FACULTY OF APPLIED SCIENCE

1973 HANDBOOK

THE UNIVERSITY OF NEW SOUTH WALES

80 CENTS

FACULTY OF APPLIED SCIENCE

1973 HANDBOOK

EIGHTY CENTS

THE UNIVERSITY OF NEW SOUTH WALES

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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 1973

Session 1: March 5 to May 12

May Recess: May 13 to May 20

May 21 to June 16

Midyear Recess: June 17 to July 22

Session 2: July 23 to August 11

August Recess: August 12 to August 26

August 27 to November 10

JANUARY

Friday 12	Last date for application for review of results of annual examinations
Monday 15	Last day for acceptance of applications for admission to university degrees and diplomas
Friday 19	Last day for application for deferred examinations Last day for acceptance of applications to enrol by new students and students repeating first year
Monday 29	Australia Day—public holiday
Tuesday 30	Deferred examinations begin

FEBRUARY

Saturday 10	Deferred examinations end
Monday 19	Enrolment period begins for new students and students repeating first year
Monday 26	Enrolment period begins for students re-enrolling (second and later years)

MARCH

Friday 2	Last date for application for review of deferred examination results
Monday 5	**Session 1 commences**
Tuesday 13	Faculty of Applied Science meeting, 10 a.m.
Friday 16	Last day for acceptance of enrolments by new students (late fee payable)
Friday 30	Last day for changes in course programmes Last day for acceptance of enrolments by students re-enrolling (late fee payable)

APRIL

Friday 6	Last day for discontinuation without failure of subjects which extend over the first session only
Thursday 19	Last day for acceptance of corrected enrolment details forms

APRIL

Friday 20 to Monday 23	Easter
Wednesday 25	Anzac Day—public holiday

MAY

Monday 7	Provisional timetable for June/July examinations published
Sunday 13	May Recess begins
Sunday 20	May Recess ends
	Last date for discontinuation without failure of subjects which extend over the academic year

JUNE

Tuesday 5	Timetable for June/July examinations published
Thursday 7	Faculty of Applied Science meeting, 10 a.m.
Monday 11	Queen's Birthday—public holiday
Saturday 16	**Session 1 ends**
Sunday 17	Midyear Recess begins
Tuesday 19	Midyear examinations begin
Saturday 30	Last day for acceptance of applications for re-admission after exclusion under rules governing re-enrolment

JULY

Tuesday 3	Midyear examinations end
Sunday 22	Midyear Recess ends
Monday 23	**Session 2 commences**
Tuesday 31	Faculty of Applied Science meeting, 10 a.m.

AUGUST

Thursday 2	Foundation Day
Sunday 12	August Recess begins
Wednesday 22	Last day for acceptance of corrected enrolment details forms
Friday 24	Last date for discontinuation without failure of subjects which extend over the second session only
Sunday 26	August Recess ends

SEPTEMBER

Monday 10	Provisional timetable for annual examinations published

OCTOBER

Monday 1	Eight Hour Day—public holiday
Tuesday 16	Faculty of Applied Science meeting, 10 a.m.
Tuesday 30	Timetable for annual examinations published

NOVEMBER

Saturday 10	**Session 2 ends**
Tuesday 13	Annual examinations begin

DECEMBER

Tuesday 4	Annual examinations end
Tuesday 25	Christmas Day—public holiday
Wednesday 26	Boxing Day—public holiday

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

Friday 11	Last date for application for review of results of annual examinations
Monday 14	Timetable for deferred examinations published Last date for application for admission to University degrees and diplomas
Friday 18	Last date for application for deferred examinations
Tuesday 29 to Saturday 9	Deferred examinations

FEBRUARY

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) Results of deferred examinations available

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. In addition there are short recesses within the sessions—one week within Session 1 and two weeks within Session 2.

The first session commences on the first Monday of March.

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CHAIRMAN—Professor R. T. Fowler

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SENIOR INSTRUCTORS
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R. E. Sallaway

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Barbara Quinnell, BSc *N.S.W.*

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 1973 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.

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.

MATRICULATION REQUIREMENTS

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 and Wool and Pastoral Sciences courses (Faculty of Applied Science)	(a) Science at Level 2S or higher AND (b) Mathematics at Level 2S or higher
Arts Social Work Degree Course	English at Level 2 or higher
Commerce	(a) Mathematics at Level 2S or higher AND (b) either English at Level 2 or higher OR English at Level 3, provided that the candidate's performance in this subject and his general level of attainment are at standards acceptable to the Professorial Board.
Law Combined Arts/Law Combined Commerce/Law Combined Jurisprudence/Law	Nil As for Arts As for Commerce Nil
Military Studies (Arts Course)	English at Level 2 or higher OR English at Level 3, provided that the candidate's performance in this subject and his general level of attainment are at standards acceptable to the Professorial Board, and provided that a candidate so qualified shall not enrol in a course of English literature.

SUBJECT	SUBJECT PRE-REQUISITES
1.011—Higher Physics I 1.001—Physics I 1.041—Physics IC	As for Faculty of Science
2.001—Chemistry I 17.001—General and 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 IT	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 1973 it will be necessary for the University to impose quotas in 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 27th October 1972.

