10.121B Higher Pure Mathematics II—Real and Complex Analysis

Construction of reals; uniform convergence; implicit and inverse function theorems; analytic functions; Laurent and Taylor series; calculus of residues; conformal mapping.

TEXTBOOK

SESSION 1

Williamson, R. E., Crowell, R. H. & Trotter, H. F. *Calculus of Vector Functions*. Prentice-Hall.

SESSION 2

Jamieson, G. J. D. *A First Course on Complex Functions*. Chapman & Hall.

REFERENCE BOOKS

Derrick, W. *Introductory Complex Analysis*. Academic.

Goldberg, R. R. *Methods of Real Analysis*. Blaisdell.

Knopp, K. *Elements of the Theory of Functions*. Dover.

Lang, S. *Calculus of Several Variables*. Addison-Wesley.

Spivak, M. *Calculus*. Benjamin.

10.211A Applied Mathematics II—Mathematical Methods

Review of functions of two and three variables, divergence, gradient, curl; line, surface, and volume integrals; Green's and Stokes' theorems. Special functions, including gamma and Bessel functions. Differential equations and boundary value problems, including vibrating string and vibrating circular membrane; Fourier series.

TEXTBOOKS

Blatt, J. M. *Introduction to Fortran IV Programming*. Prentice-Hall.

Sneddon, I. N. *Fourier Series*. Routledge.

Spiegel, M. R. *Advanced Mathematics for Scientists and Engineers*. Schaum.

Spiegel, M. R. *Theory and Problems of Vector Analysis*. Schaum.

REFERENCE BOOKS

Betz, H., Burcham, P. B. & Ewing, G. M. *Differential Equations with Applications*. I.S.R. Harper.

Blatt, J. M. *Basic Fortran IV Programming*. Computer Systems (Aust.).

Dettman, J. W. *Mathematical Methods in Physics and Engineering*. McGraw-Hill.

Smith, G. D. *Vector Analysis Including the Dynamics of a Rigid Body*. O.U.P.

10.331 Statistics SS

An introduction to the theory of probability, with finite, discrete and continuous sample spaces. The standard elementary univariate distributions: binomial, Poisson and normal; an introduction to multivariate distributions. Standard sampling distributions, including those of χ^2 , t and F . Estimation by moments and maximum likelihood (including sampling variance formulae, and regression); confidence interval estimation. The standard tests of significance based on the above distributions, with a discussion of power where appropriate. An introduction to experimental design: fixed, random and mixed models, involving multiple comparisons and estimation of variance components.

TEXTBOOKS

Statistical Tables

Freund, J. E. *Mathematical Statistics*. 2nd ed. Prentice-Hall.

REFERENCE BOOKS

Bennett, C. A. & Franklin, N. L. *Statistical Analysis in Chemistry and the Chemical Industry*. Wiley.

Davies, O. L. *Statistical Methods in Research and Production*. Oliver & Boyd.

Steel, R. G. D. & Torrie, J. H. *Principles and Procedures of Statistics*. McGraw-Hill.

SCHOOL OF PSYCHOLOGY

12.001 Psychology I

An introduction to the content and methods of psychology as a behavioural science, with special emphasis on (a) the biological and social bases of behaviour, (b) learning, and (c) individual differences.

The course includes training in methods of psychological enquiry, and the use of elementary statistical procedures.

*Part A—Theory***TEXTBOOKS**

There is no set text for this course, but students are advised to obtain, as a general reference, an introductory text such as one of the following:

CRM Books. *Psychology Today*. 1st or 2nd ed. 1970 or 1972.

Dember, W. N. & Jenkins, J. J. *General Psychology*. Prentice-Hall, 1970.

Morgan, C. T. & King, R. A. *Introduction to Psychology*. 4th ed. McGraw-Hill, 1971.

The following is recommended as an additional text for intending honours students:

Hebb, D. O. *Textbook of Psychology*. 3rd ed. Saunders, 1972.

REFERENCE BOOKS

Allport, G. W. *Pattern and Growth in Personality*. Holt, 1961.

Allport, G. W. *Personality*. Holt, 1937.

Anastasi, A. *Individual Differences*. Wiley, 1965.

Beech, H. R. *Changing Man's Behaviour*. Penguin, 1969.

Coopersmith, S. *Frontiers of Psychological Research. Readings from Scientific American*. Freeman, 1964.

Cronbach, L. J. *Essentials of Psychological Testing*. 2nd or 3rd ed. Harper & Row, 1960 or 1970.

Deese, J. *Psycholinguistics*. Allyn & Bacon, 1970.

Lazarus, R. S. *Personality*. 2nd ed. Prentice-Hall, 1971.

McGaugh, J. L. ed. *Psychobiology: The Biological Bases of Behaviour. Readings from Scientific American*. Freeman, 1966.

McKinney, F. *Understanding Personality: Cases in Counselling*. Houghton, 1965.

Reynolds, G. *Primer of Operant Conditioning*. Scott, Foresman, 1968.

Vernon, P. E. *Personality Assessment: A Critical Survey*. Methuen, 1964.

Vernon, P. E. *Personality Tests and Assessments*. Methuen, 1953.

Walker, E. L. *Conditioning and Instrumental Learning*. Brooks/Cole, 1967.

*Part B—Practical***TEXTBOOK**

Lumsden, J. *Elementary Statistical Method*. Univ. of W.A. Press, 1969.

12.101 Psychology

Refer Theory content of 12.001 Psychology I.

SCHOOL OF TEXTILE TECHNOLOGY

13.111 Textile Technology I

Testing: Principles and practice of sampling textile materials. Statistical techniques. Physical testing of fibres and yarns. *Yarn Manufacture:* Introduction, historical development. Principles and practices of manufacture of yarns on the cotton, worsted and woollen systems. *Fabric Manufacture:* Principles of weaving. The mechanics of shedding, picking and beating up. Secondary and auxiliary mechanisms of looms. Elementary cloth structures. Warp and weft yarn preparation. Principles of drafting. Cloth setting theories.

TEXTBOOK

Booth, J. E. *Principles of Textile Testing*. 3rd ed. National Trade Press, 1961.

13.112 Textile Technology II

Part A. Testing: Physical testing of fabrics. Evaluation of the serviceability of textile fabrics. Qualitative and quantitative assessment of damage in textile materials. *Part B. Yarn Manufacture:* Principles and practice of yarn manufacture for other natural fibres such as silk, flax, jute, etc. Fancy yarns, paper yarns, twistless yarns. Manufacture of yarns from man-made fibres and blends with natural fibres. *Part C. Fabric Manufacture:* Elements of woven fabric design. Compound cloths, extra threads. Jacquard woven fabrics. Woven fabric analysis. Principles of knitting. Basic warp and weft knitted structures. Elementary knitted fabric geometry. The mechanics of loop formation. *Part D. Dyeing and Finishing:* General descriptions of properties of dyes, dyeing assistants, solvents used in dyeing, water supplies and water treatment, machinery used in dyeing, classification and methods of application of dyes, textile printing methods. Objects of finishing and typical flow diagrams, the principles underlying and the technology of processes concerned with: the removal of impurities and discoloration; the improvement and elimination of deficiencies in properties of textile fibres.

TEXTBOOK

Peters, R. H. *Textile Chemistry*. Vol. 2. Elsevier, 1967.

13.113 Textile Technology III

Part A. Testing and Yarn Manufacture: Functions of quality control. The organisation and integration of a quality control department in a textile factory. Fault investigation. Recent developments and trends in industrial textile testing methods. Recent research and development in yarn manufacture. *Part B. Fabric Manufacture:* Pile fabric production, tapestries, gauzes and carpets. Pirnless weaving. Narrow fabric weaving. Circular weaving. Tufting, non-woven fabrics. Double knit structures and mechanisms. Needle selection for fabric decoration. Loop transfer for decoration and garment shaping. Hosiery manufacture. Multi-bar warp knitting. Laid-in fabrics. Raschel knitting. Stitch bonded fabrics. Basic garment assembly. *Part C. Dyeing and Finishing:* The production of specified dimensions in textile fabrics. The development of specific properties: mechanical, surface finishes, protective finishes.

REFERENCE BOOKS FOR TEXTILE TECHNOLOGY I, II and III

Textile Testing

- Brearley, A. & Cox, D. *An Outline of Statistical Methods for Use in the Textile Industry*. WIRA, Leeds, 1956.
- Garner, J. W. *A Textile Laboratory Manual*. Nat. Trade Press, 1951.
- Grover, E. B. & Hamby, D. S. *Handbook of Textile Testing and Quality Control*. Textile Book Publishers, 1960.
- Hearle, J. W. S. & Peters, R. H. *Moisture in Textiles*. Textile Inst., Manchester & Butterworths, London, 1960.
- Howell, H. G., Mieszkis, K. W. & Tabor, D. *Friction in Textiles*. Butterworths, 1959.
- Kaswell, E. R. *Textile Fibres, Yarns and Fabrics*. Reinhold, 1953.
- Koch, P. *Microscopic and Chemical Testing of Textiles*. Chapman & Hall, 1963.
- Luniak, B. *Identification of Textile Fibres*. Pitman, 1953.
- Morton, W. E. & Hearle, J. W. S. *Physical Properties of Textile Fibres*. Textile Inst., Manchester, 1962.
- Identification of Textile Materials*. Textile Inst., Manchester, 1965.
- Methods of Test for Textiles*. Brit. Standards Institution, 1963.
- Physical Properties of Wool Fibres and Fabrics*. Vol. 2. WIRA, Leeds, 1955.
- Standards*. Vols 24 and 25. Amer. Soc. for Testing & Materials. Philadelphia. Annual.
- Technical Manual Test Methods*. Amer. Assoc. of Textile Chemists & Colourists. Durham, Annual.
- Testing and Control in the Wool Industry*. Vol. 3. WIRA, Leeds, 1955.
- Textile Institute Manual of Cotton Spinning*. Vol. 2. Part 1. *The Characteristics of Raw Cotton*. Textile Inst., Manchester, 1955.
- Textile Standards*. Standards Assoc. of Aust.

Dyeing and Finishing

- Beech, W. F. *Fibre Reactive Dyes*. Logos, London, 1970.
- Bird, C. L. *The Theory and Practice of Wool Dyeing*. Soc. Dyers & Colourists, Bradford, 1963.
- Crank, J. & Park, G. S. *Diffusion in Polymers*. Academic, 1968.
- Giles, C. H. *Laboratory Course in Dyeing*. 2nd ed. Soc. Dyers & Colourists, Bradford, 1971.
- Marsh, J. T. *Introduction to Textile Bleaching*. Chapman & Hall, 1956.
- Marsh, J. T. *Introduction to Textile Finishing*. Chapman & Hall, London, 1966.
- Marsh, J. T. *Mercerising*. Chapman & Hall, 1941.
- Marsh, J. T. *Self Smoothing Fabrics*. Chapman & Hall, 1962.
- Moilliet, J. L., Collie, B. & Black, W. *Surface Activity*. Spon, 1961.
- Peters, R. H. *Textile Chemistry*. Vol. II. Elsevier, 1967.
- Rys, P. & Zollinger, H. *Fundamentals of the Chemistry and Application of Dyes*. Wiley, 1970.
- Schick, M. J. *Non-Ionic Surfactants*. Vols I & II. Arnold, 1967.
- Schwarz, A. M. & Perry, J. W. *Surface Active Agents*. Intersci., 1958.
- Colour Index*. 2nd ed. Soc. Dyers & Colourists, 1971.

Knitting

- Chamberlain, J. *Knitting Mathematics and Mechanisms*. Coll. of Tech. & Commerce. Leicester, 1952.
- Chamberlain, J. *Principles of Machine Knitting*. Textile Inst., Manchester, 1951.
- Mills, R. W. *Fully Fashioned Garment Manufacture*. Cassell, 1965.
- Paling, D. *Warp Knitting Technology*. 2nd ed. Columbine Press, 1965.
- Reichman, C. ed. *Advanced Knitting Principles*. N.K.O.A., N.Y., 1964.

Reichman, C. ed. *Principles of Knitting Outerwear Fabrics and Garments*. N.K.O.A., N.Y., 1961.

Reisfeld, A. *Warp Knit Engineering*. N.K.O.A., N.Y., 1966.

Shinn, W. *Principles of Knitting*. Vols I and II. Clark Pub. Co., Charlotte, 1957.

Wignall, H. *Knitting*. Pitman, 1964.

Weaving

Aitken, J. B. *Automatic Weaving*. Columbine Press, 1964.

Bennett, G. A. *Introduction to Automatic Weaving*. Harlequin Press, 1948.

Crossland, A. *Modern Carpet Manufacture*. Columbine Press, 1958.

Duxbury, V. & Wray, G. R. *Modern Developments in Weaving Machinery*. Columbine Press, 1962.

Middlebrook, W. *Primary Aspects of the Power Loom*. Emmott, 1953.

Middlebrook, W. *Secondary Aspects of the Power Loom*. Emmott, 1956.

Robinson, A. T. C. *Rayon Fabric Construction*. Skinner, 1951.

Robinson, A. T. C. *Woven Cloth Construction*. Butterworths, 1967.

Seydel, P. V. *Warp Sizing*. Smith Pub. Co., 1958.

Watson, W. *Advanced Textile Design*. 3rd ed. Longman, 1955.

Watson, W. *Textile Design and Colour*. 6th ed. Longman, 1954.

Wright, R. W. *Modern Textile Design and Production*. Nat. Trade Press, 1949.

Yarn Manufacture

Griffin, T. F. *Practical Worsted Carding*. Nat. Trade Press, 1957.

Griffin, T. F. *Practical Worsted Combing*. Nat. Trade Press, 1957.

Morton, W. E. *Introduction to the Study of Spinning*. Textile Book Service, 1949.

Nissan, A. H. *Textile Engineering Processes*. Butterworths, 1959.

Radcliffe, J. W. *Woollen and Worsted Yarn Manufacture*. Emmott, 1953.

Wray, G. R. *Modern Yarn Production from Man-made Fibres*. Textile Book Services, 1968.

Manual of Cotton Spinning. Vol. II, Part 2. *Opening and Cleaning*. Butterworths, London & Textile Inst., Manchester, 1963.

Manual of Cotton Spinning. Vol. IV, Part I. *The Principle of Roller Drafting*. Vol. IV, Part II. *Drawframes, Combers and Speedframes*. Butterworths, London & Textile Inst., Manchester, 1964.

Manual of Cotton Spinning. Vol. III. *Carding*. Vol. V. *The Principles and Theory of Ring Spinning*. Butterworths, London & Textile Inst., Manchester, 1965.

Studies in Modern Yarn Production. Papers of the Textile Inst. Annual Conf. Textile Inst., Manchester, 1968.

von Bergen, W. *Wool Handbook*. Vol. 2. 3rd ed. Interscience, 1970.

Wool Research. Vol. IV. *Carding*. Vol. VI. *Drawing and Spinning*. WIRA, Leeds, 1948.

13.211 Textile Science I

Production, properties and uses of textile fibres. Fibres, rubbers and plastics. Addition and condensation polymerisation. Chemical constitution and reactivity of the natural and man-made fibres. Optical microscopy and birefringence of fibres. Electron microscopy, X-ray diffraction and infrared absorption. Molecular and morphological structure of fibres, crystallinity and orientation of polymers. First and second order phase transitions. Relationship between molecular structure and mechanical properties of fibres.

TEXTBOOK

Peters, R. H. *Textile Chemistry*. Vol. 1. Elsevier, 1963.

13.212 Textile Science II

Adhesion theory of friction, differential friction effects of wool, friction in textile processing. Static electrification of textile materials. Yarn structure, idealised helical yarn geometry, fibre migration, mechanics of twisted continuous filament yarns. Molecular interactions in fibres, elastomeric theory, viscoelasticity, spring and dashpot models. Eyring's theory of rate processes. Physical properties of macromolecular structures. Sorption in fibres. Polymerisation kinetics, molecular weights of polymers, copolymers. Properties of surfactant solutions, micelle formation, surfactants as emulsifiers and detergents, detergency.

TEXTBOOK

Hearle, J. W. S., Grosberg, P., and Backer, S. *Structural Mechanics of Fibres, Yarns and Fabrics*. Vol. 1. Intersci., 1969.

13.213 Textile Science III

Mechanical properties and rheological behaviour of fibres and fibre assemblies including a thermodynamic and kinetic treatment of fibre deformation. Physical properties of textile materials including water adsorption, electrical properties, heat and moisture transfer. Geometry of yarn and fabric structures. Aspects of colour, colour mixing and colour vision. Introduction to adsorptiometry, spectrophotometry and tristimulus colorimetry. Measurement and specification of colour. Applications of colour measurement in textile dyeing.

TEXTBOOK

Wright, W. D. *The Measurement of Colour*. 4th ed. Adam Hilger, 1969.

REFERENCE BOOKS FOR TEXTILE SCIENCE I, II and III

- Alexander, P., Hudson, R. F. & Earland, C. *Wool: Its Chemistry and Physics*. 2nd ed. Chapman & Hall, 1963.
- Alfrey, T. *Mechanical Behaviour of High Polymers*. Wiley, 1948.
- Astbury, W. T. *Fundamentals of Fibre Structure*. O.U.P., 1933.
- Astbury, W. T. *Textile Fibres under the X-rays*. I.C.I.
- Barrow, G. M. *The Structure of Molecules*. Benjamin, 1964.
- Billmeyer, F. W. *Textbook of Polymer Science*. 2nd ed. Wiley, 1971.
- Borasky, R. *Ultrastructure of Protein Fibres*. Academic, 1963.
- Bowden, F. P. & Tabor, D. *Friction and Lubrication*. Methuen, 1956.
- Eirich, F. R. *Rheology*. Vols I and II. Academic, 1956.
- Ferry, J. D. *Viscoelastic Properties of Polymers*. Wiley, 1961.
- Flory, P. J. *Principles of Polymer Chemistry*. Cornell U.P., 1953.
- Fraser, R. D. B., McRae, T. P. & Rogers, G. E. *Keratins. Their Composition, Structure and Biosynthesis*. Thomas, 1972.
- Frey-Wyssling, A. *Submicroscopic Morphology of Protoplasm and Its Derivatives*. Elsevier, 1948.
- Glasstone, S., Laidler, K. J. & Eyring, H. *The Theory of Rate Processes*. McGraw-Hill, 1941.
- Hearle, J. W. S. & Peters, R. H. eds. *Fibre Structure*. Butterworth, London & Textile Inst., Manchester, 1963.
- Hearle, J. W. S. & Peters, R. H. *Moisture in Textiles*. Butterworth, London and Textile Inst., Manchester, 1960.
- Hermans, P. H. *Physics and Chemistry of Cellulose Fibres*. Elsevier, 1949.
- Heyn, A. N. J. *Fibre Microscopy*. Wiley, 1954.
- Hill, R. ed. *Fibres from Synthetic Polymers*. Elsevier, 1953.
- Howell, H., Mieszkis, K. W. & Tabor, D. *Friction in Textiles*. Butterworths, 1959.
- Judd, D. B. & Wyszecki, G. *Colour in Business, Science and Industry*. 2nd ed. Wiley, 1963.

- Kaswell, E. R. *Textile Fibres, Yarns and Fabrics*. Reinhold, 1953.
- Meredith, R. *Mechanical Properties of Textile Fibres*. North-Holland, 1956.
- Meredith, R. & Hearle, J. W. S. eds. *Physical Methods of Investigating Textiles*. Wiley, 1959.
- Moore, W. R. *An Introduction to Polymer Chemistry*. London U.P., 1963.
- Morton, W. E. & Hearle, J. W. S. eds. *Physical Properties of Textile Fibres*. Butterworth, London and Textile Inst., Manchester, 1962.
- Optical Society of America. *The Science of Colour*. Crowell, N.Y., 1953.
- Oster, G. & Pollister, A. W. *Physical Techniques in Biological Research*. Vols I and II. Academic, 1955.
- Ott, E. & Spurlin, H. M. *Cellulose. High Polymers*. Vol. V. Wiley, N. Carolina U.P., 1954.
- Preston, J. M. ed. *Fibre Science*. Textile Inst., Manchester, 1953.
- Stoves, J. L. *Fibre Microscopy*. Nat. Trade Press, 1957.
- Tanford, C. *Physical Chemistry of Macromolecules*. Wiley, 1961.
- Textile Institute & Soc. of Dyers & Colourists. *Review of Textile Progress*. Annual.
- Tobolsky, A. V. *Properties and Structure of Polymers*. 2nd ed. Wiley, 1962.
- Treloar, L. R. G. *The Physics of Rubber Elasticity*. 2nd ed. O.U.P., 1958.
- Urquhart, A. R. & Howitt, F. O. *The Structure of Textile Fibres: an Introductory Study*. Textile Inst., Manchester, 1953.
- Ward, K. Jnr. *Chemistry and Chemical Technology of Cotton*. Wiley, 1955.
- Woods, H. J. *Physics of Fibres*. Inst. of Physics, London, 1955.
- Wool Research. Vol. 2. *Physical Properties of Wool Fibres and Fabrics*. WIRA, Leeds, 1955.
- Raw Materials*
- Carrol-Porczynski, C. Z. *Manual of Man-made Fibres*. Astex, Guildford, 1960.
- Cook, J. G. *Handbook of Textile Fibres*. 3rd ed. Mellow, Watford, 1964.
- Harris, M. *Handbook of Textile Fibres*. Harris Research Lab., Washington, D.C., 1954.
- Lord, E. *Manual of Cotton Spinning*. Vol. II. *Cotton Raw Material*. Textile Inst., Manchester, 1961.
- McFarlane, S. B. ed. *Technology of Synthetic Fibres*. Fairchild, 1953.
- Matthews, J. M. *Textile Fibres*. Wiley, 1947.
- Moncrieff, R. W. *Man-made Fibres*. 3rd ed. Nat. Trade Press, 1957.
- Onions, W. J. *Wool—An Introduction to its Properties, Varieties, Uses and Production*. Benn, 1962.
- Press, J. ed. *The Man-made Textile Encyclopaedia*. Wiley, 1959.
- Von Bergen, W. *Wool Handbook*. Vol. 1. 3rd ed. Wiley, N.Y., 1963.
- Wormell, R. L. *New Fibres from Proteins*. Butterworths, 1954.
- American Cotton Handbook*. 2 Vols. 3rd ed. Wiley, 1965.