(b) New South Wales residents qualifying for admission by the 1972 New South Wales Higher School Certificate Examination or the 1973 Sydney University Matriculation Examination and those who have attended a University in New South Wales in 1972 must apply for enrolment to the Metropolitan Universities Admissions Centre, 13-15 Wentworth Avenue, Sydney (P.O. Box 7049 G.P.O., Sydney) by 19th January 1973.

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. Course details must be completed and 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 1972 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 enrol through the appropriate School, bringing with them their notification of examination results for the previous year. This enrolment must be effected before or during the week preceding the beginning of Session 1, in accordance with the special arrangements made by the individual schools.

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 (16th March, 1973) except with the express approval of the Registrar and the Head of the School concerned; no *later year enrolments* will be accepted after 31st 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.

UNDERGRADUATE COURSE FEES

Where course fees are assessed on the basis of session hours of attendance the hours of each subject for purposes of fee assessment shall be those prescribed in the Calendar, irrespective of any variation from the prescribed hours which may be necessary in conducting the subject. The granting of an exemption from portion of any of the requirements of a subject in which a student is enrolled does not necessarily carry with it any exemption from the payment of fees.

Fee determination for courses in the Faculty of Applied Science is on a session basis. **Fees quoted in this schedule are current at the time of publication and may be amended by the Council without notice.**

A full-time course fee will be charged for any session where more than 15 hours' per week instruction, etc., is involved.

(i) Full-time Course Fee (more than 15 hours' attendance per week)—$270 per session.

(ii) Part-time Course Fee—over 6 hours' and up to 15 hours' attendance per week—$135 per session.

(iii) Part-time Course Fee—6 hours' or less attendance per week—$67.50 per session.

(iv) Course Continuation Fee—A fee of $39 per annum (no session payment) is payable by:

Category (a) students who have once been enrolled for a thesis and have only that requirement outstanding, *or*

Category (b) students given special permission to take annual examinations without attendance at the University. (Students in this category are not required to pay the subscriptions to the University Union, the Students' Union, the Sports Association and the Library Fee.)

Miscellaneous Subjects

Undergraduate subjects taken as "miscellaneous subjects" (i.e., not for a degree or diploma) or to qualify for registration as a candidate for a higher degree are assessed on an hourly basis in accordance with the schedule above.

Students given approval to enrol in a miscellaneous subject or subjects in addition to being enrolled in a course are assessed according to the total hours of attendance as if the additional subject formed part of the course.

OTHER FEES

In addition to the course fees set out above all registered undergraduates will be required to pay—

Matriculation Fee—$11—payable at the beginning of first year.

Library Fee—annual fee—$19.

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.

Graduation or Diploma Fee—$11 payable at the completion of the course.

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

Psychology Kit Hiring Charge—$2 per kit. Additional payment for breakages and losses in excess of $1.

Biochemistry Kit Hiring Charge—$4 per kit. Additional charge for breakages and losses in excess of $1 may be required.

Chemistry Kit Hiring Charge—$4 per kit. Additional charge for breakages and losses in excess of $1 may be required.

Excursion Fee—$2 per subject (plant morphology, plant taxonomy, environmental botany).

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

Special Examination Fees

Deferred examination—$8 for each subject.

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

Review of examination result—$11 for each subject.

LATE FEES

First Enrolments

Fees paid at the late enrolment session and before the commencement of Session 1	$10
Fees paid during the first and second weeks of Session 1	$20
Fees paid after the commencement of the third week of Session 1 with the express approval of the Registrar and Head of the School concerned	$40

Re-Enrolments

Session 1

Failure to attend enrolment centre during enrolment week	$10
Fees paid after the commencement of the third 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 third and fourth weeks of Session 2	$20
Fees paid thereafter	$40
Late lodgement of corrected enrolment details forms (late applications will be accepted for three weeks only after the prescribed dates)	$8

WITHDRAWAL FROM COURSE

1. Students withdrawing from a course are required to notify the Registrar in writing. Fees for the course accrue until a written notification is received.

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 other than the matriculation fee will be made.

3. Where a student terminates for acceptable reasons a course of study within thirty days of the commencement of Session 1, a refund of fees paid, less a sum of $39, may be made in respect of all fees except the University Union Entrance and Membership Fees, the University of New South Wales Students' Union Fee and the University of New South Wales Sports Association Fee, in regard to which fees refunds may be made as shown hereunder.

4. Where a student terminates for acceptable reasons a course of study: (1) after the lapse of thirty days and before the lapse of half of Session 1, one half of each of the course fee, the library fee and the miscellaneous (student activities) fee may be refunded; (2) before the lapse of half of Session 2, one half of the session's course fee may be refunded.

5. Where a student terminates a course of study after half a session has elapsed, no refund may be made in respect of that session's fees.

6. No portion of the matriculation fee is refundable on withdrawal.

7. On notice of withdrawal a partial refund of the University Union entrance fee is 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.

8. On notice of withdrawal a partial refund of the 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 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 30th April a full refund is made, thereafter no refund.

9. Where initial registration 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.

PAYMENT OF FEES

Completion of Enrolment

All students are required to attend the appropriate enrolment centre during the prescribed enrolment period* for authorization of course programme. Failure to do so will incur a late fee of $8.