13.223 Advanced Textile Chemistry

Chemistry of amino acids, proteins and carbohydrates. Photochemistry of fibres and dyes. Physical-chemical concepts of dyeing.

13.233 Advanced Textile Physics

(a) General analysis of textile structures. Flexure and torsion of a twisted yarn. Flexure and shear properties of fabrics. Mechanisms of fabric deformation.

(b) Varieties of macromolecules. Interactions with macromolecular structures. The physical properties of polymeric solids (including biopolymers). Absorption and the role of water in polymers.

13.311 Textile Engineering I

Textile mill location, layout and design. Mill illumination. Elements of strength of materials — tension, compression, shear, torsion and bending. Dynamics of rotary motion and mechanical power transmission. Industrial electricity.

13.312 Textile Engineering II

Fluid flow. Applied heat, steam, air and heat transfer, air conditioning. Elements of automatic control. Introduction to Methods Engineering.

REFERENCE BOOKS FOR TEXTILE ENGINEERING I and II

- Clifford, A. E. *Textile Organisation and Production*. Carter, Belfast, 1951.
Cook, A. L. & Carr, C. C. *Elements of Electrical Engineering*. Wiley, 1949.
Eckman, D. P. *Industrial Instrumentation*. Wiley, 1950.
Enrich, N. L. *Industrial Engineering Manual for Textile Industry*. Textile Book Pub., N.Y., 1962.
Greenhut, M. L. *Plant Location in Theory and Practice*. N. Carolina U.P., Chapel Hill, 1956.
Grosberg, P. *An Introduction to Textile Mechanisms*. Benn, 1968.
The Efficient Use of Fuel. H.M.S.O., London, 1958.
Illumination Engineering Soc. Lighting Handbook. Illumination Engin. Soc., N.Y., 1959.
Kent's Mechanical Engineers Handbook. Vol. I. Power. Wiley, 1964.
Kent's Mechanical Engineers Handbook. Design and Production. Wiley, 1964.
Kern, D. Q. *Process Heat Transfer*. McGraw-Hill, 1950.
Lyle, O. *The Efficient Use of Steam*. H.M.S.O., 1960.
Michell, A. G. M. *Lubrication: Its Principles and Practice*. Blackie, 1950.
Stanjar, W. ed. *Plant Engineering Handbook*. 2nd ed. McGraw-Hill, 1959.
Swale, W. E. *Electricity in Textile Industry*. Nat. Trade Press, 1956.
Wrangham, D. A. *The Theory and Practice of Heat Engines*. 2nd ed. C.U.P., 1948.
Young, A. F. *An Introduction to Process Control System Design*. Longmans, 1957.

13.313 Advanced Textile Engineering

- (a) Same as (a) in 13.233 Textile Physics.
- (b) Heat and mass transfer. Conveying of gases, fluids and solids.

SCHOOL OF ACCOUNTANCY

14.081 Introduction to Business Finance

The course objective is to provide students, other than those enrolled within the Faculty of Commerce, with an understanding of the basic concepts and principles necessary to make effective financial management decisions.

The nature of financial management; the business environment; financial analysis, planning and control; capital investment decisions; organization of the financial structure; operating and working capital management; growth and development; and the causes and prevention of financial instability and failure.

Specific industry studies.

TEXTBOOKS

Pierson, G. & Bird, G. *Business Finance*. McGraw-Mill, 1972.

Weston, J. F. *The Scope and Methodology of Finance*. Prentice-Hall, 1966.

14.501 Accounting and Financial Management IA

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 taxation and auditing.

TEXTBOOKS

Carrington, A. S., Battersby, G. B., & Howitt, G. *Accounting—An Information System*. Whitcombe & Tombs, 1974.

Grouse, P. J. *An Introduction to Computer Programming in PL/1, Part One: The Simple Subset*. 2nd ed. New College Publications, 1972.

Mathews, R. *The Accounting Framework*, 3rd rev. ed. of *Accounting for Economists*. Cheshire, 1972.

Mueller, G. G. & Smith, C. H. *Accounting, a Book of Readings*. Holt, Rinehart & Winston, 1970.

14.511 Accounting and Financial Management IB

Development of basic concepts introduced in Accounting and Financial Management IA including management accounting and operations research, corporate reporting, business finance, system design, elementary computer programming and applications.

TEXTBOOKS

As for Accounting and Financial Management IA.

14.602 Information Systems

Management information systems, including data collection and processing, internal control and internal reporting. System design and computer applications.

TEXTBOOKS

Grouse, P. J. *An Introduction to Computer Programming in PL/1. Part 1. The Simple Subset*. 2nd ed. New College Publications, 1972.

Sanders, D. H. *Computers in Business: an Introduction*. 2nd ed. McGraw-Hill, 1972.

SCHOOL OF ECONOMICS

15.001 Economics IA

Microeconomic analysis as related to some aspects of the Australian economy, including the concept of market demand, the theory of costs and production, supply and demand analysis, the determination of exchange rates, the effects of taxes, tariffs, subsidies and quotas, price and output determination under competitive and monopolistic market structures, an introduction to distribution theory and resource allocation problems.

INTRODUCTORY READING

Samuelson, P. A., Hancock, K. & Wallace, R. *Economics: Australian Edition*. McGraw-Hill, 1970.

TEXTBOOKS

Campbell, K. *Agricultural Marketing and Prices*. Cheshire, 1973.

Lipsey, R. G. *An Introduction to Positive Economics*. 3rd ed. Weidenfeld & Nicolson, 1971.

Stilwell, J. A. & Lipsey, R. G. *Workbook to Accompany an Introduction to Positive Economics*. 2nd ed. Weidenfeld & Nicolson, 1971.

15.011 Economics IB

Macroeconomic analysis as related to some aspects of the Australian economy, including national income and product, money and banking, consumption, investment, liquidity preference, the Keynesian model of income determination and economic growth.

TEXTBOOKS

Commonwealth of Australia. *Australian National Accounts: National Income and Expenditure 1971-1972*. Commonwealth Bureau of Census & Statistics, Canberra, 1973.

Perkins, J. O. N. & Sullivan, J. E. *Banks and the Capital Market*. M.U.P., 1970.

Rowan, D. C. *Output, Inflation and Growth*. Macmillan, 1968.

15.002 Economics IIA

Micro-economic theory, including consumer theory, oligopolistic competition, market stability and general equilibrium.

TEXTBOOKS

Archibald, G. C. ed. *The Theory of the Firm*. Penguin, 1971.

Breit, W. & Loranson, R. *The Academic Scribblers*. Holt, Rinehart & Winston, 1971.

Ferguson, C. E. *Micro-Economic Theory*. 3rd ed. Irwin, 1972.

Townsend, H. ed. *Price Theory*. Penguin, 1971.

15.022 Economics IIB

An introduction to welfare economics and its application to some contemporary problems of public policy.

TEXTBOOKS

Ferguson, C. E. *Micro-Economic Theory*. 3rd ed. Irwin, 1972.

Mishan, E. J. *Cost-Benefit Analysis*. Allen & Unwin, 1971.

Rosenberg, N. ed. *Economics of Technological Change*. Penguin, 1971.

Sirkin, G. *The Visible Hand: The Fundamentals of Economic Planning*. McGraw-Hill, 1968.

15.042 Economics IIC

Extensions of the Keynesian model of income determination to an open economy, fluctuations and growth, monetary theory, financial institutions, inflation and incomes policies.

TEXTBOOKS

Nevile, J. W. *Fiscal Policy in Australia*. Cheshire, 1970.

Nevile, J. W. & Stammer, D. W. eds. *Inflation and Unemployment*. Pelican, 1971.

Rowan, D. C. *Output, Inflation and Growth*. Macmillan, 1968.

Smith, W. L. & Teigen, R. L. eds. *Readings in Money, National Income and Stabilization Policy*. Rev. ed. Irwin, Homewood, 1970.

Wrightsmann, D. *An Introduction to Monetary Theory and Policy*. Collier-Macmillan, 1971.

15.082 Labour Economics

The theory of the labour market and applications to the Australian situation, including labour supply and demand, with emphasis on structural changes in the work force, industry, occupations and technology; work-leisure preferences; types of unemployment and Phillips Curve analysis; wage theory and practice, with reference to market forces, collective bargaining and government regulation; the development of the Australian arbitration system, and wage determinants within and outside the arbitration system; wage differentials; wages and incomes policies.

TEXTBOOKS

Hutson, J. *Six Wage Concepts*. A.E.U., Sydney

McCormick, B. J. & Owen Smith, E. eds. *The Labour Market*. Penguin, 1968.

McCormick, B. J. *Wages*. Penguin, 1969.

15.003 Economics IIIA

Goals and instruments of macro-economic policy, theory and application of fiscal policy, monetary models and policy, growth and stabilization policies.

TEXTBOOKS

Nevile, J. W. *Fiscal Policy in Australia*. Cheshire, 1970.

Nevile, J. W. & Stammer, D. eds. *Inflation and Unemployment*. Pelican, 1971.

Smith, W. L. & Teigen, R. L. eds. *Readings in Money, National Income and Stabilization Policy*. Rev. ed. Irwin, 1970.

15.023 Economics IIIB

International trade and investment, tariffs and other restrictions, the balance of payments, external balance, the international monetary system.

TEXTBOOKS

Cohen, B. *Balance of Payments Policy*. Penguin, 1969.

Cooper, R. ed. *International Finance*. Penguin, 1969.

Heller, H. R. *International Trade: Theory and Empirical Evidence*. 2nd ed. Prentice-Hall, 1973.

McColl, G. D. ed. *Overseas Trade and Investment*. Pelican, 1972.

Sodersten, B. *International Economics*. Macmillan, 1970.

15.043 Comparative Economic Systems

Analysis of different economic systems and the way in which the basic economic problems are solved; a critical appraisal of the efficiency with which resources are allocated in different economies. The emphasis will be on the study of socialist economies, including the U.S.S.R., China and Yugoslavia. The Japanese economy will be included as an example of indicative planning.

TEXTBOOKS

Halm, N. H. *Economic Systems: A Comparative Analysis*. Holt, Rinehart & Winston, 1968.

Nove, A. & Nuti, D. M. eds. *Socialist Economics: Selected Readings*. Penguin, 1972.

Wilczynski, J. *The Economics of Socialism*. Allen & Unwin, 1970.

15.053 Economic Development

The gap between the welfare of the rich and the poor nations. Earlier theories of development as a basis for an appreciation of the various economic and non-economic theories of underdevelopment; such as social and technological dualism, balanced and unbalanced growth, structural change and development. The general principles and techniques of development planning and their application in particular countries.

TEXTBOOKS

Seers, D. & Joy, L. eds. *Development in a Divided World*. Penguin, 1971.

Spiegelglas, S. & Welsh, C. J. eds. *Economic Developments*. Pentic-Hall, 1970.

Sutcliffe, R. B. *Industry & Underdevelopment*. Addison-Wesley, 1971.

15.073 Natural Resource Economics

Nature of natural resources and rents, optimization of natural resource use in space and time, decision criteria in natural resource policy, natural resources and the intangible qualities of life.

TEXTBOOKS

Barnett, H. J. & Morse, C. *Scarcity and Growth: The Economics of Natural Resource Availability*. Johns Hopkins U.P., 1963.

Dorfman, R. & N. eds. *Economics of the Environment*. Norton, 1972.

15.093 Public Sector Economics

Determinants of the size and structure of the public sector of the economy, the nature of public goods and their effects on economic welfare. Pricing policies of public utilities, application of cost-benefit analysis and other techniques to resource allocation, income redistribution and other objectives of public policy, analysis of transport, health, education, regional, urban and environmental issues.

TEXTBOOKS

Herber, B. P. *Modern Public Finance: The Study of Public Sector Economics*. Rev. ed. Irwin, 1971.

Munby, D. ed. *Transport*. Penguin, 1968.

Schreiber, A. F., Gatons, P. K. & Clemmer, R. B. *Economics of Urban Problems*. Houghton Mifflin, 1971.

Turvey, R. ed. *Public Enterprise*. Penguin, 1968.

15.601 Economic History IA—The Making of Modern Economic Society

The purpose of this course is to provide a survey of the forces that have determined the pattern and course of economic development in the later nineteenth and twentieth centuries. Stages of economic development; the transformation of agrarian society; the triumph of industrialism and liberal democracy. Pax Britannica and the European hegemony. The First World War and capitalist society in crisis; competing forms of political and economic organization; shifts in world power. The quest for unity in Europe. Problems of affluence in advanced industrial economies. The development of the administrative state and the multi-national corporation. The progress of the underdeveloped nations.

PRELIMINARY READING

Hohenberg, P. M. *A Primer on the Economic History of Europe. Part 1.* 1968.

TEXTBOOKS

*Hughes, J. *Industrialization and Economic History.* McGraw-Hill, 1970.

*Kenwood, A. G. & Lougheed, A. L. *The Growth of the International Economy: 1820-1960.* Australasian Pub. Co.

15.611 Economic History IB—Australian Economic Development in the Twentieth Century

The aim of the course is to delineate and explain the origins and evolution of the modern Australian economy from Federation to the present day. Topics include: a general overview of Australian economic development and its main features; economic fluctuations and their consequences, especially the Great Depression of the 1930s; the rise of Australian economic institutions; changes in the philosophy of development and the role of the State; the impact of war on the Australian economy; the growth of manufacturing and the creation of an industrial base; problems of the rural sector; and changes in the Australian standard of living. Throughout the course particular attention is given to Australia's changing economic relations with other countries.

PRELIMINARY READING

*Alexander, F. *Australia since Federation.* Nelson, 1967.

TEXTBOOKS

*Boehm, E. A. *Twentieth Century Economic Development in Australia.* Longman, 1971.

*Forster, C. ed. *Australian Economic Development in the Twentieth Century.* Allen & Unwin, 1970.

*Playford, J. & Kirsner, D. *Australian Capitalism.* Penguin, 1972.
Schedvin, C. B. *Australia and the Great Depression.* Sydney U.P., 1970.

* Paperback.

FACULTY OF BIOLOGICAL SCIENCES

17.011 Human Biology

Mankind Evolving: Primate evolution; background of early man.

Evolution of Technological Man: Biological problems associated with communication and tool-making; development of man as a hunting predator.

Development of Utilization of Natural Resources: Development of man as a pastoralist and farmer; animal and plant domestication.

Evolution of Urban Man, Culture, Society: Reproductive biology and genetics of man; population growth, fluctuation, control; natural history of disease, background of medical and industrial microbiology.

Effects of Modern Society: Biology of social stress; effect of society in contemporary environments, planning and control.

TEXTBOOKS

Abercrombie, M. et al. *A Dictionary of Biology*. Penguin, 1967.

Boughey, A. S. *Man and the Environment*. Macmillan, 1971.

Clarke, C. A. *Human Genetics and Medicine*. Arnold, 1970.

REFERENCE BOOKS

Baker, H. B. *Plants and Civilisation*. Wadsworth, 1970.

Bates, M. *Man in Nature*. Prentice-Hall, 1964.

Carter, C. O. *Human Heredity*. Penguin, 1962.

Ehrlich, P. A. & Ehrlich, A. H. *Population, Resources, Environment*. Freeman, 1972.

Jorgensen, J. G. ed. *Biology and Culture in Modern Perspective*. Freeman, 1972.

Mulvaney, D. J. & Golson, G. eds. *Aboriginal Man and Environment in Australia*. A.N.U.P., 1971.

Nix, H. A. ed. *The City as a Life System*. Southwood, 1973.

Thomas, W. L. ed. *Man's Role in Changing the Face of the Earth*. Chic. U.P., 1956.

Watt, K. F. *Principles of Environmental Science*. McGraw-Hill, 1973.

Weiner, J. S. *Man's Natural History*. Weidenfeld & Nicolson, 1971.

Young, J. Z. *An Introduction to the Study of Man*. Clarendon, 1971.

17.021 Comparative Functional Biology

Maintenance of the Organism: Gas exchange systems in plants and animals; transport inside organisms; uptake, digestions, absorption; enzymes structure and function; photosynthesis, process and structural relationships; metabolic systems, energy yields and pathways.

Developing Organisms: Sexual reproduction in plants and animals; general life cycle patterns; cell development and differentiation in flowering plants and mammals.

Control and Co-ordination in Organisms: Organisms and water, uptake and effects; control mechanisms, urinary systems and kidney structure and function; stimuli and responses, plant hormones, hormones in vertebrate animals, muscle activity and muscle structure, eye structure and vision mechanism; ear structure and hearing mechanism; nerves, central nervous system, nerve action, brain structure and functioning.

TEXTBOOKS

Abercrombie, M. et. al. *A Dictionary of Biology*. Penguin, 1967.

Roberts, M. B. V. *Biology: Functional Approach*. Nelson, 1971.

REFERENCE BOOKS

Grenville, H. W. *Biology of the Individual*. Longman, 1971.

Griffin, D. R. & Novick, A. 2nd ed. *Animal Structure and Function*. Holt, Rinehart & Winston, 1970.

Kramer, A. ed. *Topics in the Study of Life*. Harper & Row, 1971.

Ray, P. M. 2nd ed. *The Living Plant*. Holt, Rinehart & Winston, 1972.

DEPARTMENT OF INDUSTRIAL ENGINEERING

18.121 Production Management

Pre-requisites: 10.031, 10.331.

Engineering Economics—The structure of the Australian economy. The theory of the firm, pricing, fluctuations in demand. The economics of 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, e.g. mathematical programming, queueing theory, inventory models, simulation.

TEXTBOOKS

- Buffa, E. S. *Modern Production Management*. 3rd ed. Wiley, 1969.
Lu, F. P. S. *Economic Decision-making for Engineers and Managers*. Whitcombe & Tombs, 1969.
Moore, P. G. *Basic Operational Research*. Pitman, 1968.

REFERENCE BOOKS

- Barnes, R. M. *Motion and Time Study*. 6th ed. Wiley, 1968.
Greene, J. H. *Production Control Systems and Decisions*. Irwin, 1968.
Hillier, F. S. & Lieberman, G. J. *Introduction to Operations Research*. Holden-Day, 1968.
Smith, G. W. *Engineering Economy*. Iowa State U.P., 1968.

18.551 Operations Research

Pre-requisites: either 5.071 and 18.021 or 10.031, 10.331 and 18.121.

TEXTBOOK

- Taha, H. A. *Operations Research: An Introduction*. Macmillan, 1971.

REFERENCE BOOKS

- Gass, S. L. *Linear Programming*. 2nd ed. McGraw-Hill, 1964.
Hansmann, F. *Operations Research in Production and Inventory Control*. Wiley, 1962.
Hillier, F. S. & Lieberman, G. J. *Introduction to Operations Research*. Holden-Day, 1967.
Houlden, B. T. ed. *Some Techniques of Operational Research*. E.U.P., 1962.
Moder, J. J. & Phillips, C. R. *Project Management with CPM and PERT*. Van Nostrand, 1964.

SCHOOL OF CHEMICAL TECHNOLOGY

22.112 Chemical Process Equipment

Review of services in the chemical industry; the principles of operation, construction and fields of application of equipment used in carrying out various processes and operations in the chemical industry.

REFERENCE BOOKS

Badger, W. L. & Banchero, J. T. *Introduction to Chemical Engineering*. McGraw-Hill.

Brown, G. G. *Unit Operations*. Wiley.

Foust, A. S., Wenzel, A., Clump, C. W., Maus, L. & Anderson, L. B. *Principles of Unit Operations*. Wiley.

McCabe, W. L. & Smith, J. C. eds. *Unit Operations of Chemical Engineering*. McGraw-Hill.

22.113 Industrial Chemistry Processes

A study of 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, aluminium 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 will be required to attend lectures on Report Writing, carry out laboratory assignments and attend factory inspections at local and country centres as required.

TEXTBOOKS

Kent, J. A. *Riegel's Industrial Chemistry*. Reinhold. or

Shreve, R. N. *Chemical Process Industries*. McGraw-Hill.

REFERENCE BOOKS

Groggins, P. H. *Unit Processes in Organic Syntheses*. McGraw-Hill.

Kobe, K. A. *Inorganic Process Industries*. Macmillan.

Rogers, A. *Industrial Chemistry*. Macmillan.

22.114 Processes

Topics selected from the following will be studied in depth: refractories, high-temperature processes, high-pressure processes (especially ammonia synthesis—thermodynamics and equipment), nuclear metals, industrial polymers, fermentation industries, applied electrochemistry.

REFERENCE BOOKS

Billmeyer, F. W. *Textbook of Polymer Science*. Wiley.

Bockris, J. O'M. & Reddy, A. K. N. *Modern Electrochemistry*. Vol. 2. Plenum.

Campbell, I. E. & Sherwood, E. M. *High Temperature Materials and Technology*. Wiley.

Chesters, J. *Steel Plant Refractories*. United Steel Co.

Cuthbert, F. L. *Thorium Production Technology*. Addison-Wesley.

Di Benedetto, A. T. *The Structure and Properties of Materials*. McGraw-Hill.

Foley, D. D. & Clegg, J. W. eds. *Uranium Ore Processing*. Addison-Wesley.

- Ford, W. F. *The Effect of Heat on Ceramics*. Maclaren.
Freeman, G. G. *Silicones*. Newnes.
Gerrard, G. A. *Proc. A.I.M.E. Symposia on Extraction of Aluminium*. Vol. 2. Wiley.
Glasstone, S. *Nuclear Reactor Engineering*. Van Nostrand.
Harrington, C. D. & Ruehle, A. E. *Uranium Production Technology*. Van Nostrand.
Katz, T. J. & Seaborg, G. T. *Chemistry of the Actinide Elements*. Methuen.
Kingery, W. D. *Introduction to Ceramics*. Wiley.
McQuillan, A. D. & McQuillan, M. K. *Titanium*. Butterworths.
Miller, G. L. *Zirconium*. Plenum.
Norton, F. H. *Refractories*. McGraw-Hill.
Palin, G. R. *Plastics for Engineers*. Pergamon.
Rochow, E. G. *An Introduction to the Chemistry of the Silicones*. Wiley.
Ryskhewitch, E. *Oxide Ceramics: Physical Chemistry and Technology*. Academic.
Salmang, H. *Ceramics: Physical and Chemical Fundamentals*. Butterworths.
Underkofler, L. A. & Hickey, R. J. eds. *Industrial Fermentations*. Tudor.

22.122 Instrumental Analysis

Basic principles of volumetric and gravimetric analysis and the application of spectrometric and selected techniques to the analysis of process streams and quality control.

TEXTBOOKS

- Skoog, D. A. & West, D. M. *Fundamentals of Analytical Chemistry*. Holt, Rinehart.
OR
Skoog, D. A. & West, D. M. *Principles of Instrumental Analysis*. Holt, Rinehart.

REFERENCE BOOKS

- Delahay, P. *Instrumental Analysis*. Macmillan.
Reilley, C. N. & Sawyer, D. T. *Experiments for Instrumental Methods*. McGraw-Hill.

22.123 Chemical Thermodynamics and Kinetics

Thermodynamics: the laws of thermodynamics, power cycles, thermodynamics of fluids, heterogeneous equilibrium, chemical reaction equilibrium, irreversible thermodynamics.

Kinetics: kinetics of homogeneous reactions, analysis of rate equations of reversible and irreversible reactions. Design fundamentals of industrial reactors during operation under isothermal, adiabatic and non-isothermal conditions. Kinetics of polymerization processes, control of polymer properties by kinetic considerations.

TEXTBOOKS

- Smith, J. M. *Chemical Engineering Kinetics*. McGraw-Hill.
Smith, N. O. *Chemical Thermodynamics — A Problems Approach*. Reinhold.

REFERENCE BOOKS

- Darken, L. S. & Gurry, R. W. *Physical Chemistry of Metals*. McGraw-Hill.
Kirkwood, J. G. & Oppenheim, I. *Chemical Thermodynamics*.
Walas, S. M. *Reaction Kinetics for Chemical Engineers*. McGraw-Hill.

22.124 Applied Kinetics

The defect solid state; solid-state diffusion; solid-state reactions; heterogeneous catalysis and heterogeneous kinetics; continuous stirred tank reactors; semi-batch reactors; tubular reactions; fixed bed catalytic reactors; optimization; scale-up of reactors.

TEXTBOOK

Smith, J. M. *Chemical Engineering Kinetics*. McGraw-Hill.

REFERENCE BOOKS

Denbigh, K. G. *Chemical Reactor Theory*. C.U.P.

Garner, W. E. ed. *Chemistry of the Solid State*. Butterworths.

Griffith, R. H. & Marsh, J. D. *Contact Catalysis*. Butterworths.

Levenspiel, O. *Chemical Reaction Engineering*. Pergamon.

Rees, A. L. G. *Chemistry of the Defect Solid State*. Methuen.

Rietema, K. ed. *Chemical Reaction Engineering*. Pergamon.

Shewmon, P. G. *Solid State Diffusion*. McGraw-Hill.

22.133 Data Processing

Application of the principles of statistics to chemical problems (z test, t test, F test and χ^2 test), analysis of variance, design of experiments, correlation and regression, quality control; use of graphical methods; fitting of empirical equations to experimental data; preparation of nomograms using constructional determinants.

TEXTBOOK

Crow, E. L., Davis, F. A. & Maxfield, M. W. *Statistics Manual*. Dover.

REFERENCE BOOKS

Davies, O. L. *Statistical Methods in Research and Production*. Oliver & Boyd.

Johnson, L. H. *Nomography and Empirical Equations*. Wiley.

Worthing, A. G. & Geffner, J. *Treatment of Experimental Data*. Wiley.

22.134 Applied Thermodynamics

Calculation of thermodynamic properties, statistical methods for calculation of thermodynamic properties of gases from spectroscopic data, thermodynamics of non-ideal solutions, polymers and the glassy state, changing standard states. A study of heterogeneous equilibria in multicomponent systems with particular emphasis on systems of practical importance.

REFERENCE BOOKS

Aston, J. G. & Fritz, J. J. *Thermodynamics and Statistical Thermodynamics*. Wiley.

Janaf. *Thermochemical Tables*. Dow Chemical Co.

22.143 Introductory Instrumentation and Analogue Computation

A course of twelve two-hour periods devoted to lectures, demonstrations and laboratory exercises. Offered as part of 2.911 Applied Chemistry.

Conversion of primary variables into electrical signals, measuring instruments, introduction to analogue computation, theory and application of analogue computer elements, analogue computer programming, solution of differential equations, introduction to process control.

22.144 Instrumentation and Process Control

Instrumentation (primary sensitive elements and final control elements concerned with the parameters normally encountered in the chemical industry), elementary principles of digital computation, process dynamics, open-loop process system analysis, principles of analogue computation and simulation, automatic process control systems.

TEXTBOOK

Johnson, E. F. *Automatic Process Control*. McGraw-Hill.

REFERENCE BOOKS

Caldwell, W. I., Coon, G. A. & Zoss, L. M. *Frequency Response in Process Control*. McGraw-Hill.

Considine, D. M. *Process Instruments and Control Handbook*. McGraw-Hill.

Del Toro, V. & Parker, S. *Principles of Control Systems Engineering*. McGraw-Hill.

Huskey, H. D. & Korn, G. A. *Computer Handbook*. McGraw-Hill.

Johnson, C. L. *Analog Computer Techniques*. McGraw-Hill.

Shilling, G. D. *Process Dynamics and Control*. Holt, Rinehart.

Smith, G. W. & Wood, R. C. *Principles of Analog Computation*. McGraw-Hill.

22.153 Material and Energy Balances

Units, material balances, gases, vapours and liquids, energy balances, combined energy and material balances, unsteady-state material balances.

TEXTBOOK

Himmelblau, D. M. *Basic Principles and Calculations in Chemical Engineering*. 2nd ed. Prentice Hall.

22.154 Process Simulation

The application of the hybrid computer to the study of the dynamics of processes encountered in the chemical industry.

REFERENCE BOOK

Buckley, P. S. *Techniques of Process Control*. Wiley.

22.164 Management Science

Application of the principles of the feedback control loop to management in the chemical industry and dealing with production, quality control, work study, production planning, economics and project development.

22.174 Seminars

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

22.184 Process Analysis

An assignment on the integrated design of process flow diagrams involving specification of basic chemical reactions and physico-chemical parameters, selection of types of equipment required, statement of variables to be measured for the control of raw materials, process conditions and final product, and the preparation of a process model suitable for automatic control.

22.213 Chemical Ceramics

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.

TEXTBOOK

Ford, W. F. *Institute of Ceramics Textbook Series, IV Effect of Heat on Ceramics*. Maclaren.

REFERENCE BOOKS

American Ceramic Soc. *Phase Diagrams for Ceramists*.

Andrews, A. J. *Porcelain Enamels*. Garrard.

Campbell, I. E. & Sherwood, E. M. *High Temperature Materials and Technology*. Wiley.

Chesters, J. *Steelplant Refractories*. United States Steel Co.

Eitel, W. *Physical Chemistry of the Silicates*. Chicago U.P.

Findlay, A., Campbell, A. N. & Smith, N. O. *The Phase Rule and its Applications*. Dover.

Goldman, J. E. *Science of Engineering Materials*. Wiley.

Green, A. T. & Stewart, O. H. eds. *Ceramics: A Symposium*. Brit. Ceramic Soc.

Kingery, W. D. *Introduction to Ceramics*. Wiley.

Klug, H. P. & Alexander, L. E. *X-Ray Diffraction Procedures*. Wiley.

Norton, F. H. *Refractories*. McGraw-Hill.

Parmelee, C. W. *Ceramic Glazes*. Industrial Publications.

Ryshkewitch, E. *Oxide Ceramics: Physical Chemistry and Technology*. Academic.

Searle, A. B. & Grimshaw, R. W. *The Chemistry and Physics of Clays and Other Ceramic Materials*. Benn.

22.224 Physical Ceramics

Physical Ceramics—Application of the principles of physical chemistry and solid-state physics to a study of the preparation and properties of ceramic materials. *Clay Mineralogy*—Structures and properties of the various clay minerals; techniques employed in the identification of clay minerals; composition and properties of the ceramic clays of New South Wales.

TEXTBOOK

Kingery, W. D. *Introduction to Ceramics*. Wiley.

REFERENCE BOOKS

Burfoot, J. C. *Ferroelectrics*. Van Nostrand.

Darken, L. S. & Gurry, R. W. *Physical Chemistry of Metals*. McGraw-Hill.

Evans, R. P. *Introduction to Crystal Chemistry*. C.U.P.

Gray, T. J. *The Defect Solid State*. Wiley.

Green, H. *Industrial Rheology and Rheological Structure*. Wiley.
Kingery, W. D. *Ceramic Fabrication Processes*. Wiley.
Jaffe, B., Cook, W. R. & Jaffe, H. *Piezoelectric Ceramics*. Academic.
Kittel, C. *Introduction to Solid State Physics*. Wiley.
McKenzie, J. D. *Modern Aspects of the Vitreous State*. Butterworths.
Sinnott, M. J. *Solid State for Engineers*. Wiley.
Smoluchowski, R. *Phase Transformations in Solids*. Wiley.
Stanworth, J. E. *Physical Properties of Glass*. Clarendon.

22.231 Introductory Ceramic Engineering

The nature of ceramic materials, the history of ceramics and the ceramic industry, the structure of the ceramics industry and the role of the ceramic engineer.

22.2331 Ceramic Process Principles

Clay and non-clay raw materials. Unit operations in the ceramic industry: beneficiation, forming, drying, firing, melt forming, hot forming and miscellaneous forming process. Testing methods and instrumentation in quality control. Stoichiometry and ceramic calculations, including glaze, porcelain enamel and body formulation.

Students are required to take part in a series of factory inspections.

TEXTBOOKS

Ford, R. W. *Institute of Ceramics Textbook Series, III. Drying*. Maclaren.
Griffiths, R. & Radford, C. *Calculations in Ceramics*. Maclaren.
Moore, F. *Institute of Ceramics Textbook Series, II. Rheology of Ceramic Systems*. Maclaren.
Worrall, W. E. *Institute of Ceramics Textbook Series, I. Raw Materials*. Maclaren.

REFERENCE BOOKS

Andrews, A. I. *Ceramic Tests and Calculations*. Wiley.
Andrews, A. I. *Porcelain Enamels*. 2nd ed. Garrard.
Clews, F. H. *Heavy Clay Technology*. 2nd ed. Academic.
Ford, W. F. *Institute of Ceramics Textbook Series, IV Effect of Heat on Ceramics*. Maclaren.
Jones, J. T. & Berard, M. F. *Ceramics: Industrial Processing and Testing*. Iowa State U.P.
Lewis, W. K., Radasch, A. H. & Lewis, H. C. *Industrial Stoichiometry*. McGraw-Hill.
Norton, F. H. *Elements of Ceramics*. Addison-Wesley.
Parmelee, C. W. *Ceramic Glazes*. 2nd ed. Industrial Publications.
Salmang, H. & Francis, M. *Ceramics—Physical and Chemical Fundamentals*. Butterworths.
Singer, F. & Singer, S. S. *Industrial Ceramics*. Chapman & Hall.
Wayne, B. E. *Introduction to Technical Ceramics*. Maclaren.

22.2332 Ceramic Engineering I

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.

22.234 Ceramic Engineering II

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. Power transmissions. Pollution control equipment.

Students are required to take part in a series of factory inspections.

REFERENCE BOOKS

A. S. Code CA1-1972 *SAA Steel Structures Code*.

Coulson, J. M. & Richardson, J. F. *Chemical Engineering* Vols. 2 and 3. Pergamon.

Dusinberre, G. M. *Heat-Transfer Calculations by Finite Differences*. Int. Textbook Co.

Etherington, H. & Etherington, G. *Modern Furnace Technology*. Charles Griffin.

Kern, D. Q. *Process Heat Transfer*. McGraw-Hill.

Kreith, F. *Principles of Heat Transfer*. 2nd ed. Int. Textbook Co.

Magill, P. L., Holden, F. R. & Ackley, C. eds. *Air Pollution Handbook*. McGraw-Hill.

McAdams, W. H. *Heat Transmission*. McGraw-Hill.

Perry, J. H. *Chemical Engineers Handbook*. McGraw-Hill.

Skelland, A. H. P. *Non-Newtonian Flow and Heat Transfer*. Wiley.

Tooley, F. V. *Handbook of Glass Manufacture*. Ogden.

Treybal, R. E. *Mass-Transfer Operations*. 2nd ed. McGraw-Hill.

Trinks, W. & Mawhinney, M. H. *Industrial Furnaces*. Vols 1 and 2. Wiley.

Wilkinson, W. L. *Non-Newtonian Fluids*. Pergamon.

22.313 Polymer Processes

Industrial methods of polymerization: bulk, suspension, emulsion, solution, high pressure. Polymerization processes: stepwise and chain growth, free radical and ionic, Ziegler-Natta catalyst systems. Selected examples taken from polyesters, vinyl and acrylic polymers, phenolic resins, synthetic elastomers. Introduction to qualitative and quantitative analysis by chemical and instrumental methods.

TEXTBOOK

Lenz, R. W. *Organic Chemistry of Synthetic High Polymers*. Wiley.

REFERENCE BOOKS

Kappelmeier, C. P. A. ed. *Chemical Analysis of Resin Based Coating Materials*. Wiley.

Long, R. R. & Myers, J. S. *Treatise on Coatings*. Vol. II, Part 1. Dekker.

22.314 Polymer Chemistry

Inorganic polymers, polymers for high temperature service, the use of modern instrumental methods for establishing composition and structure of high polymers.

REFERENCE BOOKS

Eaborn, C. *Organo-Silicon Compounds*. Butterworths.

Hawkins, W. L. *Polymer Stabilisation*. Wiley.

Slade, P. E. & Jenkins, L. T. *Thermal Characterization Technique*. Dekker.

Stevens, M. P. *Characterization and Analysis of Polymers of Gas Chromatography*. Dekker.

Henniker, J. C. *Infrared Spectrometry of Industrial Polymers*. Academic.

22.323 Physical Chemistry of Polymers I

Molecular weight applied to macromolecules, number, weight, viscosity and \bar{z} average molecular weights. Molecular weight distribution. Thermodynamics of polymer solutions related to molecular weight determination. Measurement of molecular weight: viscometry, osmometry, light scattering, ebulliometry, cryoscopy, chemical methods. Fractionation methods.

TEXTBOOK

Allen, P. W. ed. *Techniques of Polymer Characterisation*. Butterworths.

22.324 Physical Chemistry of Polymers II

Theory of polymer solutions, polyelectrolytes. Structure/property relationships: Thermal transitions, polymer viscoelasticity.

REFERENCE BOOKS

Flory, P. J. *Principles of Polymer Chemistry*. Cornell U.P.

Morawetz, H. *Macromolecules in Solution*. Interscience.

Sharples, A. *Introduction to Polymer Crystallization*. Arnold.

22.333 Polymer Physics I

Stress-strain behaviour of polymeric materials at ordinary and elevated temperatures. Rheological considerations of polymer processing operations. Physical testing of polymers. Design of high polymer formulations.

TEXTBOOK

Schmidt, A. X. & Marlies, C. A. *Principles of High Polymers—Theory and Practice*. McGraw-Hill.

REFERENCE BOOKS

A.S.T.M. Standards. Part IX.

Billmeyer, F. W. *Textbook of Polymer Science*. Wiley.

British Standards.

Eirich, F. R. ed. *Rheology Theory and Application*. Vols I, II and III. Academic.

Frith, E. M. & Tuckett, R. F. *Linear Polymers*. Longman.

Materials and Compounding Ingredients for Rubber. Bill Communications Inc., N.Y.

Ott, E. & Spurling, H. M. *Cellulose*. Wiley.

Reiner, M. *Deformation and Flow*. Lewis.

Treloar, L. R. *The Physics of Rubber Elasticity*. O.U.P.

Wilson, B. J. *British Compounding Ingredients for Rubber*. W. Hefler, Cambridge.

22.334 Polymer Physics II

Rubber elasticity, extrusion plastometry, rheological aspects of polymer processing operations.

REFERENCE BOOKS

A.S.T.M. Standards. Parts 14, 20, 21, 24, 25, 26, 27.

Eirich, F. R. ed. *Rheology Theory and Application*. Vols I, II and III. Academic.

Houwink, R. *Elastomers and Plastomers*. Vols I and II. Elsevier.

22.311G Polymer Processes I

Classification of polymers; methods of polymerization—bulk, suspension, emulsion, high pressure. Processes; stepgrowth, chain growth. The chemistry and applications of polymer systems including—polyesters, vinyl polymers, phenolic condensation resins, synthetic rubbers and elastomers, fluorinated polymers. Natural polymers.

TEXTBOOKS

Lenz, R. W. *Organic Chemistry of Synthetic High Polymers*. Wiley.

REFERENCE BOOKS

Alfrey, T. & Gurnee, E. F. *Organic Polymers*. Prentice-Hall.

Fettes, E. M. *Chemical Reactions of Polymers*. Wiley.

Kline, G. M. *Analytical Chemistry of Polymers*. Wiley.

Long, J. S. & Myers, R. R. *Treatise on Coatings*. Vol. I, Parts I-III. Dekker.

Long, R. *The Production of Polymer and Plastics Intermediates from Petroleum*. Butterworths.

Schildknecht, C. A. *Vinyl and Related Polymers*. Wiley.

22.312G Polymer Processes II

Polymers containing backbones other than carbon: phosphorus, arsenic, sulphur; polysilanes.

Instrumental analytical methods, U.V. and I.R. spectroscopy, endgroup analysis, vapour phase chromatography; degradation; X-rays, radioisotopes; stereoisomers, chemical methods.

REFERENCE BOOKS

Eaborn, C. *Organo-Silicon Compounds*. Butterworths.

Hunter, D. N. *Inorganic Polymers*. Wiley.

22.321G Physical Chemistry of Polymers I

Mechanisms and Kinetics: stepgrowth polymerization kinetics, structure effects, chain growth polymerization. (i) Free radical polymerization—chemistry and properties of free radicals and initiators; kinetics, transfer reactions; copolymerization; monomer radical structure and reactivity, (ii) ionic polymerization including stereo-regular polymers.

Polymer Characterization: molecular weight, average distributions; thermodynamics of polymer solutions; theta temperature; measurement of number average and weight average molecular weights; ultra centrifuge; optical properties; monomolecular films; thermal methods, fractionation methods and their limitations, dual dispersity; control of molecular weight.

TEXTBOOKS

Allen, P. W. ed. *Techniques of Polymer Characterisation*. Butterworths.

Flory, P. J. *Principles of Polymer Chemistry*. Cornell U.P.

Lenz, R. W. *Organic Chemistry of Synthetic High Polymers*. Wiley.

REFERENCE BOOK

Ke, B. ed. *Newer Methods of Polymer Characterization*. Intersci-Wiley.