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 fails to complete enrolment (including fee payment) 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 earlier.) 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) from new students after the end of the second week of Session 1 (i.e., 16th March 1973), 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.

Payment of Fees by Session

Students who are unable to pay their fees by the year may pay by the session, in which case they are required to pay Session 1 course fees and other fees for the year, within the first two weeks of Session 1. Students paying under this arrangement will receive accounts from the University for Session 2 fees. These fees must be paid within the first two weeks of Session 2.

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.

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* The enrolment periods for Sydney students are prescribed annually in the leaflet on Enrolment Procedures.

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 the applicant wishes to enrol, describe clearly and fully the reasons why payment cannot be made and the extension sought, 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 until 31st March 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

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.

No student is eligible to attend the annual examinations in any subject where any portion of his course fees for the year is outstanding after the end of the fourth week of Session 2 (17th August, 1973).

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.

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 three weeks of each session.

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, 19th January. As quotas will operate on entry to all Faculties and the Board of Vocational Studies in 1973, failure to apply by 19th January 1973 will most likely 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, 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.

STUDENT RECORDS

All students will receive enrolment details forms by 4th April and 7th August. 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 19th April and 22nd August respectively. Amendments notified after the closing date will not be accepted unless exceptional circumstances exist and approval is obtained from the Registrar. Where a late amendment is accepted, a late fee of $7.00 will be payable. 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 19th January 1973. 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

Most annual examinations are held in November-December and examinations in many subjects are also held during the mid-year recess. Timetables indicating the dates and times of examinations and notices of the location 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.

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.

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. 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. An application to take an examination away from the centre in which enrolled must be lodged with the Registrar immediately examination results are received. 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 $7 per subject, by the date indicated on the notification of results.

APPLICATION FOR ADMISSION TO DEGREE

Applications for admission to a degree of the University must be made on the appropriate form by 15th January. Applicants should ensure that they have completed all requirements for the degree, including industrial training where necessary.

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 annual examination counts, for the purpose of this regulation, as one failure.) Where such subject is prescribed 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 Branch, 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.

The full 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.

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 $308 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 110 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 $23.50 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 is the first of the independent Colleges on the Campus of the University. There are no religious tests, and accommodation is available for 210 men in single study-bedrooms. Fees are $25 per week.

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, was completed in 1970, and provides accommodation for 200 male students and fourteen resident tutors.

Basic fees are $24 per week for board and residence, payable on a session basis, and a registration fee of $20. Intending students should write to the Master, Warrane College, Box 123, P.O. Kensington, N.S.W. 2033.

The Jewish College

The Jewish College will provide accommodation for 86 men and women students when it is ready for occupation in 1973. The basic fee for residents will be $28 a week. Non-resident membership will be 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, The Jewish 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 secretary. 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.

FINANCIAL ASSISTANCE TO STUDENTS

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.

In all cases assistance is limited to students with reasonable academic records and whose financial circumstances warrant loans.

Applications 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 Open Entrance Commonwealth University Scholarships, there is also a Commonwealth Aboriginal Study Grant Scheme. Furthermore, the University may assist Aboriginal students with some essential living expenses or the waiving of course fees in exceptional circumstances.

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

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 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 authorities, 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 is open to graduates of the University and to members of its academic staff. The annual subscription is $6.

The 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 (117ft x 86ft) 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.

UNDERGRADUATE SCHOLARSHIPS AND PRIZES

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

Students undertaking courses in the Faculty of Applied Science are eligible to apply for the following scholarships. Not all scholarships are offered each year. During the first week of January 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, within seven days of the publication of the award of Commonwealth University Undergraduate Scholarships.

In addition to those scholarships made available by the University and other bodies as set out below, cadetships are offered by the Commonwealth Service, the New South Wales Public Service Board, the Department of Railways and a number of private industrial organizations. Cadets generally have their University fees paid by the employer, and are employed at cadet rates of pay during their course.

Commonwealth University Scholarships

There are three types, and all may be applied to full-time, part-time and external courses, and for pass and honours courses:— *Open Entrance Scholarships*, which are granted on the results of the Higher School Certificate Examination to students who are under thirty years of age on 1st January of the year in which they are first awarded the scholarship; *Second or Later Year Scholarships*, have the same age qualification, and are awarded on the results obtained by students who have completed the equivalent of one year of an approved, full-time university course; and *Mature Age Scholarships*, which are available to students who are over thirty on 1st January of the year in which they are first awarded a scholarship. In general, applicants should be permanent residents

of Australia. Candidates who are under bond or similar obligation are ineligible, and those who have already completed tertiary courses may be ineligible.

Benefits include payment of all tuition fees and other compulsory fees and living allowances (these latter being subject to a means test) up to $700 per annum or $1,100 per annum if living away from home. The closing date for applications is 30th September in the year immediately preceding that for which the scholarship is desired. Full particulars and application forms may be obtained from the Department of Education and Science, 70 Castlereagh Street, Sydney, 2000, or Box 3987, G.P.O. Sydney, 2001 (Telephone: 2-0323).