22.322G Physical Chemistry of Polymers II

(i) Configurational effects; conformational effects; elastomers, fibres, plastics; temperature resistant polymers, rigidity, crystallinity, morphology, kinetics, nucleation, melting, effect on properties; polar interactions; chemical reactivity; chemistry of adhesion; stereoregular polymers; tacticity; biological systems; medical application of plastics; choice and design of materials for specific applications. (ii) Degradation—thermal, photolytic, mechanical and ultrasonic radiation, oxidative, model compounds; biological degradation; protection of materials against degradation.

TEXTBOOK

Sharples, A. *Introduction to Polymer Crystallization*. Arnold.

REFERENCE BOOKS

Hawkins, W. L. ed. *Polymer Stabilization*. Interscience.

Meares, P. *Polymers: Structure and Bulk Properties*. Nostrand.

22.331G Polymer Engineering I

(a) *Polymer Compound Design*—Safety precautions. Formulation principles of: elastomers, thermosets, thermoplastics, adhesives and bonding, cellular polymers (open and closed cell, rigid and flexible), surface coatings, films, sheeting and pipes. Formulation cost data. Milling, mixing and curing of polymer formulations.

(b) *Polymer Processing*—Mixing and dispersion; extrusion fundamentals (screw type)—isothermal operation, adiabatic operation, die design; ram extrusion fundamentals; screwless extrusion fundamentals; injection moulding (plastics and elastomers); press and transfer moulding; calendaring; sheet forming; hollow articles; sealing and welding.

(c) *Laboratory*—Selected experiments illustrating principles developed in lectures.

Natural rubber gum stock; carbon black reinforced tyre tread stock; neoprene compound design; acrylonitrile compound design; flexible PVC compound design; plasticizer ratios in PVC; polyester castings; glass reinforced—polyester laminates; polyurethane foams; epoxy chemical resistant coatings; surface coating formulation and testing.

Mixing processes (2- and 3-roll mills and Banbury mixer); dispersion processes (Sigma arm mixer) press moulding of thermosets; injection moulding of polyethylene and nylon; screw extrusion of thermoplastics (1½" extruder); screw extrusion of elastomers (1½" extruder); screwless extrusion of thermoplastics; vacuum forming from sheet material; hot gas welding of thermoplastics; hot sealing of plastic films.

TEXTBOOKS

Billmeyer, F. W. *Textbook of Polymer Science*. Wiley.

or

Schildknecht, C. A. *Vinyl and Related Polymers*. Wiley.

Schmidt, A. X. & Marlies, C. A. *Principles of High Polymers—Theory and Practice*. McGraw-Hill.

REFERENCE BOOKS

Materials and Compounding Ingredients for Rubber. Bill Communications Inc. N.Y.

Wilson, B. J. *British Compounding Ingredients for Rubber*. W. Hefler, Cambridge.

A.S.T.M. Standards. Parts 14, 20, 21, 24, 25, 26, 27.

22.332G Polymer Engineering II

(a) *Polymer Physical Properties and Engineering Applications of Polymers*—

(i) *Polymer Physical Properties*—Theory of rubber elasticity; molecular chain tension; force-extension fundamentals; large strain region in elastomers; rheological phenomena (flow); extrusion plastometry; reinforcement of polymer physical properties.

(ii) *Engineering Applications of Polymers*—Thermosets thermoplastics; elastomers, cellular polymers; adhesives and bonding; surface coatings; thermal and acoustic insulation; vibration isolation; chemical resistance; accelerated ageing.

(b) *Physical Testing II*—Density of solid and cellular polymers; hardness, stress-strain fundamentals (ultimate tensile strength, modulus) for thermosets, thermoplastics and elastomers; elastic modulus; work of deformation; compressive strength and modulus; shear; torsion; flexural strength and modulus; impact; resilience; flex cracking; tear. Creep; relaxation; first and second order transition; thermal conductivity through polymers; extrusion plastometry; cone and plate viscometry (solid polymers).

(c) *Laboratory*—Stress-strain; creep; relaxation; second order transition; thermal conductivity (K factor); cell size and per cent closed cells (cellular polymers); refractive index; extrusion plastometer; cone and plate viscometer; Mooney viscometer.

REFERENCE BOOKS

Eirich, F. R. ed. *Rheology Theory and Application*. Vols I, II & III. Academic.

Frith, E. M. & Tuckett, R. F. *Linear Polymers*. Longman.

Houwink, R. *Elastomers and Plastomers*. Vols I & II. Elsevier.

A.S.T.M. Standards. Parts 14, 20, 21, 24, 25, 26, 27.

SCHOOL OF NUCLEAR ENGINEERING

23.051 Nuclear Power Technology

Nuclear processes, fission and energy deposition, nuclear reaction rates, fuel cycles and nuclear reactor types. Primary and secondary radiation sources, multiplication slowing down and diffusion of neutrons, criticality conditions and reactivity changes with burnup. Fine scale flux in fuel element lattices, effects of control rods and reflectors. Delayed neutrons, point reactor neutron kinetics, and reactor control.

Heat conduction, transfer and transport in canned reactor fuel elements and reactor coolant channels. Gas, non-metallic fluid and liquid metal cooling. Boiling, two phase flow and burnout problems. Void, temperature and fission product power reactivity feedback mechanisms. Thermo-mechanical aspects of reactor core performance.

The thermodynamics of nuclear power systems. The special nuclear, thermal and cost characteristics of gas cooled, pressurised water, boiling water and liquid metal fast reactor systems. Isotopic power generators, process heat and other reactor applications.

REFERENCE BOOKS

Bonilla, C. F. *Nuclear Engineering*. McGraw-Hill.

El Wakil, M. M. *Nuclear Power Engineering*. McGraw-Hill.

Glasstone, S. & Sesonske, A. *Nuclear Reactor Engineering*. Van Nostrand. *Directory of Nuclear Reactors—Power Reactors*. Vol. IV, 1962. Vol. VII, 1968. Vol. IX, 1971. Int. Atomic Energy Agency, Vienna.

International Conference on Nuclear Power Costs. Int. Atomic Energy Agency, Vienna, 1968.

Nuclear Energy Costs and Economic Development. Int. Atomic Energy Agency, Vienna, 1970.

SCHOOL OF APPLIED GEOLOGY

25.001 Geology I

Physical Geology—The structure and main surface features of the earth: geological cycle—processes of erosion, transportation, sedimentation and lithification. Surface and sub-surface water. Weathering, lakes, rivers, glacial phenomena. Vulcanism, earthquakes, orogenesis and epeirogenesis. Introductory physiography.

Crystallography and Mineralogy—Introduction to crystal symmetry, systems, forms, habit, twinning. Occurrence, form and physical properties of minerals. Mineral classification. Descriptive mineralogy. Principal rock forming minerals. Basic structures of silicate minerals.

Petrology—Field occurrence, lithological characteristics and structural relationships of igneous, sedimentary and metamorphic rocks. Introduction to coal, oil and ore deposits.

Stratigraphy and Palaeontology—Basic principles of stratigraphy; introductory palaeontology. The geological time scale. The geological history of the Australian continent and more specifically that of New South Wales in introductory outline.

Practical Work—Preparation and interpretation of geological maps and sections. Map reading and use of simple geological instruments. Study of simple crystal forms and symmetry. Applied stereoscopic projection. Identification and description of common minerals and rocks in hand specimen. Recognition and description of examples of important fossil groups. Supplemented by three field tutorials, attendance at which is compulsory.

TEXTBOOKS

Bickford, M. E. *et al. Geology Today*. CRM Books, California, 1973.

Black, R. M. *Elements of Palaeontology*. C.U.P., 1970.

Rutley, F. *Elements of Mineralogy*. Ed. H. H. Read, Murby, 1970.

Tyrrrell, G. W. *The Principles of Petrology*. Methuen.

REFERENCE BOOKS

Bryan, J. H., McElroy, C. T., & Rose, G. *Explanatory Notes to Accompany the Sydney 4-mile Geological Map (with map)*. 3rd ed. Bureau of Mineral Resources, 1966.

Holmes, A. *Principles of Physical Geology*. N.A.P. or

Kostov, I. *Mineralogy*. Oliver & Boyd, 1968.

Longwell, C. R., Flint, R. F. & Sanders, J. E. *Introduction to Physical Geology*. Wiley, 1969.

Packham, G. H. ed. *The Geology of New South Wales. Vol. 16, Part 1, J. Geol. Soc. Aust.* Mercury Press, 1969.

25.002 Geology II

Mineralogy: Principles of optical crystallography; the construction and use of a polarizing microscope. Polymorphism; the crystal chemistry, crystallography and geological occurrence of the main groups of rock forming minerals. Description and recognition of common ore and rock forming minerals in both hand specimen and thin section.

Petrology—Igneous Petrology: Occurrence, genesis and classification of the commoner igneous rocks. Crystallization of magma. Binary systems. The reaction series. Introduction to micropetrography.

Metamorphic Petrology—Principles, concepts and theories relating to the occurrence, origin and classification of metamorphic rocks. A.C.F. and A.K.F. diagrams. Metamorphic facies. Practical: megascopic and micro-

scopic examination of selected metamorphic rocks. Field Work: at least one field trip to illustrate the above course.

Petrology—Sedimentary Petrology: The influence of transportation, deposition and diagenesis on the composition, texture and structure of the sedimentary rocks. The classification of detrital sediments. The non-clastic sediments.

Palaeontology: Morphology and systematics of major fossil Invertebrate phyla (Part 1) and their stratigraphic distribution. Practical: examination of representative fossils from each phylum.

Stratigraphy: Classification of sedimentary rocks. Sedimentary processes. Environments of deposition. The facies concept. Stratigraphic principles. Geosynclines and their evolution. Development of a geosyncline and an intracratonic basin. Stratigraphy of selected provinces of Eastern Australia.

Structural Geology: Description of structures, mesoscopic-macroscopic, fractures, joints, faults, folds and their structural elements; foliation, lineation. Introduction to tectonics and plate tectonics. Practical: stereographic projection; analysis of fractures, faults, folds and their structural elements; foliation, lineation, strain analysis and rotation problems. Field Work: at least one compulsory field trip to illustrate the above course.

TEXTBOOKS

Mineralogy

Bloss, F. D. *An Introduction to the Methods of Optical Crystallography*. Holt, Rinehart & Winston, 1967.

Heinrich, E. W. *Microscopic Identification of Minerals*. McGraw-Hill, 1965.

Petrology

Williams, H., Turner, F. J. & Gilbert, C. M. *Petrography*. Freeman, 1954.

Winkler, H. G. F. *Petrogenesis of Metamorphic Rocks*. 2nd ed. Springer, 1967.

Palaeontology

Moore, R. C., Lalicker, C. G. & Fischer, A. G. *Invertebrate Fossils*. McGraw-Hill, 1952.

Stratigraphy

Blatt, H., Middleton, G. & Murray, R. *Origin of Sedimentary Rocks*. Prentice Hall.

Brown, D. A., Campbell, K. S. W. & Crook, K. A. W. *Geological Evolution of Australia and New Zealand*. Pergamon, 1968.

Dunbar, C. O. & Rodgers, J. *Principles of Stratigraphy*. Wiley, 1957.

Structural Geology

Ragan, D. M. *Structural Geology—An Introduction to Geometrical Techniques*. Wiley, 1968.

Spencer, E. W. *Introduction to the Structure of the Earth*. McGraw-Hill, 1969.

REFERENCE BOOKS

Mineralogy

Deer, W. A., Howie, R. A. & Zussman, J. *An Introduction to the Rock Forming Minerals*. Longman, 1966.

Fyfe, W. S. *Geochemistry of Solids*. McGraw-Hill, 1964.

Hurlbut, C. S. ed. *Dana's Manual of Mineralogy*. Wiley.

Kostov, I. *Mineralogy*. Oliver & Boyd, 1968.

Mason, B. & Berry, L. G. *Elements of Mineralogy*. 2nd ed. Freeman, 1968.

Wahlstrom, E. E. *Optical Crystallography*. 4th ed. Wiley, 1969.

Petrology

Hyndman, D. W. *Petrology of Igneous and Metamorphic Rocks*. McGraw-Hill, 1972.

Turner, F. J. *Metamorphic Petrology*. McGraw-Hill, 1968.

Palaeontology

Beerbower. *Search for the Past*. Prentice-Hall, 1969.

Easton, W. H. *Invertebrate Palaeontology*. Harper, 1960.

Schrock, R. R., & Twenhofel, W. H. *Principles of Invertebrate Palaeontology*. McGraw-Hill.

Stratigraphy

Pettijohn, S. J. *Sedimentary Rocks*. 2nd ed. Harper.

Structural Geology

Billings, M. *Structural Geology*. Prentice-Hall, 1954.

Hills, E. S. *Elements of Structural Geology*. Wiley, 1963.

Whitten, E. H. T. *Structural Geology of Folded Rocks*. Wiley, 1966.

25.003 Geology III

Economic Geology I—Principles and theories of ore formation. Magmatic, hydrothermal, submarine exhalative deposits. Sedimentary deposits including biogenic alluvial and residual deposits. Metallic and non-metallic economic minerals. Hand specimen and elementary mineragraphic practical work.

Geophysics—An introduction to the physics, shape, structure, constitution and dynamics of the earth: seismology, gravity, geodesy, geothermy, geomagnetism, palaeomagnetism. An introduction to main methods of geophysical exploration.

Igneous Petrology—Magma types and differentiation trends. Ternary systems. Effects of load pressure and water vapour pressure on phase equilibria. Micropetrography of a wide range of igneous rocks.

Mineralogy—Further optical crystallography; determination of refractive indices. Laboratory methods of mineral separation. Principles of X-ray diffraction; simple application of X-ray powder cameras and diffractometers.

Oceanography—Dynamic properties of the oceanic water-masses. Physics and chemistry of sea water. Submarine geology and cartography. Recent sedimentation and its correlation with terrestrial stratigraphy. Sediments of organic origin. Oceanic materials of economic importance.

Palaeontology—Morphology and systematics of major fossil invertebrate phyla (Part 2) and their stratigraphic distribution. Palaeobotany. Elements of Palaeoecology. Practical: practical applications of Palaeontology and Palaeoecology.

Stratigraphy—Advanced stratigraphic principles and techniques. Biostratigraphy and the use of selected fossil groups in stratigraphic correlation. Geochronology. Geosynclines and plate tectonics. Sedimentational and tectonic history of selected provinces in Australia. The theory of continental drift and its stratigraphic implications.

Tectonics—The geophysical, sedimentological, petrological and structural geological aspects of global geotectonics.

Vertebrate Palaeontology—An introduction to evolution of vertebrates.

Field Work—Field Work is an essential part of the course and consists of ten days of field tutorials.

TEXTBOOKS

Economic Geology

Park, C. F., and MacDiarmid, R. A. *Ore Deposits*. Freeman, 1964.

Stanton, R. *Ore Petrology*. McGraw-Hill, 1972.

Geophysics

Bott, M. H. P. *The Interior of the Earth*. Arnold, 1971.

Garland, G. D. *The Earth's Shape and Gravity*. Pergamon, 1964.

Howell, B. *Introduction to Geophysics*. McGraw-Hill, 1959.

Parasnis, D. S. *Principles of Applied Geophysics*. Chapman & Hall, 1972.

Stacey, F. P. *Physics of the Earth*. Wiley, 1969.

Igneous Petrology

Deer, W. A., Howie, R. A., and Zussman, J. *Rock Forming Minerals*. Longman, 1966.

Turner, F. J., and Verhoogen, J. *Igneous and Metamorphic Petrology*. McGraw-Hill, 1960.

Minerology

As for 25.002 Mineralogy plus

Azaroff, L. V., and Donahue, R. J. *Laboratory Experiments in X-ray Crystallography*.

Zussman, J. ed. *Physical Methods in Determinative Mineralogy*. Academic, London, 1967.

Oceanography

Pickard, G. L. *Descriptive Physical Oceanography*. Pergamon, 1964.

Palaeontology

As for 25.002 Palaeontology plus

Ager, D. V. *Principles of Palaeoecology*. McGraw-Hill, 1963.

Vertebrate Palaeontology

Colbert, E. H. *Evolution of the Vertebrates*. Wiley.

Von Koenigswald, G. H. R. *The Evolution of Man*. Michigan U.P., 1962.

Stratigraphy

As for Stratigraphy in 25.002 plus

Krumbein, W. C., and Sloss, L. L. *Stratigraphy and Sedimentation*. 2nd ed. Freeman, 1963.

Berry, W. B. N. *Growth of a Prehistoric Time Scale Based on Organic Evolution*. Freeman, 1968.

Lahee, F. H. *Field Geology*. McGraw-Hill, 1952.

Tectonics

Gaskell, T. F. *Physics of the Earth*. Thames & Hudson, 1970.

REFERENCE BOOKS

Geophysics

Dobrin, M. B. *Geophysical Prospecting*. McGraw-Hill, 1960.

Griffith, D. H. & King, R. F. *Applied Geophysics for Engineers and Geologists*. Pergamon, 1965.

Howell, B. *Introduction to Geophysics*. McGraw-Hill, 1959.

Parasnis, D. S. *Mining Geophysics*. Elsevier, 1966.

Stacey, F. D. *Physics of the Earth*. Wiley, 1969.

Vertebrate Palaeontology

Von Koenigswald, G. H. R. *The Evolution of Man*. Michigan U.P., 1962.

Stratigraphy

Berry, W. B. N. *Growth of a Prehistoric Time Scale Based on Organic Evolution*. Freeman, 1968.

Lahee, F. H. *Field Geology*. McGraw-Hill, 1962.

Economic Geology

Lindgren, W. *Mineral Deposits*. 4th ed. McGraw-Hill, 1933.

Bateman, A. M. *Economic Mineral Deposits*. 2nd ed. Wiley, 1950.

Igneous Petrology

Barth, T. W. *Theoretical Petrology*. 2nd ed. Wiley, 1965.

Mineralogy

Nuffield, E. W. *X-ray Diffraction Methods*. Wiley, 1966.

Azaroff, L. V. *Elements of X-ray Crystallography*. McGraw-Hill, 1968.

Oceanography

Shepard, F. P. *Submarine Geology*. 2nd ed. Harper, 1968.

Menard, H. W. *Marine Geology of the Pacific*.

Palaeontology

Arnold, *An Introduction to Palaeobotany*. McGraw-Hill, 1947.

Moore, H. B. *Marine Ecology*. Wiley, 1965.

Imbrie, J. & Newell, N. D. eds. *Approaches to Palaeoecology*. Wiley, 1964.

Tectonics

Badgely, P. C. *Structural and Tectonic Principles*. Harper, 1965.

De Sitter, L. U. *Structural Geology*. McGraw-Hill, 1964.

25.0041, 25.0042, 25.0043, 25.0044 and 25.0045 Geology IV

The course consists of 25.0041 and 25.0045, and one of 25.0042 or 25.0043 or 25.0044.

25.0041 Advanced Applied Geology

Exploration Geophysics—Application of gravity, magnetic, seismic and electrical methods in exploration for minerals, hydrocarbons and ground-water.

Computer Applications in Geological Analysis—Advanced methods of mathematical geology, including stochastic processes, deterministic simulation, ore body delineation, ore reserve estimation, exploration risk classification and prediction, and introduction to methods of operations research.

Geochemistry—Sampling, sample preparation; some modern analytical procedures. Factors governing elemental distributions. Examination of some well-documented geochemical investigations.

Seminar—A weekly activity in which all students will participate.

TEXTBOOKS

25.0041

Dobrin, M. B. *Geophysical Prospecting*. McGraw-Hill, 1960.

Jenkins, R. & De Vries, L. *Practical X-ray Spectrometry*. 2nd ed. Philips Tech. Library, Eindhoven.

Koch, G. S. & Link, R. F. *Statistical Analysis of Geological Data*. Vol. 2. Wiley, 1971.

Parasnis, D. S. *Principles of Applied Geophysics*. Chapman & Hall, 1972.

REFERENCE BOOKS

25.0041

Grant, F. S. & West, G. F. *Interpretation Theory in Applied Geophysics*. McGraw-Hill, 1965.

Harbaugh, J. W. & Merriam, D. F. *Computer Applications in Stratigraphic Analysis*. Wiley, 1968.

Harbaugh, J. W. & Bonham-Carter, G. *Computer Simulation in Geology*. Wiley, 1970.

Keller, H. B. & Frischknecht, F. C. *Electrical Methods in Geophysical Prospecting*. Pergamon, 1966.

Parasnis, D. S. *Mining Geophysics*. Elsevier, 1966.

Wedepohl, K. H. ed. *Hand Book of Geochemistry*. Springer-Verlag, Berlin, 1969.

Wyllie, M. R. J. *The Fundamentals of Well Log Interpretation*. 3rd ed. Academic, 1963.

25.0042 Engineering Geology

Introductory Geomechanics—Engineering classification, behaviour and tests of rocks and soils. Stress and strain: elasticity and plasticity, stress distribution in virgin rock masses about excavations and beneath foundations.

Hydrogeology—Hydrological cycle; aquifers: flow; relevant properties of rocks. Hydrogeological mapping and maps. Pollution of groundwater. Arid zone hydrology.

Environmental Geology—Geology in urban development and regional planning. Terrain evaluation and rehabilitation with special reference to beaches.

Site and Material Investigations—Methods and field tests. Petrography, physical and chemical properties of concrete aggregates, road and earth construction materials. Quarry sites and borrow areas.

Engineering Geology—Geology in civil engineering investigations. Geological factors in the design and construction of various civil engineering undertakings. Stability of slopes and open cuts.

TEXTBOOKS

Heath, R. C. & Trainor, F. W. *Introduction to Groundwater Hydrology*. Wiley, 1968.

Krynine, D. P. & Judd, W. R. *Principles of Engineering Geology and Geotechnics*. McGraw-Hill, 1957.

REFERENCE BOOKS

- Coates, D. F. *Rock Mechanics Principles. Mines Branch: Department of Energy, Mines and Resources, Canada.* 2nd ed. Queens Printer, Ottawa, 1970.
- Paige, S. ed. *The Applications of Geology to Engineering Practice.* Berkeley Volume: Geological Society of America. N.Y., 1950. (reprint 1958).
- Marshall, T. J. *Relations between Water and Soil.* British C'wlth. Agric. Bureaux, London, 1959.
- Stagg, K. G. & Zienkiewicz, O. C. *Rock Mechanics in Engineering Practice.* Wiley, 1968.
- Terzaghi, K. & Peck, R. B. *Soil Mechanics in Engineering Practice.* Wiley, 1948 (1960 reprint).

25.0043 Mineral Exploration

Mineral Exploration—Theory and application of exploration techniques, including geochemical prospecting and soil-gas geochemistry; remote sensing and radiometric surveys. Geological appraisal. "Proving" ore discoveries. Cost factors in exploration.

Structural Analysis—Advanced techniques in solving field and applied problems of rock deformation.

Petrogenesis—Advanced studies in the geochemistry of rock-forming minerals and in igneous and metamorphic petrogenesis; advanced petrofabrics.

TEXTBOOKS

- Lawrence, L. J. *Exploration and Mining Geology.* A.I.M.M., Melbourne, 1965.
- Spry, A. *Metamorphic Textures.* Pergamon, 1969.
- Turner, F. J. *Metamorphic Petrology.* McGraw-Hill, 1968.
- Turner, F. J. & Weiss, L. E. *Structural Analysis of Metamorphic Tectonites.* McGraw-Hill, 1963.

REFERENCE BOOKS

- Belousov, U. U. *Basic Problems in Geotectonics.* McGraw-Hill, 1962.
- Forrester, J. D. *Field and Mining Geology.* Wiley, 1946.
- Glover, J. J. E. ed. *The Archaean.* Spec. Pub. No. 3. Geol. Soc. Aust., 1971.
- McKinstry, H. E. *Mining Geology.* Prentice-Hall, New York, 1949.
- Mehnert, K. R. *Migmatites.* Elsevier, 1968.
- Pitcher, W. S. & Flinn, G. *Controls of Metamorphism.* Oliver & Boyd, 1965.
- Ramberg, H. *The Origin of Metamorphic and Metasomatic Rocks.* Chicago U.P., 1958.
- Ramsay, J. G. *Folding and Fracturing of Rocks.* McGraw-Hill, 1967.
- Whitten, E. H. T. *Structural Geology of Folded Rocks.* Rand McNally, 1966.
- Wilson, H. D. B. ed. *Magmatic Ore Deposits.* Soc. Econ. Geol. Monograph 4, 1969.

25.0044 Sedimentary Basins

Lectures, tutorials and a laboratory project in Advanced Sedimentology, Palaeontology, Palaeoecology and Petroleum Geology.

TEXTBOOKS

- Levorsen, A. I. *Geology of Petroleum.* 2nd ed. Freeman, 1967.
- Loeblich, A. R. & Tappan, H. *The Treatise on Invertebrate Palaeontology* —Part C. Protista. 1964 Geol. Soc. America, 1964.

REFERENCE BOOKS

- Carter, A. N. *Tertiary Foraminifera from Gippsland and their Stratigraphical Significance*. Geol. Surv. Vic., 1964.
- Haun, J. D. & Leroy, L. W. eds. *Subsurface Geology in Petroleum Exploration*. Colorado School of Mines, 1958.
- Weeks, L. G. *Habitat of Oil*. Amer. Assoc. Petroleum Geologists, 1958.
- Wopfner, H. & Douglas, J. G. *The Otway Basin of Southeastern Australia*. Geol. Surv., Vic. & S.A., 1971.

25.0045 Project

25.023 Geology III (Applied)

Clay Mineralogy—The structures and properties of the clay mineral groups. Techniques for their recognition. Clay-water systems and ion exchange. Some applied aspects of clay mineralogy. Laboratory work to illustrate the lecture course.

Economic Geology II—Case histories; discovery, exploration, exploitation. Procedures in marking and lodging claims, leases, various types of mining titles, obligations under mining Acts.

Fuels—Origin and distribution of coals. The type, rank and grade of coal. Coal petrography. Structural and stratigraphical occurrence of oil. Reservoir mechanics and reservoir assessment.

Geochemistry—Some modern methods of rock and mineral analysis. Accuracy, precision and quality of geochemical data. The distribution of elements in terrestrial rocks. Norms.

Geological Surveying (and Photogeology)—Part I offered by the School of Surveying: (see subject 29.441 Part A only) Part II contour surveying and structure contour techniques. Mining surveying. Hydrographic surveying. Basic principles of cartography. Theoretical elements of Photogrammetry, aerial photographs and maps. Photomosaics. Principles of photo-interpretation.

Mathematical Geology—Measurement scales and models, probability axioms, frequency distributions basic parametric and non parametric statistics, introduction to geostatistics and lognormal assay distributions, sampling procedures line and surface fitting and the analysis of mappable geological variates. Fortran programming exercises form an important part of this course.

Metamorphic Petrology—Metamorphic mineral assemblages, fabric. Experimental petrology, metamorphic reactions. Facies and facies series. Metamorphic mapping. Metamorphic petrology of Australia. Practical: Megascopic and microscopic examination of classic metamorphic rock suites. Mineral assemblages and fabric studies. Field Work: At least one field trip to study structural and mineral problems in metamorphic terrain.

Micropalaeontology—The morphology, taxonomy and stratigraphic distribution of the principal groups of microfossils. Practical: study and description of foraminifera, ostracoda, conodonts and plant microfossils, also certain examples of megafossils from the invertebrate phyla. Micropalaeontological techniques.

Mineragraphy—Reflected light optics-orthoscopic and conosopic, measurement of optical parameters in reflected light, microhardness and reflectivity-photometric and photoelectric measurements. Methods of ore mineral identification in reflected light. Microparagenesis and ore textures. Phase equilibrium studies. **Laboratory**—Mineragraphic preparations, polishing methods. Measurement of optical properties. Mineralogical and textural features of selected suites of ore minerals.

Sedimentary Petrology—The chemistry of weathering and soil formation. The chemically formed sedimentary rocks including the phosphates, zeolites, evaporites, ferruginous and siliceous deposits. The distribution of trace elements in sedimentary rocks.

Sedimentology—Methods of sediment analysis and sediment parameters. Laboratory flume experiments. Selected stratigraphic topics. Stratigraphic maps and stratigraphic photo-interpretation. Field tutorial project.

Field Work—will be held during the year. This includes a geological survey camp which will be held in the first session and ten days of field instruction. Attendance is compulsory.

TEXTBOOKS

Clay Mineralogy

Loughnan, F. C. *Chemical Weathering of Silicate Minerals*. American Elsevier.

Fuels

Levorsen, A. I. *Petroleum Geology*. Freeman, 1954.

Raistrick, H. & Marshall, C. E. *The Nature and Origin of Coal and Coal Seams*. E.U.P., 1952.

Geochemistry

Ahrens, L. H. *Distribution of the Elements in our Planet*. McGraw-Hill.

Zussman, J. ed. *Physical Methods in Determinative Mineralogy*. Academic, 1967.

Geological Surveying and Photogeology

Leuder, D. R. *Aerial Photographic Interpretation*. McGraw-Hill, 1959.

Mathematical Geology

Blatt, J. M. *Introduction to Fortran IV Programming*. Goodyear Publishing Co.

Koch, G. S. & Link, R. F. *Statistical Analysis of Geological Data*. Vol. II. Wiley, 1971.

Metamorphic Petrology

Joplin, G. *A Petrography of Australian Metamorphic Rocks*. A. & R., 1968.

Winkler, H. G. F. *Petrogenesis of Metamorphic Rocks*. 2nd ed. Springer, 1967.

Micropalaeontology

Glaessner, M. F. *Principles of Micropalaeontology*. M.U.P., 1955. Hafner reprinted 1963.

Mineragraphy

Edwards, A. B. *Textures of the Ore Minerals*. 2nd ed. A.I.M.M., 1954.

Sedimentary Petrology

Milner, H. B. *Sedimentary Petrography*. 4th ed. Arnold.

Sedimentology

Folk, R. L. *Petrology of Sedimentary Rocks*. Texas U.P., 1968.

REFERENCE BOOKS

Geochemistry

Wedepohl, K. H. *Handbook of Geochemistry*. Springer, 1969.

Mathematical Geology

Koch, G. S. & Link, R. F. *Statistical Analysis of Geological Data*. Vol. I. Wiley, 1970.

Krumbein, W. C. & Graybill, F. A. *An Introduction to Statistical Models in Geology*. McGraw-Hill, 1965.

Harbaugh, J. W. & Merriam, D. F. *Computer Applications in Stratigraphic Analysis*. Wiley, 1968.

Metamorphic Petrology

Mehnert, K. R. *Migmatites*. Elsevier, 1968.

Spry, A. *Metamorphic Textures*. Pergamon, 1969.

Turner, F. J. *Metamorphic Petrology*. McGraw-Hill, 1968.

Mineragraphy

Ramdohr, P. *Ore Minerals and their Textures*. Pergamon, 1969.

Hallimond, A. F. *Manual of the Polarizing Microscope*. Cooke, 1953.

Uytenbogaardt, W. *Tables for Microscopic Identification of Ore Minerals*. Princeton U.P.

Sedimentology

Griffiths, J. C. *Scientific Methods in Analysis of Sediments*. McGraw-Hill, 1967.

Clay Mineralogy

Mason, B. *Principles of Geochemistry*. 2nd ed. Wiley.

Geochemistry

Fyfe, W. S. *Geochemistry of Solids*. McGraw-Hill, 1964.

25.0303 Geology for Geomorphologists and Pedologists

Pre-requisites: Geoscience II A and B.

Clay Mineralogy—the structure and properties of clay minerals. Techniques for their recognition. Clay-water systems and ion exchange. Some applied aspects of clay mineralogy. Laboratory work to illustrate the above course.

Sedimentary Petrology—the chemistry of weathering and soil formation. The chemically formed sedimentary rocks including the phosphates, zeolites, evaporites, ferruginous and siliceous deposits. The distribution of trace elements in sedimentary rocks.

TEXTBOOKS

Loughnan, F. C. *Chemical Weathering of Silicate Minerals*. American Elsevier.

Milner, H. B. *Sedimentary Petrography*. 4th ed. Arnold.

25.101 Geology for Engineers I

Introduction to physical mineralogy. Silicate crystal structures. The rock forming minerals. Ore minerals. Clay minerals. Igneous activity, sedimentation and metamorphism. The texture and composition of igneous, sedimentary and metamorphic rocks. Weathering of rocks.

Structural geology—stratification, foliations. Folds, faults, joints. Introduction to structural analysis.

Introduction to geomorphology. Geomorphic mapping. Fluvial and coastal geomorphology.

Laboratory work will consist of exercises related to the lecture course. Two field tutorials will be held at which attendance is compulsory. Satisfactory reports must be submitted.

TEXTBOOK

Blyth, F. G. *Geology for Engineers*. 4th ed. 1960.

25.102 Geology for Engineers II

Mineralogy and Petrology—Crystalline state, crystal symmetry, crystal systems, physical and chemical properties of minerals, crystal optics, micropetrology. Occurrence and structures of igneous rocks, consolidation of magmas, igneous rock classification. Thermal and regional metamorphism. Composition and classification of sedimentary rocks, sedimentation and sedimentary environments, micropetrology. *Laboratory*: Hand specimen crystallography, mineralogy and petrology; thin section petrology.

Stratigraphy and Palaeontology—Principles and methods in stratigraphy; stratigraphy of selected geological provinces of Australia. Systematic Palaeontology—plants and invertebrates, stratigraphic palaeontology. Elementary structural geology. *Laboratory*: study of more common plant and animal fossils. Stratigraphic mapping.

Geophysics—An introduction to the basic principles of geophysics, and to the principles, methods and applications of geophysical exploration, viz. gravity, magnetic, electrical, seismic, radioactive and miscellaneous. Discussion of various physical properties of rocks.

Ore Deposits and Fuels—Nature and origin of ore deposits, ore magmas—synmagmatic, epimagmatic and post-magmatic processes. Submarine exhalative deposits. Sedimentary biogenetic deposits. Alluvial and residual deposits. Nonmetallic ores. Nature and origin of petroleum and coal. Coal seams, type and rank variation, coal petrology, coalfield geology. *Laboratory*: macroscopic study of ores and country rocks, ores in thin and polished sections.

Exploration and Mining Geology—As for 25.0043, Part III, Exploration and Mining Geology.

TEXTBOOKS

Rutley, F. *Rutley's Elements of Mineralogy*. Rev. Read, H. H. Murby, London.

Tyrrell, G. W. *Principles of Petrology: An Introduction to the Science of Rocks*. Methuen, London.

25.1021 Geology for Mining Engineers (BSc(Tech) and BSc (Eng))

An abridged version of 25.102.

Occurrence and structures of igneous rocks, consolidation of magmas, igneous rock classification. Thermal and regional metamorphism. Composition and classification of sedimentary rocks—sedimentary environments. Ore genesis, synmagmatic, epimagmatic and post-magmatic processes, volcanic exhalative deposits, sedimentary biogenetic deposits. Structural control of ore deposits. Alluvial deposits, non-metallic ores. Nature, origin and occurrence of coal and petroleum. Type and rank variation, coal petrology, coal-field geology. Geological evolution of the Australian continent from Pre-Cambrian to Recent times. Introductory geophysics—methods and applications. *Laboratory*: macroscopic and microscopic study of rocks and minerals. Ore mineralogy and mineralography. Coal petrology. Study of more common plant and animal fossils. Stratigraphic and other forms of geological mapping.

25.201 Mineralogy (Applied Science Course)

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.

TEXTBOOKS

Hurlbut, C. S. ed. *Dana's Manual of Mineralogy*. Wiley.

Rutley, F. *Rutley's Elements of Mineralogy*. Rev. by H. H. Read, Murby.

APPLIED GEOLOGY GRADUATE SUBJECTS

25.331G Applied Geophysics I

Seismic Methods—The theory, interpretation, application and practice of seismic exploration; the theory of seismic wave propagation, seismic reflection and refraction methods.

Electrical Methods—The theory, interpretation, application and practice of electrical galvanic and inductive methods; spontaneous potential, potential, resistivity, induced polarization and electromagnetic methods of exploration; theory, interpretation, application and practice of well-logging techniques.

Gravity and Magnetic Methods—The theory, interpretation, application and practice of gravimetric and magnetic methods of exploration.

25.332G Applied Geophysics II

Continuation of the seismic, electrical, gravity and magnetic methods as listed under Applied Geophysics I. Computer Applications.

Basic Geophysical Instrumentation and Other Geophysical Techniques—Basic instrumentation in seismic electrical and electromagnetic methods: Radioactivity, thermal and remote sensing techniques.

25.336G Elective Subjects

To be chosen from Computer Applications in Geological Analysis; Economic Geology; Photogeology; Petroleum Geology; Field Methods. This subject replaces 25.341G.

25.334G Applied Geophysics Project Assignment

A project involving interpretation of geophysical field data collected by the student.

TEXTBOOKS

Bhattacharya, P. K. & Patra, H. P. *Direct Current Geoelectric Sounding*. Elsevier, 1968.

Grant, F. S. & West, G. F. *Interpretation Theory in Applied Geophysics*. McGraw-Hill, 1965.

Keller, H. B. & Frischkenect, F. C. *Electrical Methods in Geophysical Prospecting*. Pergamon, 1966.

25.402G Hydrogeology

Surface and sub-surface methods of geological and geophysical investigation; well logging; lithology and structure of rocks in relation to groundwater storage and quality. Geological characteristics of aquifers. Hydrogeological maps. Hydrogeological systems analysis, including computer methods. Hydrogeology of arid and semi-arid zones. Groundwater resources evaluation. Case history studies. The laboratory work will include the study and interpretation of hydrogeological data. A field tutorial is included in the course.

TEXTBOOKS

Walton, W. C. *Groundwater Resource Evaluation*. McGraw-Hill.

Davis, S. N. & De Wiest, R. J. M. *Hydrogeology*. Wiley, 1966.

25.121G Engineering Geology

Design and execution of site investigation projects. Terrain evaluation. Discontinuities in rock masses; analysis, influence on engineering properties of rocks. Microfabric and microtexture of rocks. Residual tectonic stresses. Engineering classification and description of weathered rocks and soils. Discontinuities, anisotropy, and weathering in design and construction. Residual tectonic stress fields. The geological and geomorphic bases of slope stability analyses. Transmission of vibrations through rock and soil. Aseismic design. Laboratory work will be related to the lecture course.

TEXTBOOK

Ragan, R. *Structural Geology*. 2nd ed. Wiley, 1971.

REFERENCE BOOKS

References to recently published original papers will be given during the course.

25.404G Environmental Geology

Advanced terrain evaluation. Civil engineering works, extractive and mining industries and the environment. Reclamation and rehabilitation after extraction. Urban development, regional planning and geological environment. Sub-surface disposal of wastes. Groundwater pollution, chemical and biological. Rivers, harbours and beaches.

Laboratory work will include advanced studies in terrain evaluation and the studies of case histories. A field tutorial is included in the course.

REFERENCE BOOKS

Bell, G. et al. *Geology of the Melbourne District*. Geol. Surv. Vic. Bull. No. 59. 1967.

Detwyler, T. R. *Man's Impact on Environment*. McGraw-Hill.

Grant, K. *Terrain Classification for Engineering Purposes of the Melbourne Area, Victoria*. C.S.I.R.O. Div. App. Geomechanics Paper No. 11, 1972.

Griffin, R. J. *The Botany Basin*. Geol. Surv. N.S.W. Bull. No. 18.

25.701G Subsurface Geology and Pollution Control

Lithology of main rock types involved in subsurface waste disposal; mass properties of rocks affecting fluid flow, porosity, permeability, capillarity, etc., and their inter-relationships. Elements of structural geology, stratification, lenticularity, folding, faulting, unconformities etc.; use of structural contours in subsurface geology; interpretation of simple geological maps. Hydrostatic and hydrodynamic conditions in subsurface flow of liquids and gases; reservoir engineering topics, compressibility, rock pressure. Design and

cementation of casing strings; importance of preservation of subsurface waters, especially fresh water aquifers; rational exploitation of subsurface water for domestic and industrial use. Technology of subsurface disposal of wastes—liquid, gaseous and solid, including radioactive wastes. Some ethical considerations and statutory requirements of governmental bodies. Investigation of sedimentary basins and individual structures for waste injection. Case histories, e.g. Rocky Mountain Arsenal Well etc.

SCHOOL OF GEOGRAPHY

27.001 Applied Geography I

Introduces the physical basis of geography. Principles of meteorology. Climatic types and world climate patterns. Hydrologic cycle and water balance. Geologic and climatic factors in landforms and soils. Mass movement and slope form, river action and valley features. Concepts of landscape evolution. Coastal processes and forms. Soil properties, classes and distribution. Soils in the landscape. Spatial organization of plants and animals over the earth's surface and the processes underlying their organization. Characterization of plant communities and ecosystems. Composition, structure, dynamics and classification of vegetation and ecosystems. Vegetation dynamics and patterns. Land systems illustrating the interaction of physical and biological factors. Man as a geographic agent. Weather recording and analysis of climatic data. Use of maps and air-photos. Elementary map-making. Methods of describing soils, vegetation and land systems.

The course includes three compulsory one-day field tutorials.

TEXTBOOKS

- Barry, R. G. & Chorley, R. J. *Atmosphere, Water and Climate*. Methuen.
 Bridges, E. M. *World Soils*. C.U.P. Paperback.
 Corbett, J. R. *The Living Soil*. Martindale Press.
 Twidale, C. R. *Geomorphology*. Nelson. Paperback.
 Whittaker, R. H. *Communities and Ecosystems*. Macmillan. Paperback.