University Undergraduate Scholarships

The University annually awards up to fifteen scholarships to students who have matriculated at the Higher School Certificate Examination; ten scholarships to students who have completed certificate courses (Department of Technical Education); ten scholarships to students who have completed Trade Courses (Department of Technical Education) and ten scholarships to part-time students who have taken the Diploma Entrance course of the Department of Technical Education. The scholarships exempt the holder from payment of course fees, and subject to satisfactory progress, are tenable for the duration of the course. Applicants must qualify for admission to the course of their choice. The scholarships may be held only by persons who do not hold another award and whose parents are permanent residents of Australia.

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. Candi-

dates 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 Kensington College Ltd. The annual value of the Scholarship is $100. It may be held concurrently with Commonwealth and 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 College Ltd., 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 offers scholarships for students wishing to undertake degree courses in Mining Engineering or Applied Geology. The scholarships are valued at $600 to $900 p.a., plus $200 living-away-from-home allowance where applicable, fees and a book allowance of $100 p.a. Further details may be obtained from Australian Coal Industry Research Laboratories Ltd., P.O. Box 169, Chatswood, N.S.W.

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. Preference is given to Commonwealth Scholarship holders. 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 one scholarship annually for students wishing to undertake a degree course in Mining Engineering, Metallurgy or Geology. The value of the scholarship is $800 p.a., plus $300 living-away-from-home allowance where applicable and paid vacation work, and is tenable for the duration of the course. 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. The value of these scholarships ranges from $700 to $1,100 per annum (including allowance for books and instruments). These scholarships will be awarded on the understanding that applicants will normally hold a Commonwealth University Scholarship which covers the cost of University fees. However, applicants without Commonwealth University Scholarships may be given consideration. While scholarship holders are not under bond it is expected that they will obtain employment in Coal Mining or a related industry on graduation. Applications on forms obtainable from headmasters or from the Secretary, Joint Coal Board, Box 3842, G.P.O., Sydney, must be lodged with the Board's Secretary not later than seven days after the publication of the award of Commonwealth University Scholarships.

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 scholarships which are valued at $250-$1,200 p.a., are tenable until the course has been completed. 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. The scholarships have a value of $700 per annum and are tenable for four years. 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. The scholarships are tenable for four years and are valued at $980 p.a. for adults and from $650 to $980 p.a. for juniors, plus University fees and allowances. 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 scholarships are valued at $800 p.a., plus tuition fees, and are tenable for the duration of the course. 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. The scholarship is tenable for the duration of the course and is valued at $800 p.a. with annual increments of $100. Where a Commonwealth Scholarship is not held full University fees will be paid. 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 B.Sc. 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 a Commonwealth Scholarship.

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. Applicants are expected to apply for a Commonwealth Scholarship to cover course and other University fees.

University of New South Wales Chemical Engineering Association Scholarships

The Association offers two scholarships, 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 Chemical Engineering course or have satisfactorily completed Year 1 of the course or some programme of equivalent academic standard. The scholarships have a value of $200 p.a. and are normally tenable for four years. Applicants are expected to apply for a Commonwealth Scholarship to cover course and other University fees.

Western Mining Corporation Ltd.

The Company provides three 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 scholarships are each valued at $1,000 per annum and are tenable for the duration of the course, subject to satisfactory progress. Should a student fail a subject twice, the scholarships will automatically be terminated.

The Company offers vacation employment at one of its operations and also anticipates being able to offer employment after graduation to each scholarship holder. However, no bond is involved. Applications should be lodged with the Registrar by 31st December.

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 a Commonwealth University Undergraduate Scholarship.

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 and holders of Commonwealth Scholarships may apply. 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, 1972.

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.

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 $500 per annum payable in fortnightly instalments as a living allowance. Applicants are expected to apply for a Commonwealth Scholarship to cover course and other University fees.

Conzinc Riotinto of Australia Ltd.

The Company offers each year two scholarships for students wishing to qualify for the degree of Bachelor of Science in Metallurgy or Bachelor of Engineering in Mining Engineering. Applicants shall be students who have completed one or more years of an approved course. The value of each scholarship is $700 per annum, or $1,000 per annum if the student is living away from home, plus a book allowance of $100. It is expected that applicants will hold Commonwealth Scholarships, which will cover the cost of fees.

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 and may be held concurrently with a Commonwealth Scholarship.

School of Metallurgy Scholarship

Staff members of the School of Metallurgy have undertaken to provide a scholarship for students wishing to enrol in Year 1 of the full-time course (Pass or Honours) in Metallurgy. The value of the scholarship is $500 per annum, and 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. The scholarship has a value of $200 per annum and is tenable for one year.

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 and may be held concurrently with a Commonwealth Scholarship.

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, and may be held concurrently with a Commonwealth Scholarship.

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, and successful applicants may hold a Commonwealth Scholarship concurrently.

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.

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 degrees of Bachelor of Science and Bachelor of Engineering. The Schools of Chemical Engineering, Chemical Technology, Metallurgy, and Mining Engineering (at Wollongong and Broken Hill), offer part-time courses leading to the degree of Bachelor of Science (Technology) and 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 requiring 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 thirty-six weeks' approved practical work. In Mining Engineering students will undertake a programme of practical training of at least 100 days.