REFERENCE BOOKS

- Billings, W. D. *Plants, Man and the Ecosystem*. 2nd ed. Wadsworth. Paperback.
 Chorley, R. J. ed. *Water, Earth and Man*. Methuen.
 Commonwealth Bureau of Meteorology. *Manual of Meteorology*. Govt. Printer.
 CSIRO. *The Australian Environment*. M.U.P.
 Daubenmire, R. F. *Plants and Environment*. Wiley.
 Daubenmire, R. F. *Plant Communities*. Harper & Rowe.
 Lueder, D. R. *Aerial Photographic Interpretation, Principles and Applications*. McGraw-Hill.
 Odum, E. P. *Ecology*. Holt, Rinehart & Winston.
 Pettersen, S. *Introduction to Meteorology*. McGraw-Hill.
 Riley, D., and Young, A. *World Vegetation*. C.U.P.
 Shields, A. J. *Australian Weather*. Jacaranda.
 Stace, H. C. T. *A Handbook of Australian Soils*. Rellim.
 Strahler, A. N. *An Introduction to Physical Geography*. Wiley. Paperback.
 Thornbury, W. D. *Principles of Geomorphology*. Wiley.
 Tweedie, A. D. *Water and the World*. Nelson.

27.002 Applied Geography II

Part I (Session 1). *Introduction to Economic Geography*: The geographic problems of scale and distance. The relevance of theory and quantitative methods. Economic landscape systems. Patterns and structures of systems of agriculture, manufacturing and tertiary production. Geographic significance of population growth components in modernizing and advanced countries—natural increase, fertility and mortality patterns and internal and international migration. Includes an urban field tutorial of one day.

TEXTBOOKS

- Toyne, P. & Newby, P. T. *Techniques in Human Geography*. Macmillan. Paperback.
- Wilson, M. G. A. *Population Geography*. Nelson.

REFERENCE BOOKS

- Abler, R., Adams, J. S. & Gould, P. *Spatial Organisation*. Prentice-Hall.
- Chisholm, M. *Rural Settlement and Land Use*. Hutchinson.
- Clarke, J. L. *Population Geography*. Pergamon.
- Cooke, R. U. & Johnson, J. H. *Trends in Geography*. Pergamon. Paperback.
- Cox, K. R. *Man, Location and Behavior: An Introduction to Human Geography*. Wiley.
- Davies, W. K. D. ed. *The Conceptual Revolution in Geography*. Uni. of London Press.
- Demko, G. J., Schnell, G. A. & Rose, H. M. *Population Geography: A Reader*. McGraw-Hill.
- Dohrs, F. E. & Sommers, L. M. eds. *Introduction to Geography: Selected Readings*. Crowell. Paperback.
- Ehrlich, P. R. & A. H. *Population, Resources, Environment*. Freeman. Paperback.
- Haggett, P. *Geography: A Modern Synthesis*. Harper Internat. Paperback.
- Logan, M. I. & Missen, G. J. *New Viewpoints in Urban and Industrial Geography*. Reed Education.
- McCarty, H. H., & Lindberg, J. B. *A Preface to Economic Geography*. Prentice-Hall.
- Minshull, R. *The Changing Nature of Geography*. Hutchinson.
- Morgan, W. B. & Munton, R. J. C. *Agricultural Geography*. Methuen. Paperback.
- Morrill, R. L. *The Spatial Organisation of Society*. Wadsworth.
- Pollard, A. H. *Demography: An Introduction*. Pergamon.
- Rose, A. J. *Patterns of Cities*. Nelson.
- Taaffe, E. J. *Geography*. Prentice-Hall. Paperback.

Part II (Session 2). *Urban Systems*: The evolution of urban areas. Classification of cities. City size distribution and the urban hierarchy. Central place theory; urban interaction. The economic and social structure of urban areas. The problems of urban growth. Includes a field tutorial of up to three days.

REFERENCE BOOKS

- Abler, R., Adams, J. S. & Gould, P. *Spatial Organisation*. Prentice-Hall.
- Berry, B. *Geography of Market Centres and Retail Distribution*. Prentice-Hall.
- Berry, B. & Horton, F. E. *Geographic Perspectives on Urban Systems*. Prentice-Hall.
- Clarke, J. I. *Population Geography*. Pergamon.
- Clarke, J. I. *Population Geography and the Developing Countries*. Pergamon.
- Haggett, P. *Locational Analysis in Human Geography*. Arnold.
- Haggett, P., & Chorley, R. eds. *Integrated Models in Geography*. Methuen. Paperback.
- Haggett, P., & Chorley, R. eds. *Socio-economic Models in Geography*. Methuen.
- Johnson, J. H. *Urban Geography*. Pergamon.
- Johnston, R. J. *Urban Residential Patterns*. Bell.
- Logan, M. I. & Missen, G. T. *New Viewpoints in Urban and Industrial Geography*. Reed Education.

Rose, A. J. *Patterns of Cities*. Nelson.

Zelinsky, W. *A Prologue to Population Geography*. Prentice-Hall.

Part III. *Statistical Methods in Geography*: Laboratory classes throughout the year dealing with the application of statistical methods to geographic data. Descriptive statistics, sampling techniques, elementary probability, correlation, regression, significance-testing, and an introduction to non-parametric statistics.

REFERENCE BOOKS

Cole, J. P., & King, C. A. *Quantitative Geography*. Wiley.

Hoel, P. G. *Elementary Statistics*.

Huntsberger, D. V. & Billingsley, P. *Elements of Statistical Inference*. Allyn & Bacon.

King, L. J. *Statistical Analysis in Geography*. Prentice-Hall.

Toyne, P. & Newby, P. T. *Techniques in Human Geography*. Macmillan.

Yeomans, K. A. *Introductory Statistics: Statistics for the Social Scientist*. Vol. I. Penguin. Paperback.

Yeomans, K. A. *Applied Statistics: Statistics for the Social Scientist*. Vol. II. Penguin. Paperback.

This course includes two compulsory field tutorials, one of one day and one of three days' duration. These will involve study of the structure and function of an urban and/or industrial complex and its impact on the adjacent agricultural area.

27.013 Geographic Methods

Students projects based on instruction in research design, data sources, field methods; collection, classification and analysis of data. Includes an emphasis on multivariate techniques and computer library programmes.

REFERENCE BOOKS

Clawson, M. *Land Use Information*. Johns Hopkins U.P. Paperback.

Cole, J. P. & King, C. A. M. *Quantitative Geography*. Wiley.

Dixon, W. J. & Massey, F. J. *Introduction to Statistical Analysis*. McGraw-Hill. Paperback.

Jackson, J. N. *Surveys for Town and Country Planning*. Hutchinson. Paperback.

Kerlinger, R. *Foundations of Behavioural Research*. Holt, Rinehart & Winston.

King, L. J. *Statistical Analysis in Geography*. Prentice-Hall.

Lueder, D. R. *Aerial Photographic Interpretation*. McGraw-Hill.

Siegel, S. *Nonparametric Statistics for the Behavioural Sciences*. McGraw-Hill.

Veldman, D. J. *Fortran Programming for Behavioural Sciences*. Holt, Rinehart & Winston.

Ya-lun Chou. *Statistical Analysis with Business and Economic Applications*. Holt, Rinehart & Winston.

Yeates, M. H. *Introduction to Quantitative Analysis in Economic Geography*. McGraw-Hill.

27.103 Climatology

Components of the radiation and heat balance of the earth surface as affected by differing atmospheric, soil and surface cover conditions. Factors controlling evaporation and transpiration under freely-available and

restricted water supply conditions, and methods for the measurement and estimation of evapotranspiration. Characteristic patterns of energy and water exchange for differing types of natural or man-modified land surface. Man's modification of factors affecting the local climate in rural and urban settings.

Laboratory work is directed toward developing an appreciation of the operational principles and limitations of instruments commonly used in radiation and water balance studies. An introduction is given to the practical application of energy and water balance models for evaluation of the climatic environment as related to catchment hydrology, agricultural productivity and land resource management problems.

TEXTBOOKS

Miller, D. H. *A Survey Course. The Energy and Mass Budget at the Surface of the Earth*. Assoc. Amer. Geog.

Sellers, W. D. *Physical Climatology*. Chicago U.P.

REFERENCE BOOKS

Bradley, E. F. & Denmead, O. T. eds. *The Collection and Processing of Field Data*. Wiley.

Chang, Jen-Hu. *Climate and Agriculture*. Aldine.

Chorley, R. J. ed. *Water, Earth and Man*. Methuen.

Chow, Ven Te. ed. *Handbook of Applied Hydrology*. McGraw-Hill.

Crowe, P. R. *Concepts in Climatology*. Longman.

Gates, D. H. *Energy Exchange in the Biosphere*. Harper & Row.

Landsberg, H. E. ed. *World Survey of Climatology. Vol. 2, General Climatology*. Elsevier.

Munn, R. E. *Biometeorological Methods*. Academic, N.Y., 1970.

Platt, R. B. & Griffiths, J. F. *Environmental Measurements and Interpretation*. Reinhold.

Reifsnyder, W. E. & Lull, H. W. *Radiant Energy in Relation to Forests*. U.S.D.A. Tech. Bull. 1344.

Rose, C. W. *Agricultural Physics*. Pergamon.

Shapley, H. ed. *Climatic Change*. Harvard U.P.

Slatyer, R. O. & McIlroy, I. C. *Practical Microclimatology*. CSIRO.

Waggoner, P. E. et al. *Agricultural Meteorology. Vol. 6 Meteorological Monographs*. Amer. Meteor. Soc.

World Meteorological Organization. *Guide to Meteorological Instrument and Observing Practices*. W.M.O. Secretariat.

27.104 Bioclimatology

Energy exchange between organism and environment in typical habitats of distinctive plant communities. Characteristics of water balance components as related to plant community attributes and meteorological factors. Wind profiles and aerodynamic characteristics as affected by height, density and structure of plant communities. The soil microclimate: thermal and moisture characteristics, soil aeration properties; their relation with biological processes. Periodic biological phenomena as related to climate (phenology), and climatic factors in the migration of organisms and the transport of insects, spores and pathogens. Development of analytical models for improved understanding of organism environment relationships, and stimulation models for assessment of plant growth and development under variable weather conditions.

Laboratory work consists of measurements and observations of the aerial and soil microclimate and interpretation of environmental data for purposes of bioclimatic assessment and classification.

REFERENCE BOOKS

- Bear, F. E. *Soils in Relation to Crop Growth*. Reinholdt, N.Y., 1965.
- Black, C. A. *Soil-Plant Relationships*. 2nd ed. Wiley, N.Y., 1968.
- Buckman, H. O. & Brady, N. C. *The Nature and Property of Soils*. 7th ed. Macmillan, London, 1969.
- Hillel, D. ed. *Optimising the Soil Physical Environment Toward Greater Crop Yields*. Academic, 1972.
- Kozlowski, T. T. ed. *Water Deficits and Plant Growth*. Vols. I & II. Academic, 1968.
- Lowrey, W. P. *Biometeorology*. Oregon State Univ. Press, 1968.
- Lowrey, W. P. *Weather and Life*. Academic, 1970.
- Munn, R. E. *Biometeorological Methods*. Academic, 1970.
- Pierre, W. H. et al. *Plant Environment and Efficient Water Use*. Amer. Soc. of Agron. & Soil, 1966.
- Shaw, R. H. *Ground Level Climatology*. Amer. Assoc. Adv. Sci., 1967.
- Taylor, S. A. & Ashcroft, G. L. *Physical Edaphology*. Freeman.
- UNESCO. *Agroclimatological Methods*. Symp. on Methods in Agroclimatology, 1966. Univ. of Reading, 1968.
- UNESCO. *Plant Response to Climatic Factors*. Proc. Uppsala Symp., 1970. 1973.
- Van Wijk, W. R. ed. *Physics of Plant Environment*. North Holland, Amsterdam, 1966.
- Waggoner, P. E. et al. *Agricultural Meteorology*. Amer. Meteorol. Soc., 1965.
- W.M.O. *Guide to Agricultural Meteorological Practices*. World Meteorological Organisation, 1963.

27.113 Urban Geography

The city and the urban region as elements of the wider urban system. These elements are viewed from three distinct perspectives; static, connectivity of parts and dynamic process. Topics of particular relevance include temporal modes of explanation spatial interaction and diffusion processes within urban systems and spatial decision making in normative and behavioural contexts. The course is an extension of 27.002 Applied Geography II, Part II.

REFERENCE BOOKS

- Bourne, L. S. *Internal Structure of the City: Readings on Space and Environment*. O.U.P.
- Brown, L. A. *Diffusion Dynamics*. C. W. K. Gleerup.
- Carter, H. *The Study of Urban Geography*. Arnold.
- Berry, B. J. L. ed. *City Classification Handbook: Methods and Applications*. Wiley.
- Chapin, F. S. *Urban Land Use Planning*. Univ. of Illinois Press.
- Chapin, F. S. & Weiss, S. F. *Urban Dynamics*. Wiley.
- Chorley, R. J. & Haggett, P. *Models in Geography*. Methuen.
- English, P. W. & Mayfield, R. C. *Man, Space and Environment*. O.U.P.
- McConnell, H. & Yaseen, D. W. *Perspectives in Geography I: Models of Spatial Variation*. Northern Illinois U.P.
- Meier, R. L. A. *Communication Theory of Urban Growth*. Joint Center for Urban Studies of M.I.T. and Harvard.
- Morrill, R. L. *Migration and the Spread and Growth of Urban Settlement*. C. W. K. Gleerup.
- Perloff, H. S. & Wingo, L. *Issues in Urban Economics*. Johns Hopkins Press.
- Sweet, D. *Models of Urban Structure*. Aust. & New Zealand Book Co.
- Thompson, W. *Preface to Urban Economics*. Johns Hopkins Press.

27.123 Social Geography

The relationship of spatial and social structures in rural and urban contexts. Emphasis on social processes producing spatial patterns, with themes such as community, social networks and innovation adoption and diffusion. A problem-oriented approach to topics including modernization of the peasantry, urbanization, social deprivation and segregation of minorities, and the results of social area studies. Cultural influences in the rate and form of urbanization. Rurality and urbanism as ways of life. Relation of overseas experience to Australian society.

Laboratory sessions will include census data handling, questionnaire construction, interviewing, participant observation and other unobtrusive techniques.

REFERENCE BOOKS

- Burnley, I. H. ed. *Urbanisation in Australia*. C.U.P.
 Butterworth, E. *Minority Groups*. Longman.
 Clout, H. D. *Rural Geography*. Pergamon.
 Davies, A. F. & Encel, S. eds. *Australian Society*. Cheshire.
 Frankenberg, R. *Communities in Britain*. Penguin.
 Franklin, S. H. *The European Peasantry: the Final Phase*. Methuen.
 Franklin, S. H. *Rural Societies (in Contemporary Europe)*. Macmillan.
 Hagerstrand, T. *Innovation Diffusion as a Spatial Process*. Chicago U.P.
 Johnston, R. J. *Urban Residential Patterns*. Bell.
 Jones, E. *A Social Geography of Belfast*. Methuen.
 Jones, C. E. *Rural Life*. Longman.
 Kluckhohn, F. R. & Strodtbeck, F. *Variations in Value Orientations*. Petersen, Illinois.
 Lancaster-Jones, F. *Dimensions of Urban Social Structure*. A.N.U.P.
 McGee, T. G. *The South-East Asian City*. Bell.
 Mitchell, C. ed. *Social Networks in Urban Situations*. Manchester U.P.
 Morrill, R. L. & Wohlenberg, E. H. *The Geography of Poverty in the U.S.A.*
 Pahl, R. E. *Patterns of Urban Life*. Longman.
 Rapoport, A. ed. *Australia as Human Setting*. A. & R.
 Rose, H. M. *The Black Ghetto*. McGraw-Hill.
 Rowley, C. D. *The Destruction of Aboriginal Society*. A.N.U.P.
 Stoberg, G. *The Pre-Industrial City*. Free Press.
 Smith, D. M. *The Geography of Social Well-Being in the U.S.A.* McGraw-Hill.
 Theodorson, G. *Human Ecology*. Row Peterson.
 Timms, D. W. *The Urban Mosaic*. C.U.P.
 Wagner, P. & Mikesell, M. *Readings in Cultural Geography*. Prentice-Hall.
 Wagner, R. *Environments and Peoples*. Prentice-Hall.
 Wheatley, P. *The Pivot of the Four Quarters*. Aldine, Chicago.

27.124 Geographic Thought and Perspectives

A series of seminars throughout the year on the development of geographic thought and ideas. The seminars will cover in the first session the major geographic traditions and in the second, emergent theories related to students' special interests.

27.203 Biogeography

Ecosystems, their structure and dynamics. Energy flow and biogeochemical cycles. Comparative photosynthetic capacity of plants. Productivity, exploitation, pollution, management and conservation of ecosystems. Man as an ecological agent.

Quantitative sampling, measurement and description of vegetation. Spatial distribution (pattern) of individual species. Association between species.

Ecology of tropical and sub-tropical regions with special reference to Australia. Floristic composition, structure and physiognomy of the principle vegetation formations of Australia (rain forest, woodland, shrubland, heath and grasslands). Geographical affinities of component species. Environmental and biotic controls. Adaptations of plants to humid and arid conditions. Vegetation management under humid and arid conditions.

Fieldwork forms an integral part of the course.

TEXTBOOKS

Kershaw, K. A. *Quantitative and Dynamic Ecology*. Arnold, 1964.
Odum, E. P. *Fundamentals of Ecology*. 3rd ed. Saunders, 1971.

REFERENCE BOOKS

- Anderson, R. H. *The Trees of New South Wales*. N.S.W. Govt. Printer.
Barnard, C. *Grasses and Grasslands*. Macmillan, 1964.
Beadle, N. C. W., Evans, O. D. & Carolin, R. L. *Flora of the Sydney District*. Reed.
Curtis, J. T. *The Vegetation of Wisconsin: an Ordination of Plant Communities*. Madison, 1959.
Darlington, P. J. *Biogeography of the Southern End of the World*. Harvard U.P.
Elton, C. S. *The Ecology of Invasions by Animals and Plants*. Methuen, 1958.
Eyre, S. R. *Vegetation and Soils. A World Picture*. 2nd ed. Arnold, 1968.
Eyre, S. R. ed. *World Vegetation Types*. Macmillan, 1971.
Hutchinson, J. *The Families of Flowering Plants*. Vols. I & II. O.U.P.
Keast, A., Crocker, R. L. & Christian, C. S. eds. *Biogeography and Ecology in Australia*. Monographiae Biologicae. Vol. 8. W. Junk.
Lazarides, M. *The Grasses of Central Australia*. A.N.U.P., 1970.
Leper, C. W. *The Australian Environment*. M.U.P.
Lemee, G. *Précis de Biogéographie*. Masson, Paris, 1967.
Moore, R. M. ed. *Australian Grasslands*. A.N.U.P.
Odum, E. P. *Ecology*. Holt, Rinehart & Winston, 1963.
Quezel, P. *La Végétation du Sahara*. Fischer-Verlag. Stuttgart, 1966.
Richards, P. W. *The Tropical Rain Forest*. C.U.P., 1952.
Schnell, R. *Introduction à la Phytogéographie des Pays Tropicaux*. Vols. I and II. Gauthier-Villars. Paris, 1970.
Slatyer, R. O. & Perry, R. A. eds. *Arid Lands of Australia*. A.N.U.P.
Udvardy, M. D. F. *Dynamic Zoogeography*. Van Nostrand Reinhold, 1969.
Walter, H. *Ecology of Tropical and Subtropical Vegetation*. Mueller-Dombois, D. trans. Oliver & Boyd, 1972.
Walter, H. *Die Végétation der Erde*. In *Oko-Physiologischer Betrachtung*. Vols. I (2nd ed.) and II. Jena, 1964 and 1968.
Watts, D. *Principles of Biogeography*. McGraw-Hill.

27.204 Advanced Biogeography

Taxonomic biogeography. Variation and delimitation of species. Dispersal, distribution and discontinuities of taxa. Endemic and relict species. Geological, ecological and biotic determinants of species distributions. Biotic regions and the problem of their reality and definition. Oceanic islands, evolution and biogeographic theory.

Community biogeography. Quantitative analysis of vegetation. Variation and delimitation of communities. Survey, classification, ordination and mapping of vegetation. Correlation with environment. Identification of environmental and other controls determining the distribution of vegetation and of individual component species.

Aspects of applied biogeography. Assessment and management of natural resources. Conservation of ecosystems. Use of vegetation in ground water, mineral and geological survey and exploration in Australia. Medical geography and human ecology. The role of statistics in the study and utilization of biogeographical variation and covariation.

Two field tutorials: a field project of about one week to investigate plant communities in a selected environment and a two-day excursion for comparative study of a contrasting environment.

TEXTBOOKS

- Good, R. *The Geography of the Flowering Plants*. 3rd ed. Longman, 1964.
 Greig-Smith, P. *Quantitative Plant Ecology*. 2nd ed. Butterworths, 1964.
 Usher, M. *Biological Management and Conservation: Ecological Theory, Application, Planning*. Chapman & Hall, 1972.

REFERENCE BOOKS

- Brooks, R. R. *Geobotany and Biogeochemistry in Mineral Exploration*. Harper & Row, 1972.
 Commoner, B. *The Closing Circle: Nature, Man and Technology*. Knopf, 1971.
 Curtis, J. T. *The Vegetation of Wisconsin: an Ordination of Plant Communities*. Madison, 1959.
 Duffey, E. & Watt, A. S. eds. *The Scientific Management of Animal and Plant Communities for Conservation*. Blackwell. Oxford, 1971.
 Jeffers, J. N. R. *Mathematical Models in Ecology*. Blackwell, Oxford, 1972.
 Kershaw, K. A., *Quantitative and Dynamic Ecology*. Arnold, 1964.
 Lemee, G. *Précis de Biogéographie*. Masson. Paris, 1967.
 May, J. M. *The Ecology of Human Disease*. M.D. Publications, N.Y., 1958.
 Spedding, C. R. W. *Grassland Ecology*. O.U.P., 1972.
 Stamp, L. D. *Some Aspects of Medical Geography*. O.U.P., 1964.
 Watt, K. E. F. *Ecology and Resource Management: a Quantitative Approach*. McGraw-Hill, 1968.