Part-Time Courses

The Schools of Chemical Engineering, Chemical Technology, Metallurgy and Mining Engineering offer six-year part-time courses leading to the degree of Bachelor of Science (Technology) in Chemical Engineering, Food Technology, Industrial Chemistry, Ceramics, Metallurgy, and Mining Engineering (Wollongong). At Broken Hill a part-time course in Mining Engineering leads to the degree of Bachelor of Science (Engineering) and a part-time course in Mineral Processing to the degree of Bachelor of Science (Technology).

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

All undergraduates in Faculties other than Arts and Law are required to complete a General Studies programme. In this way the University hopes to give its students a general understanding of the different aspects of the world in which they live. 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.

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 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	
YEAR 1		Lec.	Lab. Tut.	Lec.	Lab. Tut.
25.001	Geology I*	3	3	3	3
1.001 / 1.031	Physics I *or* Physics IAS	3	3	3	3
2.001	Chemistry I	2	4	2	4
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4	2	4	2
		12	12	12	12

* 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
1.112	Physics II (units A and C) *or*	2	—	5	3
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:					
5.001	Engineering I *or*	3	3	3	3
10.111	Pure Mathematics II (units A and B)‡ *or*	4	—	4	—
10.211	Applied Mathematics II (units A and (B or C))‡ *or*	2/6	0	6/2	—
17.001	General and Human Biology *or*	3	3	3	3
27.001	Applied Geography I	2	4	2	4

* Univ. of Tas. Summer School course, Geology I, is accepted as entrance qualification for Year II of Applied Geology in case of students who have not previously attempted Geology I at this University.

† 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.

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 3		Lec.	Lab. Tut.	Lec.	Lab. 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
		13	13	13	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†

7.551	Mining and Mineral Process Engineering	2	2	0	0
8.241	Geomechanics	2	3	0	0
25.0041	Geology IV, Part 1*	2	1	0	0
25.0042	Geology IV, Part 2*	2	2	0	0
25.0043	Geology IV, Part 3*	3	1	0	0
25.0044	Geology IV, Part 4*	1½	2	0	0
25.0045	Geology IV, Part 5*	0	0	0	30
	General Studies Advanced Elective	1	½	1	½
		13½	11½	1	30½

† Session 2 is devoted to field and laboratory work on a project.
* Four short visits to civil engineering works and mine workings are included in the course.

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 technologists are concerned with the management of foods from the time of production until they reach the consumer. It is their responsibility 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 B.E. 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	
YEAR 1		Lec.	Lab. Tut.	Lec.	Lab. Tut.
1.031	Physics IAS	3	3	3	3
2.001	Chemistry I	2	4	2	4
5.001	Engineering I	3	3	3	3
10.001 10.011	Mathematics I *or* Higher Mathematics I	4	2	4	2
		12	12	12	12
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	1	1	1	1
	Two General Studies Electives	2	1	2	1
		11	10	12	16

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 2 (Cont.)		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
		13	10½	11	12½
	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 Lec.	Lab. Tut.	SESSION 2 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 Elective	1	½	1	½
	Project*	0	1	0	11
		9½	9	3½	15
	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
7.311	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.†				

*One 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

† 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 require-

ments of students who are employed in the chemical processing industries.†

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 B.Sc. (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.

† See page B12 for outline of this course involving combined full-time and part-time study.

		Hours per week			
		SESSION 1		SESSION 2	
STAGES 1 and 2*		Lec.	Lab. Tut.	Lec.	Lab. Tut.
1.031	Physics IAS	3	3	3	3
2.001	Chemistry I	2	4	2	4
5.001	Engineering I	3	3	3	3
10.001	Mathematics I *or*				
10.011	Higher Mathematics I‡	4	2	4	2
		12	12	12	12
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
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	1	1	1	1
		5	5	4	7

* 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 in 1973.

		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
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
7.311 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.

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.

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 responsibility 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.

Years 3 and 4 of the course have been revised. Full-time students who completed Year 3 in 1972 will continue with the course programme appearing in the 1971 Calendar and Handbook.

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 1		Lec.	Lab. Tut.	Lec.	Lab. Tut.
1.031	Physics IAS	3	3	3	3
2.001	Chemistry I	2	4	2	4
10.001	Mathematics I *or*				
10.011	Higher Mathematics I	4	2	4	2
17.001	General and Human Biology	2	4	2	4
		11	13	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	½	1	½
		10	14½	10	14½

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	1	1	1	1
44.102B	Basic General Microbiology—Microbial Physiology and Ecology	2	4	0	0
	General Studies Elective	1	½	1	½
		10	14½	11	16½
YEAR 4					
3.221	Food Technology IV	3	4	3	4
3.250	Project	0	8	0	8
	Two General Studies Electives	2	1	2	1
		5	13	5	13
	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
28.104	Marketing Models and Systems	4	0	4	0
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
44.102A	Basic General Microbiology—Nature of Microorganisms	0	0	2	4
44.102D	General Applied Microbiology—or such other electives, to a total of not less than 6 hrs/week, as approved by the Head of School	0	0	2	4

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.

Stages 5 and 6 of the course have been revised. Part-time students who completed Stage 5 in 1972 will continue with the course programme appearing in the 1971 Calendar and Handbook.

		Hours per week			
		SESSION 1		SESSION 2	
STAGES 1 and 2*		Lec.	Lab. Tut.	Lec.	Lab. Tut.
1.031	Physics IAS	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†				
17.001	General and Human Biology	2	4	2	4
		11	13	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 in 1973.

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
		5	10	3	6
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
		6	9	5	7
STAGE 6					
3.212	Food Technology III	2	0	2	8
10.331	Statistics	1	1	1	1
44.102B	Basic General Microbiology—Microbial Physiology and Ecology	2	4	0	0
	General Studies Elective	1	½	1	½
		6	5½	4	9½

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

STAGE 5A

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	
YEAR 1		Lec.	Lab. Tut.
1.031	Physics IAS	3	3
2.001	Chemistry I	2	4
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4	2
Plus one of:—			
5.001	Engineering I	3	3
17.001	General and Human Biology	2	4
25.111	Geoscience I*	2	4

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

		Hours per week SESSION 1		SESSION 2	
YEAR 2		Lec.	Lab. Tut.	Lec.	Lab. 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	1	1	1	1
22.112	Chemical Process Equipment	0	0	2	0
22.122	Instrumental Analysis	2	2	0	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
3.112	Chemical Engineering Material Balances and Thermodynamics	1	2	0	0
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
	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 3.112 Chemical Engineering Material Balances and Thermodynamics, 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 Lec.	Lab. Tut.	SESSION 2 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*	2	0	2	0
		10	14	5	19

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.

* 18 weeks' course, terminating before recess in Session 2.

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

STAGES 1 and 2*		Hours per week for 2 Sessions Lec.	Lab. Tut.
1.031	Physics IAS	3	3
2.001	Chemistry I	2	4
10.001 / 10.011	Mathematics I *or* Higher Mathematics I†	4	2
Plus *one* of:—			
5.001	Engineering I	3	3
17.001	General and Human 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 in 1972.

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

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

* 14 weeks' course.

STAGE 4		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
2.311	Physical Chemistry	1½	3	1½	3
2.411	Inorganic Chemistry	1	2	1	2
22.112	Chemical Process Equipment	0	0	2	0
22.122	Instrumental Analysis	2	2	0	2
	General Studies Elective	1	½	1	½
		5½	7½	5½	7½
STAGE 5					
3.111	Chemical Engineering Principles I	2	0	1	2
3.112	Chemical Engineering Material Balances and Thermodynamics	1	2	0	0
3.311	Fuel Engineering I	1½	½	1½	½
22.113	Industrial Chemistry Processes	1½	2½	1½	2½
		6	5	4	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 3.112 Chemical Engineering Material Balances and Thermodynamics, 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	
STAGE 6		Lec.	Lab. Tut.	Lec.	Lab. Tut.
2.622	Organic Chemistry	2	4	0	0
22.123	Chemical Thermodynamics and Kinetics	1½	1½	1½	1½
22.133	Data Processing	0	0	2	2
18.551	Operations Research	2	1	2	1
	General Studies Elective	1	½	1	½
		6½	7	6½	5

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

YEAR 1					
1.031	Physics IAS	3	3	3	3
2.001	Chemistry I	2	4	2	4
5.001	Engineering I	3	3	3	3
10.001 10.011	Mathematics I *or* Higher Mathematics I	4	2	4	2
		12	12	12	12

YEAR 2		Hours per week for 2 Sessions	
		Lec.	Lab. 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	1	1
	General Studies Elective	1	½
		9	14

YEAR 3*		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
3.111	Chemical Engineering Principles I	2	0	1	2
3.112	Chemical Engineering Material Balances and Thermodynamics*	1	2	0	0
3.311	Fuel Engineering I	1½	½	1½	½
22.123	Chemical Thermodynamics and Kinetics	1½	1½	1½	1½
22.213	Principles of Chemical Ceramics	2	2	2	2
22.223	Applied Chemical Ceramics	1	3	1	3
22.233	Ceramic Equipment	1	0	1	0
25.201	Mineralogy	1	1	1	2
	Two General Studies Electives	2	1	2	1
		13	11	11	12

* 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
22.214	Physical Ceramics	3	3	3	3
22.224	Ceramic Engineering	2	2	2	2
22.294	Project	0	3	0	10
	General Studies Advanced Elective*	2	0	2	0
		11	12	9	15

* 18 weeks' course, terminating before recess in Session 2.

303. Ceramics—Part-Time Course Bachelor of Science (Technology)

STAGES 1 and 2*		Hours per week for 2 Sessions Lec.	Lab. Tut.
1.031	Physics IAS	3	3
2.001	Chemistry I	2	4
5.001	Engineering I	3	3
10.001 / 10.011	Mathematics I *or* Higher Mathematics I†	4	2
		12	12

* Two subjects will be taken in the first year and the other two in the second year (as directed).
† There will be no evening lectures in this subject in 1973.

		Hours per week for 2 Sessions	
			Lab.
STAGE 3		Lec.	Tut.
1.212	Physics IIT (Units B and C)	1½	1½
2.311	Physical Chemistry	1½	3
10.031	Mathematics	1	1
10.331	Statistics	1	1
		5	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
		4	7½
STAGE 5			
22.123	Chemical Thermodynamics and Kinetics	1½	1½
22.213	Principles of Chemical Ceramics	2	2
25.201	Mineralogy	1	1*
	General Studies Elective	1	½
		5½	5

* 2 hours per week in Session 2.