27.303 Transportation Geography

Includes the structure of transportation systems, for example modal systems, network and flow analysis, communication and circulation theories, and the analysis of specific problems, for example transport and economic development and highway impact studies. Laboratory classes include case studies and practical applications.

REFERENCE BOOKS

- Bunge, W. *Theoretical Geography*. Lund Studies in Geography.
 Chorley, R. & Haggett, P. *Socio-economic Models in Geography*. Methuen.
 Haggett, P. *Locational Analysis in Human Geography*. Arnold.
 Haggett, P. *Network Analysis*. Arnold.
 Kansky, K. J. *Structure of Transportation Networks*. University of Chicago, Dept. of Geography. Research Paper No. 84.
 Mayer, J., Kain, J. F. & Wohl, M. *Urban Transportation Problems*. Harvard U.P.
 Owen, W. *Strategy for Mobility*. Brookings.
 Smith, R. H. T., Taaffe, E. & King, L. eds. *Readings in Economic Geography*. Rand McNally.
 Taaffe, E. & Gauthier, W. *Geography of Transportation*. Prentice-Hall.

27.304 Advanced Economic Geography

Analytical approaches to the study of the space economy with emphasis on the spatial problems of economic growth and development. Problems raised are viewed from a planning perspective.

TEXTBOOK

Richardson, H. *Regional Economics*. Weidenfeld & Nicolson.

REFERENCE BOOKS

- Friedmann, J. *Regional Development Policy*. M.I.T. Press.
 Friedmann, J. & Alonso, W. *Regional Development and Planning*. M.I.T. Press.
 Goodall, B. *The Economics of Urban Areas*. Pergamon.
 Hoover, E. *An Introduction to Regional Economics*. Knopf.
 Isard, W. *Methods of Regional Analysis*. M.I.T. Press.
 Nourse, H. O. *Regional Economics*. McGraw-Hill.
 Perloff, H. S. et al. *Regions, Resources and Economic Growth*. Johns Hopkins U.P.
 Siebert, H. *Regional Economic Growth: Theory and Policy*. Int. Textbook Co.
 Smith, R. H. T., Taaffe, E. & King, L. *Readings in Economic Geography*. Rand McNally.
 Thompson, W. *A Preface to Urban Economics*. Johns Hopkins U.P.

27.313 Location Theory

Classical and more recent adaptations of location theory. Consideration of external economies. City and regional structure. Spatial competition and patterns of location. Emphasis on an examination of the effects of the spatial distribution of resources and markets on the locational equilibrium of the firm. Decision theory relevant to location.

TEXTBOOK

Richardson, H. W. *Regional Economics*. Weidenfeld & Nicolson.

REFERENCE BOOKS

- Brown, L. A. *Diffusion Processes—Location*. Reg.Sci.Res.Inst.Bib. Series 4.
 Christaller, W. *Central Places in Southern Germany*. Prentice-Hall.
 Greenhut, M. *Plant Location in Theory and Practice*. N. Carolina U.P.
 Hoover, E. *Location of Economic Activity*. McGraw-Hill.
 Isard, W. *Location and Space Economy*. Wiley.
 Karaska, G. J. & Bramhall, D. F. eds. *Locational Analysis for Manufacturing: A Selection of Readings*. M.I.T. Press.

- Lloyd, P. E. & Dicken, P. *Location in Space: A Theoretical Approach to Economic Geography*. Harper & Row.
 Lösch, A. *Economics of Location*. Wiley.
 Pred, A. *Behaviour and Location*. Lund U.P.
 Smith, D. *Industrial Location*. Wiley.
 Smith, R. H. T., Taaffe, E. & King, L. eds. *Readings in Economic Geography*. Rand McNally.
 Stevens, B. & Brackett, C. *Industrial Location—Bibliography*. Reg.Sci. Res.Inst.
 Weber, A. *Theory of Location of Industries*. Chicago U.P.

27.323 Marketing Geography

Organisation and operation of the marketing system including the optimal location of consumer orientated enterprises and the analysis of market areas. Spatial behaviour of consumers in the market for various goods and services, with emphasis upon consumer search and decision processes.

TEXTBOOKS

- Engel, J. F., Kollatt, D. T. & Blackwell, R. D. *Consumer Behaviour*. Holt, Rinehart & Winston.
 Scott, P. *Geography and Retailing*. Hutchinson. Paperback.

REFERENCE BOOKS

- Arndt, J. ed. *Insights into Consumer Behaviour*. Allyn & Bacon.
 Bartels, R. *The Development of Marketing Thought*. Irwin.
 Berry, B. J. L. *Geography of Market Centres and Retail Distribution*. Prentice-Hall.
 Berry, B. J. L. *Commercial Structure and Commercial Blight*. University of Chicago, Dept. of Geography, Research Paper No. 85.
 Brush, J. E. & Gauthier, H. L. *Service Centres and Consumer Trips*. University of Chicago, Dept. of Geography, Research Paper No. 113.
 Bucklin, L. P. *Shopping Patterns in an Urban Area*. Inst. of Business and Econ. Research, University of Calif., Berkeley.
 Carman, J. M. *The Application of Social Class in Market Segmentation*. Inst. of Business & Economic Research, University of California, Berkeley.
 Clarkson, G. P. *The Theory of Consumer Demand*. Prentice-Hall.
 English, P. W. & Mayfield, R. C. *Man, Space and Environment*. O.U.P. Paperback.
 Garner, B. J. *The Internal Structure of Retail Nucleations*. Northwestern University Studies in Geography, No. 12.
 Jenkins, J. R. G. *Marketing and Customer Behaviour*. Pergamon, Paperback.
 Kane, B. J. *A Systematic Guide to Supermarket Location Analysis*. Fairchild Publications.
 Lewis, E. H. *Marketing Channels: Structure and Strategy*. McGraw-Hill. Paperback.
 Myers, J. G. *Consumer Image and Attitude*. Inst. of Business and Econ. Research, University of Calif., Berkeley.
 Revzan, D. *Wholesaling in Marketing Organisation*. Wiley.
 Ryan, J. K. et al. *New Dimensions in Retailing: A Decision Oriented Approach*. Wadsworth. Paperback.
 Simmons, J. *The Changing Pattern of Retail Location*. University of Chicago, Dept. of Geography, Research Paper No. 92.
 Vance, J. E. *The Merchant's World: The Geography of Wholesaling*. Prentice-Hall.

27.333 Agricultural Geography

Spatial patterns of agriculture as the result of individual and group decisions. Physical, economic, political and other cultural factors involved in origin and change of agricultural landscapes. Innovation diffusion as the process of farming change. Planning in rural areas. Examples will be drawn mainly from Australasia and Western Europe. Problems of modernizing agriculture in underdeveloped countries.

TEXTBOOKS

Morgan, W. B. & Munton, R. J. C. *Agricultural Geography*. Methuen. Paperback.

Gregor, H. F. *Geography of Agriculture: Themes in Research*. Prentice-Hall. Paperback.

REFERENCE BOOKS

Anderson, R. *Crisis on the Land*. Sun Books. Paperback.

Ashton, J. & Long, W. H. eds. *The Remoter Rural Areas of Britain*. Oliver & Boyd.

Barlowe, R. *Land Resource Economics*. Prentice-Hall.

Chisholm, M. *Rural Settlement and Land Use*. Hutchinson.

Clout, H. *Rural Geography*. Pergamon.

Clout, H. *Agriculture (in Contemporary Europe)*. Macmillan. Paperback.

Coppock, J. T. *An Agricultural Geography of Great Britain*. Bell.

Cox, K. R. & Golledge, R. G. *Behavioral Problems in Geography*. Northwestern University Study in Geography No. 17, 1969.

Found, W. C. *A Theoretical Approach to Rural Land Use Patterns*. Arnold.

Franklin, S. H. *Rural Societies (in Contemporary Europe)*. Macmillan. Paperback.

Green, R. J. *Country Planning*. Manchester U.P.

Hagerstrand, T. *Innovation Diffusion as a Spatial Process*. Chicago U.P.

Hudson, J. *Diffusion Research in Geography*. Northwestern University Studies in Geography No. 19, 1972.

Leagans, J. P. & Loomis, C. P. eds. *Behavioral Change in Agriculture*. Cornell U.P.

*Meinig, D. W. *On the Margins of the Good Earth*. Seal Books.

Pred, A. *Behavior and Location, Parts I and II*. Lund University Studies in Geography 27 and 28, 1967 and 1969.

Rogers, E. M. & Shoemaker, F. *Communication of Innovations*. Free Press.

Throsby, C. D. ed. *Agricultural Policy*. Penguin.

Williams, D. B. ed. *Agriculture in the Australian Economy*. Sydney U.P.

*Required preliminary reading.

27.413 Geomorphology

Fluvial processes and valley features. Hillslopes and slope mantles. Coastal, volcanic, structural and neotectonic landforms. Case studies illustrating approaches to geomorphic investigations. Classification and mapping of landforms, including airphoto interpretation. Morphometry. Laboratory study of aeolian, fluvial, beach and colluvial materials.

TEXTBOOKS

Bird, E. F. C. *Coasts*. A.N.U.P.

Morisawa, M. *Streams: their Dynamics and Morphology*. McGraw-Hill.

REFERENCE BOOKS

- Allen, J. R. L. *Physical Processes of Sedimentation*. Unwin.
 Brunsden, D. ed. *Slopes Form and Process*. Inst. Brit. Geographers.
 Chorley, R. G. ed. *Spatial Analysis in Geomorphology*. Methuen.
 Chorley, R. J. ed. *Water, Earth and Man*. Methuen.
 Doornkamp, J. C. & King, C. A. M. *Numerical Analysis in Geomorphology*. Arnold.
 Dury, G. H. *Rivers and River Terraces*. Macmillan.
 Dury, G. H. ed. *Essays in Geomorphology*. Heinemann.
 Jennings, J. N. *Karst*. A.N.U.P.
 Jennings, J. N. & Mabbutt, J. A. ed. *Landform Studies from Australia and New Guinea*. A.N.U.P.
 King, C. A. M. *Beaches and Coasts*. Arnold.
 King, C. A. M. *Techniques in Geomorphology*. Arnold.
 Leopold, L. B., Wolman, M. G. & Miller, J. P. *Fluvial Processes in Geomorphology*. Freeman.
 Miller, V. C. *Photogeology*. McGraw-Hill.
 Ollier, C. *Volcanoes*. A.N.U.P.
 Selby, M. J. *Slopes and Slope Processes*. N.Z. Geog. Soc. (Waikato Branch).
 Steers, A. J. ed. *Introduction to Coastline Development*. Macmillan.
 Thornbury, W. D. *Principles of Geomorphology*. Wiley.
 Twidale, C. R. *Structural Landforms*. A.N.U.P.
 Young, A. *Slopes*. Oliver & Boyd.

27.423 Pedology

History of Pedology. Morphological, physical and chemical properties of soil. Soil forming processes; rock weathering, silicate formation. Great Soil Groups; soil classification; soil-landscape relations and periodicity. Physical and chemical aspects of soil fertility; nutrient cycles; soil microbiology. Laboratory classes upon the measurement of soil properties; soil profile description; soil survey and mapping; analysis of soil maps. Up to four days field tutorials are an essential part of the course.

TEXTBOOKS

- Bridges, E. M. *World Soils*. C.U.P.
 Corbett, J. R. *The Living Soil*. Martindale.

REFERENCE BOOKS

- Alexander, M. *Introduction to Soil Microbiology*. Wiley.
 Baver, L. D. *Soil Physics*. Wiley.
 Bear, F. E. ed. *The Chemistry of the Soil*. Arnold.
 Bear, F. E. *Soil in Relation to Crop Growth*. Reinhold.
 Black, C. A. ed. *Soil-plant Relationships*. Wiley.
 Buckman, H. O. & Brady, N. C. *The Nature and Properties of Soils*. Macmillan.
 Clarke, G. C. & Beckitt, P. H. T. *The Study of the Soil in the Field*. O.U.P.
 Northcote, K. H. *A Factual Key for the Recognition of Australian Soils*. Rellim.
 Piper, C. S. *Soil and Plant Analysis*. Adelaide U.P.
 Rose, C. W. *Agricultural Physics*. Pergamon.
 Russell, E. W. *Soil Conditions and Plant Growth*. Longman.
 Stace, G. T. et al. *A Handbook of Australian Soils*. Rellim.

27.404 Advanced Geomorphology and Pedology

The monitoring of process and change in, and application of model studies to hillslope, shoreline, fluvial and dune environments. Glacial and periglacial geomorphology. Absolute dating of landform and soils and determination of rates of denudation and pedogenesis. Soil erosion and its control. The history of geomorphology and pedology, and related current problems. Soil stratigraphy, mineralogy, micro-morphology and fabric analysis. Laboratory classes include the study of correlative sediments, soils, and depositional environments, soil mineralogy and soil physical properties. A field tutorial of about one week before the beginning of first session traversing geomorphic and pedologic environments in south-eastern Australia.

TEXTBOOK

Folk, R. L. *Petrology of Sedimentary Rocks*. Hemphills.

REFERENCE BOOKS

Allen, J. R. L. *Physical Process of Sedimentation*. Unwin.

Bagnold, R. A. *The Physics of Blown Sand and Desert Dunes*. Methuen.

Black, C. A. et al. *Methods of Soil Analysis*. Amer. Soc. Agronomy.

Brewer, R. *Mineral and Fabric Analysis of Soils*. Wiley.

Chorley, R. J., Dunn, A. J. & Beckinsale, R. F. *The History of the Study of Landforms*. Methuen.

Davies, J. L. *Landforms in Cold Climates*. A.N.U.P.

Doornkamp, J. C. & King, C. A. M. *Numerical Analysis in Geomorphology*. Arnold.

Embleton, C. & King, C. A. M. *Glacial and Periglacial Geomorphology*. Arnold.

Flint, R. F. *Glacial and Quaternary Geology*. McGraw-Hill.

Grim, R. E. *Clay Mineralogy*. McGraw-Hill.

King, C. A. M. *Beaches and Coasts*. Arnold.

King, C. A. M. *Techniques in Geomorphology*. Arnold.

Leopold, L. B., Wolman, M. G. & Miller, J. P. *Fluvial Processes Geomorphology*. Freeman.

Loughnan, F. C. *Chemical Weathering of Silicate Minerals*. Elsevier.

Mascon, B. *Principles of Geochemistry*. Wiley.

Ollier, C. D. *Weathering*. Oliver & Boyd.

Stace, G. T. et. al. *A Handbook of Australian Soils*. Rellim.

Tricort, J. *Geomorphology of Cold Environments*. Macmillan.

27.414 Advanced Geomorphology*

The history of geomorphology and the development of geomorphic thought. The application of model studies and the monitoring of process and change in hillslope, shoreline, fluvial or dune environments. Studies of correlative sediments. Absolute dating of landforms and determination of rates of denudation with special reference to Australian geochronology. Applied geomorphology. There will be supporting laboratory and tutorial classes, and a field tutorial of about one week before the beginning of first session, traversing geomorphic environments in south-eastern Australia.

27.424 Advanced Pedology*

Experimental pedology including clay mineral transformations and micromorphology. Soil physical and chemical properties; their interrelation-

* Not to be offered in 1974.

ships, including physical and chemical stability of soil aggregates, soil water and its movement, soil strength. Soil erosion and its control. Modern techniques of mapping and classifying soil; land assessment. Practical applications of soil studies to environmental problems.

27.504 Projects in Applied Geography

Biogeography and Bioclimatology: study of the vegetation in an area, and detailed consideration of a problem arising from this survey, preferably with an applied aspect, or a study of the climate of some well defined plant or animal habitat as related to characteristics of the vegetative cover and substrate. *Economic Geography*: a problem in applied economic geography involving experimental design, the acquisition and manipulation of field data, and the presentation of a report. *Geomorphology and pedology*: an area study introducing soils-landscape relationships in a dynamic or chronologic sense; or a systematic study which may be primarily geomorphic or pedologic, but with some interdisciplinary aspect.

To include a field element and a supporting laboratory programme.

GEOGRAPHY GRADUATE SUBJECTS

27.901G Geomorphology for Hydrologists

Geomorphological controls in the initiation of drainage systems. Drainage networks as geomorphological systems. Types of drainage channel. River floodplains and terraces. Drainage systems of arid regions. Geomorphology of representative basins and vigil catchments. Geomorphology in the assessment of water resources. Landforms produced by underground water. Airphoto and map analyses of drainage features and map and field study of a vigil catchment.

TEXTBOOKS

- Leopold, L. B. Wolman, M.G., and Miller, J. P. *Fluvial Processes in Geomorphology*. Freeman.
 Thornbury, W. D. *Principles of Geomorphology*. International edition. Wiley.

REFERENCE BOOKS

- Chorley, R. J. ed. *Spatial Analysis in Geomorphology*. Methuen, 1972.
 Chorley, R. J. & Kennedy, B. A. *Physical Geography — A Systems Approach*. Prentice-Hall, 1971.
 Chow, Ven Te. *Handbook of Applied Hydrology*. McGraw-Hill.
 Dury, G. H. ed. *Rivers and River Terraces*. Macmillan.
 Jennings, J. B. *Karst*. A.N.U.P., 1971.
 King, C. A. M. *Techniques in Geomorphology*. Arnold.
 Mabbutt, J. A. et al. *Lands of the Wiluna-Meekatharra Area, Western Australia*. CSIRO Land.Res. Series No. 7.
 Stewart, G. A. ed. *Land Evaluation*. Macmillan, 1968.

27.902G Meteorological and Hydrological Principles

Part I. *Meteorology*: Heat and water balances of earth-atmosphere system. Global pressure, wind and climatic patterns. Atmospheric stability; temperature inversions; aerological diagrams. Synoptic and local wind

systems; dispersal of atmospheric pollutants under various conditions of stability and wind. Precipitation and precipitation fallout. Weather forecasting with particular reference to forecasting pollution potential.

Part II. *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.

REFERENCE BOOKS

- Commonwealth Bureau of Meteorology. *Manual of Meteorology*, 1966.
Shields, A. J. *Australian Weather*. Jacaranda.
Chow, Ven Te. *Handbook of Applied Hydrology*. McGraw-Hill.
Bruce, J. P. & Clark, R. H. *Introduction to Hydrometeorology*. Pergamon.
Proceedings of Clean Air Conference, 1965. N.S.W.U.P.

27.903G Geographic Background to Pollution Problems

Interactions between topographic, climatic and hydrologic factors in relation to urbanization and pollution. Soil formation, erosion and fertility. Ecological stability and sensitivity to land use. Economic and social implications of pollution.

REFERENCE BOOKS

- Chow, Ven Te. *Handbook of Applied Hydrology*. McGraw-Hill.
Corbett, J. R. *The Living Soil*. Martindale.
Detwyler, T. R. *Man's Impact on Environment*. McGraw-Hill. Paperback.
Griffin, R. J. *The Botany Basin*. Geol. Surv. of N.S.W. Bull. No. 18.
Hunter, A. ed. *The Economics of Australian Industry*. M.U.P.
Proceedings of Clean Air Conference. 1962 and 1965. N.S.W.U.P.
Rutherford, J., Logan, M. I. and Missen, G. J. *New Viewpoints in Economic Geography*. Martindale.
Smith, D. *Industrial Location*. Wiley.
Taylor, G. *Sydney-side Scenery*. A. & R., 1970.
Walker, P. H. *A Soil Survey of the County of Cumberland*. Bull. No. 2.
Soil Survey Unit, N.S.W. Dept. of Agriculture.

27.904G Geomorphology for Engineering Geologists

Landform expression of lithology and structure. Hill slope forms and processes. Climate, erosion and landforms. Landform evolution and systems theory. Geomorphology and soil erosion. Geomorphological background to coastal engineering problems. Forms of rivers and alluvial floodplains. Geomorphological approach to terrain evaluation. Exercises in the analysis and systematic description of terrain types from maps and airphotos. Field excursion on terrain assessment.

TEXTBOOKS

- Selby, M. J. *Slopes and Slope Processes*. N.Z. Geog. Soc., 1970.
Thornbury, W. D. *Principles of Geomorphology*. Wiley, 1969.

REFERENCE BOOKS

- Bird, E. F. C. *Coasts*. A.N.U.P., 1968.
CSIRO. *Lands of the Queanbeyan-Shoalhaven Area, A.C.T. and N.S.W.*
Land Research Series No. 24, 1969.
Davies, J. L. *Geographical Variation in Coastal Development*. Oliver & Boyd, 1972.