		Hours per week			
		SESSION 1		SESSION 2	
			Lab.		Lab.
STAGE 6		Lec.	Tut.	Lec.	Tut.
3.111	Chemical Engineering Principles I	2	0	1	2
3.112	Chemical Engineering Material Balances and Thermodynamics	1	2	0	0
3.311	Fuel Engineering I	1½	½	1½	½
22.223	Applied Chemical Ceramics	1	3	1	3
22.233	Ceramic Equipment	1	0	1	0
	General Studies Elective	1	½	1	½
		7½	6	5½	6

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

BIOGEOGRAPHY

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 1		Lec.	Lab. Tut.	Lec.	Lab. Tut.
2.001	Chemistry I	2	4	2	4
10.001 10.011 10.021	Mathematics I *or* Higher Mathematics I *or* Mathematics IT	4	2	4	2
17.001	General and Human Biology	3	3	3	3
27.001	Applied Geography I*	2	4	2	4
		11	13	11	13

* Up to 3 days' field tutorials are an essential part of the course.

YEAR 2

1.031	Physics IAS	3	3	3	3
27.002	Applied Geography II*	2	4	2	4
43.101A	Genetics and Biometry	3	3	0	0
43.101B	Plant Evolution and Ecology	0	0	2	4
	General Studies Elective	1	½	1	½
		9	10½	8	11½

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

YEAR 3*

27.013	Geographic Methods	0	1½	0	1½
27.103	Climatology	0	0	2	3½
27.203	Biogeography	2	3½	0	0
27.413	Geomorphology	2	3½	0	0
27.423	Pedology	0	0	2	3½
43.102E	Environmental Botany	2	4	0	0
43.101C	Plant Physiology	0	0	2	4
45.101D	Field Ecology†	0	0	1	0
	Two General Studies Electives	2	1	2	1
		8	13½	9	13½

* A four-day field tutorial prior to the beginning of Session 1, and up to seven days' field tutorials later in the year are essential parts of the third-year programme.

† This subject includes a two-week field tutorial at the end of Session 2.

		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
YEAR 4					
27.204	Advanced Biogeography	3	6	0	0
27.333	Agricultural Geography*	2	3½	0	0
27.504	Project (Biogeography)	0	2	0	10
	General Studies Advanced Elective	1	½	1	½
		6	12	1	10½

* A one-day field tutorial is an essential part of the course.

		Hours per week for 2 Sessions Lec.	Lab. Tut.
GEOMORPHOLOGY AND PEDOLOGY			
YEAR 1			
2.001	Chemistry I	2	4
10.001 10.011 10.021	Mathematics I *or* Higher Mathematics I *or* Mathematics IT	4	2
17.001	General and Human Biology	3	3
27.001	Applied Geography I*	2	4
		11	13

* Up to 3 days' field tutorials are an essential part of the course.

YEAR 2			
1.031	Physics IAS	3	3
25.111	Geoscience I	3	3
27.002	Applied Geography II*	2	4
	General Studies Elective	1	½
		9	10½

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

YEAR 3*		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
25.112	Geoscience II	5	4	4	5
27.013	Geographic Methods	0	1½	0	1½
27.103	Climatology	0	0	2	3½
27.203	Biogeography	2	3½	0	0
27.413	Geomorphology	2	3½	0	0
27.423	Pedology	0	0	2	3½
	Two General Studies Electives	2	1	2	1
		11	13½	10	14½

* A four-day field tutorial prior to the beginning of Session 1, and up to 7 days' field tutorials later in the year are essential parts of the third year programme.

YEAR 4					
8.252	Soil Mechanics	1	1	1	1
25.013	Geology III (Supplementary)*	2	2	2	2
27.404	Advanced Geomorphology and Pedology	3	6	0	0
27.504	Project (Geomorphology and Pedology)	0	2	0	10
	General Studies Advanced Elective	1	½	1	½
		7	11½	4	13½

* Selected strands in Geochemistry, Sedimentary Petrology and Clay Mineralogy.

ECONOMIC GEOGRAPHY

YEAR 1		Hours per week for 2 Sessions Lec.	Lab. Tut.
10.001 10.011 10.021	Mathematics I *or* Higher Mathematics I *or* Mathematics IT	4	2
15.101	Economics I	2	1
53.121	Sociology IT	2	2
27.001	Applied Geography I*	2	4
		10	9

* Up to 3 days' field tutorials are an essential part of the course.

YEAR 2		Hours per week for 2 Sessions Lec.	Lab. Tut.
15.102	Economics II	2	2
27.002	Applied Geography II*	2	4
28.104	Marketing Models and Systems	4	0
		8	6

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

YEAR 3		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
15.053	Economic Development	2	1	0	0
15.023	Economics IIIB	0	0	2	2
15.412	Quantitative Economic Techniques A	2	1	0	0
15.422	Quantitative Economic Techniques B	0	0	2	1
27.303	Transportation Geography*	0	0	2	3½
27.313	Location Theory*	2	3½	0	0
27.323	Marketing Geography*	0	0	2	3½
27.333	Agricultural Geography*	2	3½	0	0
27.013	Geographic Methods	0	1½	0	1½
		8	10½	8	11½

* Students will attend a weekly seminar at Honours level in two of these subjects. Up to 5 days' field tutorials are an essential part of the course.