- Grant, K. *A Terrain Evaluation System for Engineering*. CSIRO Division of Soil Mechanics, Tech. Paper No. 2, 1968.
- Grant, K. *Terrain Classification for Engineering Purposes of the Melbourne Area*. CSIRO Division of Applied Geomechanics, Tech. Paper No. 11, 1972.
- King, C. A. M. *Techniques in Geomorphology*. Arnold, 1966.
- Stewart, G. A. ed. *Land Evaluation*. Macmillan, 1968.
- Thomas, W. L. ed. *Man's Role in Changing the Face of the Earth*. Chicago U.P., 1956.
- Young, A. *Slopes*. Oliver & Boyd, 1972.

SCHOOL OF MARKETING

28.012 Marketing Systems

An introduction to Marketing from various perspectives. Marketing is looked at as an economic and social phenomenon, a management discipline and a 'science'. The respective roles of products, prices, promotion and distribution in effecting economic exchange.

TEXTBOOK

Gist, R. R. *Marketing and Society*. Holt, Rinehart & Winston, 1971.

28.022 Marketing Models

Students are introduced to the use of quantitative analysis in marketing decision-making in business situations. The derivative (pricing for profit maximization, inventory policy for cost minimization); linear programming (designing programmes to maximize profits); techniques of planning (product launch using PERT); probability competitive bidding theory); market decision-making under conditions of uncertainty; assignment algorithm (allocation of salesmen to territories); physical distribution (total system costing, etc.)

The programme is designed to provide students with the opportunity to develop their ability to apply quantitative methods to practical marketing problems.

TEXTBOOK

King, W. R. *Quantitative Analysis for Marketing Management*. McGraw-Hill, 1967.

REFERENCE BOOKS

Churchman, C. W., Ackoff, R. L. & Arnoff, E. L. *Introduction to Operations Research*. Wiley, 1957.

Clark, W. A. & Sexton Jr., D. E. *Marketing and Management Science: A Synergism*. Irwin, 1970.

Frank, R. E., Kuehn, A. A. & Massy, W. F. eds. *Quantitative Techniques in Marketing Analysis*. Irwin, 1962.

Miller, D. W. & Starr, M. K. *Executive Decisions and Operations Research*. Prentice-Hall, 1960.

Sasieni, M., Yaspan, A. & Friedman, L. *Operations Research Methods and Problems*. Wiley, 1959.

28.032 Behavioural Science

The course introduces major concepts and research in the behavioural sciences in order to reveal the dynamics of human behaviour and the variety of viewpoints that can be adopted in explaining behaviour. It covers the following areas: the nature and scope of behavioural science; concepts of man in psychology and sociology; culture; social institutions; groups; social class; interpersonal and mass media communication; learning; perception; personality.

TEXTBOOKS

Engel, J. F., Kollat, D. T. & Blackwell, T. S. *Consumer Behaviour*. Holt, Rinehart & Winston, 1968.

Kassarjian, H. H. & Robertson, T. S. eds. *Perspectives in Consumer Behaviour*. Scott, Foresman, 1968.

28.042 Consumer Behaviour

The specific sociological and psychological topics in Behavioural Science are applied to the problem of understanding the consumer in the marketing context. The following areas are covered: Proximal and distal environmental inputs; motivation and arousal; consumer behaviour as a decision process; problem recognition; search behaviour; choice behaviour; purchasing processes; post-purchase behaviour.

TEXTBOOKS

Engel, J. F., Kollat, D. T. & Blackwell, T. S. *Consumer Behaviour*. Holt, Rinehart and Winston, 1968.

Kassarjian, H. H. & Robertson, T. S. eds. *Perspectives in Consumer Behaviour*. Scott, Foresman, 1968.

SCHOOL OF SURVEYING

29.441 Engineering Surveying

Part A. Ordinary levelling. Angle measurement. Linear measurement (bands). Theodolite traversing. Tacheometry. Contour and detail surveys. Areas and volumes.

Part B. Levelling (other methods). Linear measurement (electronic). Applications of survey techniques: control surveys, provision of information for design, setting out engineering works, etc. Outline of photogrammetry.

TEXTBOOKS

Bannister, A. & Raymond, S. *Surveying*. Pitman, 1972. Paperback.
Seven Figure Mathematical Tables. Chambers, 1958 (full edition).

REFERENCE BOOKS

Admiralty Manual of Hydrographic Surveying. Vol. I. Surveying on Shore.
Hydrographic Department of the Navy, London, 1965.

Birchal, H. F. *Modern Surveying for Civil Engineers*. 2nd ed. Chapman & Hall, 1955.

Brinker, R. C. & Taylor, W. C. *Elementary Surveying*. 4th ed. Int. Textbook Co., 1964.

Clark, D. *Plane and Geodetic Surveying*. Vol. I. 6th ed. Constable, 1969.

Clark, D. *Plane and Geodetic Surveying*. Vol. II. 5th ed. Constable, 1963.

Hickerson, T. F. *Route Location and Design*. 5th ed. McGraw-Hill, 1967.

Sandover, J. A. *Plane Surveying*. Arnold, 1961.

Whyte, W. S. *Basic Metric Surveying*. Butterworths, 1969.

29.491 Survey Camp

A one-week field camp for students studying 29.441 Engineering Surveying.

SCHOOL OF TOWN PLANNING

36.411 Town Planning

The study of factors influencing the direction of the development and use of land in the public interest. Objectives of town and regional planning; the urban planning process; patterns and processes of urbanization; the industrial and urban revolution; housing and neighbourhood planning; planning law and administration; the Sydney Region Outline Plan; transportation planning; industrial location and decentralization; "Tomorrow's Canberra"; the future city.

SCHOOL OF BIOCHEMISTRY

41.101A Chemistry of Biologically Important Molecules

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. Practical work to illustrate the lecture course.

TEXTBOOKS

Barker, R. *Organic Chemistry of Biological Compounds*. 1st ed. Prentice-Hall, 1971.

Bohinski, R. C. *Modern Concepts in Biochemistry*. Allyn & Bacon, 1973.

Montgomery, R. & Swenson, C. A. *Quantitative Problems in the Biological Sciences*. Freeman, 1969.

REFERENCE BOOK

White, A., Handler, R., & Smith, E. L. *Principles of Biochemistry*. 5th ed. McGraw-Hill, 1973.

41.101B Metabolism

The intermediary metabolism of carbohydrates, lipids and nitrogenous compounds. The molecular mechanism of gene expression and protein synthesis. Practical work to illustrate the lecture course.

TEXTBOOKS

As for 41.101A plus

McGilvery, R. W. *Biochemistry: A Functional Approach*. Saunders, 1970.

REFERENCE BOOK

As for 41.101A

41.101C Control Mechanisms

The relation between structure and function of enzymes, hormones, vitamins and membranes. Photosynthesis. Metabolic networks and control mechanisms. Practical work to illustrate the lecture course.

TEXTBOOKS

As for 41.101B plus

Frieden, E. & Lipner, H. *Biochemical Endocrinology of the Vertebrates*. Prentice-Hall, 1971.

REFERENCE BOOK

As for 41.101B

41.102A Biochemistry of Macromolecules and Cell Biochemistry

Polysaccharides and glycoproteins including bacterial cell walls. Chemistry and biology of polynucleotides. Methods of amino acid and nucleic acid sequence analysis. Protein structure and synthesis. Active centres of some proteins. Sub-unit organization of proteins. Cellular degradation. Practical work to illustrate the lecture course and to provide experience in modern biochemical techniques.

TEXTBOOKS

- Barker, R. *Organic Chemistry of Biological Compounds*. 1st ed. Prentice-Hall, 1971.
- Frieden, E. & Lipner, H. *Biochemical Endocrinology of the Vertebrates*. 1st ed. Prentice-Hall, 1971.
- The Molecular Basis of Life*. An Introduction to Molecular Biology. Readings from Scientific American. Freeman, 1968.
- White, A., Handler, R., & Smith, E. L. *Principles of Biochemistry*. 5th ed. McGraw-Hill, 1973 or
- Lehninger, A. L. *Biochemistry: The Molecular Basis of Cell Structure and Function*. Worth Publishers, 1970.
- Wold, F. *Macromolecules: Structure and Function*. Prentice-Hall, 1971.

REFERENCE BOOKS

- Bernhard, S. *The Structure and Function of Enzymes*. Benjamin, 1968.
- Davidson, J. N. *The Biochemistry of the Nucleic Acids*. 7th ed. Methuen, 1972.
- Watson, J. D. *The Molecular Biology of the Gene*. 2nd ed. Benjamin, 1970.

41.102B Metabolic Pathways and Control Mechanisms

Haemoproteins, and electron transport, photosynthesis, photophosphorylation and oxidative phosphorylation. The nature and function of co-enzymes. Inter-relationships in mammalian intermediary metabolism. Biochemical control mechanisms including hormones and allosteric interactions. Enzyme kinetics. Practical work to illustrate the lecture course and to provide experience in modern biochemical techniques.

TEXTBOOKS

As for 41.102

REFERENCE BOOK

- McGilvery, R. W. *Biochemistry: A Functional Approach*. 1st ed. Saunders, 1970.

SCHOOL OF BIOLOGICAL TECHNOLOGY

42.102 Fermentation Technology

An introduction to the basic factors involved in the operation of microbial processes on an industrial scale, including: The selection, maintenance and improvement of micro-organisms; the influence of physical and chemical factors on the microbial environment; the control of environmental factors; the effects of operational patterns in batch and continuous flow cultivation; the harvesting, purification and standardisation of products; process optimisation; disposal of waste materials; an examination of selected microbial processes for chemical, pharmaceutical and food production, against the basic characteristics of large-scale fermentation processes practical exercises, including the operation of various types of fermenters, to illustrate the principal aspects of the lecture course.

TEXTBOOKS

Aiba, S., Humphrey, A. E. & Millis, N. *Biochemical Engineering*. Academic, 1965.

Casida, L. E. Jr. *Industrial Microbiology*. Wiley, 1968.

Kubitschek, H. E. *Introduction to Research with Continuous Cultures*. Prentice-Hall, 1970.

REFERENCE BOOKS

Blakebrough, N. ed. *Biochemical and Biological Engineering Science*. Vols. 1 & 2. Academic, 1968.

Ghosh, T. & Fiechter, A. *Advances in Biochemical Engineering*. Springer-Verlag, 1971.

Rhodes, A. & Fletcher, D. *Principles of Industrial Microbiology*. Pergamon, 1966.

Solomons, G. L. *Materials and Methods in Fermentation*. Academic, 1969.

Webb, F. C. *Biochemical Engineering*. Van Nostrand, 1964.

42.211G Principles of Biology

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.

TEXTBOOK

Villee, C. A. *Biology*. 6th ed. Saunders, 1972.

REFERENCE BOOKS

Loewy, A. G. & Siekevitz, P. *Cell Structure and Function*. 2nd ed. Holt, Rinehart & Winston, 1970.

Conn, E. E. & Stumpf, P. K. *Outlines of Biochemistry*. 3rd ed. Wiley, 1972.

42.212G Principles of Biochemistry

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.

TEXTBOOK

Conn, E. E. & Stumpf, P. K. *Outlines of Biochemistry*. 3rd ed. Wiley, 1972.

REFERENCE BOOKS

Karlson, P. *Introduction to Modern Biochemistry*. 3rd ed. Academic, 1968.

Mahler, H. R. & Cordes, E. H. *Biological Chemistry*. 2nd ed. Harper & Row, 1971.

42.213G Biochemical Methods

A laboratory programme 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 will be covered in tutorials.

TEXTBOOK

Montgomery, R. & Swenson, C. A. *Quantitative Problems in the Biochemical Sciences*. Freeman, 1969.

42.214G Biotechnology

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 fermentor design; control of the microbial environment involving 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.

TEXTBOOKS

Aiba, S., Humphrey, A. E. & Millis, N. *Biochemical Engineering*. Academic, 1965.

Casida, L. E. Jr. *Industrial Microbiology*. Wiley, 1968.

Kubitschek, H. E. *Introduction to Research with Continuous Cultures*. Prentice-Hall, 1970.

REFERENCE BOOKS

Blakebrough, N. ed. *Biochemical and Biological Engineering Science*. Vols. 1 & 2. Academic, 1968.

Ghosh, T. & Fiechter, A. *Advances in Biochemical Engineering*. Springer-Verlag, 1971.

Rhodes, A. & Fletcher, D. *Principles of Industrial Microbiology*. Pergamon, 1966.

Solomons, G. L. *Materials and Methods in Fermentation*. Academic, 1969.

Webb, F. C. *Biochemical Engineering*. Van Nostrand, 1964.

SCHOOL OF BOTANY

43.101A/45.101A Genetics and Biometry

Analysis of the mitotic cycle; replication of DNA and its organization in the chromosomes; linkage, non-meiotic recombination; mutation, structural changes, polyploidy, aneuploidy; population genetics; cytoplasmic inheritance; episomes; gene structure and function. An introduction to statistical methods and their application to biological data, including an introduction to analysis of variance and experimental design.

TEXTBOOKS

Clarke, M. C. *Statistics and Experimental Design*. Arnold, 1969.

Rohlf, F. T. & Sokal, R. *Statistical Tables*. Freeman, 1969.

Srb, A. M., Owen, R. D. & Edgar, R. S. *General Genetics*. 2nd. ed. Freeman, 1965.

43.101B Plant Evolution and Ecology

A study of the evolution of vegetative form and structure of vascular plants; an examination of their organisation into terrestrial communities; identification, evolution and distribution of elements of the Australian flora. Students will be required to attend field excursions, all of which form an integral part of the course.

TEXTBOOKS

Beadle, N. C. W., Evans, O. E., & Carolin, R. C. *Flora of the Sydney Region*. Reed, 1972.

Fahn, A. *Plant Anatomy*. Pergamon, 1967.

Whittaker, R. H. *Communities and Ecosystems*. Collier-Macmillan, 1970.

43.101C Plant Physiology

A general introduction to the physiology of the whole plant including a consideration of photosynthesis, inorganic nutrition, transport, translocation, physiology of growth and development, and plant growth substances and their application in agriculture.

TEXTBOOKS

Galston, A. W. & Davies, P. J. *Control Mechanisms in Plant Development*. Prentice-Hall, 1970.

Richardson, M. *Translocation in Plants*. Arnold, 1968.

Sutcliffe, J. *Plants and Water*. Arnold, 1968.

Whittingham, C. P. *Photosynthesis*. O.U.P., 1971.

43.102B Plant Taxonomy

Considers the assessment, analysis and presentation of data for classifying plants both at the specific and supra-specific level. Some field excursions are necessary.

TEXTBOOKS

Beadle, N. C. W., Carolin, R. C. & Evans, O. D. *Handbook of the Vascular Plants of the Sydney District and Blue Mountains*. 1962.

Cronquist, A. *The Evolution and Classification of Flowering Plants*. Nelson, 1968.

Sporne, K. R. *The Morphology of the Gymnosperms*. Hutchinson, 1967.

43.102E Environmental Botany

An introduction to the soil and atmospheric environment in which terrestrial plants exist. Behaviour and response of the flowering plant to its environment, both in nature and agriculture. Students will be required to attend field excursions all of which form an integral part of the course.

SCHOOL OF MICROBIOLOGY

44.101 Introductory Microbiology

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. Microbial physiology and genetics. The relationship between microorganisms and their environment; ecological considerations. Interactions between microorganisms and higher organisms.

Prerequisite: 17.001.

TEXTBOOK

Brock, T. D. *Biology of Microorganisms*. Prentice-Hall, 1970.

or

Stanier, R. Y., Doudoroff, M. & Adelberg, E. A. *General Microbiology*. 3rd ed. Macmillan, 1971 (also published as *The Microbial World*. 3rd ed. Prentice-Hall, 1970).

or

Hawker, L. E. & Linton, A. H. eds. *Micro-organisms: Function, Form and Environment*. Arnold, 1971.

The choice will depend on the likely 3rd year programme. Brock is the first recommendation if no more microbiology is to be undertaken.

44.111 Microbiology

This is a similar course to 44.101 but is modified in its treatment to suit those who do not wish to take further courses in microbiology and who may have less biological and biochemical background than is required for other microbiology courses.

TEXTBOOK

Brock, T. D. *Biology of Microorganisms*. Prentice-Hall, 1970.

or

Pelczar, M. J. & Reid, R. D. *Microbiology*, 3rd ed. McGraw-Hill.

44.142 Microbiology for Food Technologists

A laboratory course of six hours per week (Session 1), covering the following topics: microscopy, choice and preparation of media, application of aseptic techniques, quantification of microbiological growth, isolation and identification of micro-organisms important to food processing. Principles of sterilization, heat resistance of vegetative cells and spores, food spoilage, food-borne organisms.

Assessment will be continuous and grading based upon the number of objectives achieved.

TEXT AND REFERENCE BOOKS

No set texts, but specific reading assignments will be given.

SCHOOL OF SOCIOLOGY**53.111 Sociology I**

For students who propose to take sociology as one of their major subjects. Introduces sociology as a perspective for understanding society and human interaction. A main emphasis is on the development of theories of society and methodology of the social sciences. Students who do not intend to pursue the subject for more than one year should enrol in 53.121 Sociology II.

SCHOOL OF EDUCATION

58.061 Methods of Teaching I

Application of principles of educational philosophy and educational psychology to learning in sheep and wool technology, e.g., a discussion of aims, verbal learning, learning of skills, procedures to assist learning such as lesson planning and the use of audio-visual aids. Methods of teaching special aspects of sheep and wool technology.

58.062 Methods of Teaching II

An introduction to curriculum theory. The planning of units of work and programming. Evaluation of the outcomes of instruction. A continuation of the methods of teaching special aspects of sheep and wool technology.

58.401 Education IA

Educational psychology, especially child and adolescent development and learning. Philosophy and theory of education. Research methods in education.

58.402 Education IIA

Australian education. Educational psychology especially psychological factors influencing learning, and evaluation. Philosophy of education. Sociology of education.

N O T E S

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STUDENT'S TIMETABLE

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9-10					
10-11					
11-12					
12-1					
1-2					
2-3					
3-4					
4-5					
5-6					
6-7					
7-8					
8-9					

It is important to the University and to yourself that you understand its conventions and regulations. The University Calendar and faculty handbooks are means by which the University attempts to convey, amongst other things, information regarding the facilities it has to offer, and the rules and regulations which govern the conduct and progress of students. You can help us assess the efficacy of the handbooks by completing this questionnaire, and thereby help yourself and your fellow students in the years to come.

1. Name of faculty.....Course.....Yr./Stage.....

A. CONTENTS

2. What information in your handbook did you find most useful?.....

3. (a) What information did you find least useful?.....

(b) Why was the information of so little use to you?.....

4. How would you rate the following information areas for inclusion in the handbook?

(TICK APPROPRIATE SQUARE)

	ESSENTIAL	INTERESTED	UNNECESSARY
TO HAVE THEM	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

	1	2	3
Calendar of dates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
List of academic staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Course outlines or rules governing course	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Descriptions of subjects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Textbook lists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reference book lists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Requirements for admission	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Admission and enrolment procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Course fees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rules relating to students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scholarships	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Examination procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timetables	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Please comment on any aspect of the information areas listed in Question 4 and particularly, if you think necessary, on the form of presentation i.e., its content, layout, position.....

6. If there is any section which you feel might be expanded, please list and state why you feel it should be expanded.....
7. Would you like any of the following included in the handbook?
- | | YES | NO |
|---|--------------------------|--------------------------|
| Photographs of senior academic and administrative personnel | <input type="checkbox"/> | <input type="checkbox"/> |
| Prices of textbooks | <input type="checkbox"/> | <input type="checkbox"/> |
| Names of lecturers listed alongside subject descriptions | <input type="checkbox"/> | <input type="checkbox"/> |
| Timetables | <input type="checkbox"/> | <input type="checkbox"/> |
| Map of the Campus | <input type="checkbox"/> | <input type="checkbox"/> |
| Any other items | <input type="checkbox"/> | <input type="checkbox"/> |
8. Do you use the textbook lists in your handbook when buying your books? ☐ YES ☐ NO
 If 'NO', please state where you obtained a list of the required textbooks
9. Do you use your handbook when selecting reference books? ☐ YES ☐ NO
 If 'NO', please state where you obtained your list of reference books
10. The handbooks are generally available at the latest by mid-December. Is this date early enough for your purposes? ☐ YES ☐ NO
 If 'NO', please nominate a month when you feel they should be on sale.....
11. Have you ever sought information from the University Calendar because it was not available in the handbook? ☐ YES ☐ NO
 If 'YES', please indicate which information
12. If you had any difficulty in obtaining a copy of your handbook, please outline problem

B. FORMAT

13. Is the handbook a convenient size? ☐ YES ☐ NO
14. Would you prefer some of the information to be presented differently, e.g., in tabular form, or expressed in a less complex manner or perhaps communicated in some other way? ☐ YES ☐ NO
 If 'YES', please give examples of what you would like changed, and how you would change it
15. Have you any comments which you would like to make on either the contents or format?

When you have completed this form, please either return it personally to Marianne Devin, Publications Officer, Room 307, The Chancellery, or post it via the internal mail system. Thank you for your co-operation.

Law 1
Law 1 29
Law 329