YEAR 4					
36.411	Town Planning	2	1	0	0
27.304	Advanced Economic Geography	2	3	0	1
27.504	Project (Economic Geography)	0	3	0	10
12.001	Psychology I *or*	3	2	3	2
51.111	History I *or*	2	1	2	1
53.121	Sociology IT* *or*	2	2	2	2
54.111	Political Science I	2½	2	2½	2

* Students enrolled in 1970.

GEOGRAPHY IN OTHER FACULTIES

Courses in Geography are available on a full-time basis in other Faculties as follows:—

Arts and Commerce	—	27.041 Geography IA
		27.042 Geography IIA
		27.052 Geography IIA (Honours)
		27.043 Geography IIIA
		27.053 Geography IIIA (Honours)
		27.063 Geography IIIB
		27.073 Geography IIIB (Honours)
Arts	—	27.054 Geography IVA (Honours)
Science	—	27.031 Geography IS
		27.103 Climatology
		27.203 Biogeography
		27.413 Geomorphology
		27.423 Pedology

SCHOOL OF METALLURGY

The metallurgical profession is developing rapidly in importance in Australia, in keeping with the recent spectacular growth of our metal and mineral industry. In terms of value of production this industry has become recognized as one of Australia's most important, especially in terms of export earnings. Expansion of the industry has greatly enhanced the need for metallurgists.

Industrial development in metallurgy has been accompanied by, and is based on, the development of metallurgical research. This is being carried on in a number of laboratories run by industry, government, and the universities.

The graduate metallurgist has a wide choice of type of employment and location. He may work in production, technical control or development, either in the ore treatment or metal extraction plants in locations such as Newcastle, Port Kembla, Broken Hill, Mt. Isa, Mt. Morgan, Port Pirie, Whyalla, Kwinana, Gladstone or Pilbara; or in the metal manufacturing plants, including the automobile, aircraft, ship-building and other industries, of the main centres and capital cities. In the metal industry in general the opportunities for a career in management are excellent, since it is a tradition in this industry that management should be in the hands of technical men. If the graduate is inclined towards research and development, he will find considerable scope in various government, University, and industrial research laboratories.

The undergraduate courses in metallurgy have been designed to prepare students for employment in metallurgical industries and research institutions, and involve a general training in basic sciences and engineering. These fundamental principles are then extended to cover studies of the extraction, refining, working, fabrication and use of metals.

The first year of the full-time Metallurgy course consists of physics, chemistry, mathematics, and *either* engineering *or* geology. The structure of this first year course is similar to that of many other science, applied science and engineering courses. Consequently, students may delay their final choice of a professional course until the end of first year.

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	
YEAR 1		Lec.	Lab. Tut.
1.031	Physics IAS	3	3
2.001	Chemistry I	2	4
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4	2
Plus one of			
5.001	Engineering I	3	3
25.111	Geoscience I	2	4

YEAR 2		Hours per week SESSION 1 Lec.	SESSION 1 Lab. Tut.	SESSION 2 Lec.	SESSION 2 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
5.001	Engineering I, Part A *or*	2	0	2	0
25.201	Mineralogy	1	1	1	1
	General Studies Elective	1	½	1	½
		12/13	12½/—	12/13	12½/13½

YEAR 3		Hours per week for 2 Sessions 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		4	6
†From Week 12 in Session 1		0	10

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.

STAGES 1 and 2*		Hours per week for 2 Sessions Lec.	Lab. Tut.
1.031	Physics IAS	3	3
2.001	Chemistry I	2	4
10.001 10.011	Mathematics I *or* Higher Mathematics I†	4	2
Plus one of			
5.001	Engineering I	3	3
25.111	Geoscience I	2	4
		11/12	12/13

* 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 in 1973.

STAGE 3		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
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	½	1	½
		6	5½	6	6½

STAGE 4		Hours per week for 2 Sessions Lec.	Lab. Tut.
4.011	Metallurgy I	5	6
25.201	Mineralogy *or*	1	1
5.001	Engineering I (Part A)	2	0
		6/7	5/7

STAGE 5		Hours per week for 2 Sessions Lec.	Lab. Tut.
4.0121	Metallurgy IIA*	5	4
4.041	Mathematical Methods *or*	2	½
6.801	Electrical Engineering	1	2
	General Studies Elective	1	½
		7/8	5/6½
*Session 2		5	6

STAGE 6			
4.0122	Metallurgy IIB*	4	6½
	General Studies Elective	1	½
		5	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)

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

* This course is subject to revision.

SCHOOL OF MINING ENGINEERING

The School of Mining Engineering offers a full-time course in Mining Engineering leading to the degree of Bachelor of Engineering (pass or honours).

The School also offers two courses at graduate level requiring one year of full-time or two years of part-time study leading to the Graduate Diploma (Grad Dip) in Mining Engineering or Mineral Technology.

Part-time courses in Mining Engineering and Mineral Processing are conducted at the W. S. & L. B. Robinson University College, Broken Hill. The first two years of a full-time course leading to the degree of Bachelor of Engineering have been available at Wollongong since 1970, the third and fourth years of this course to be completed at Kensington. Students in the part-time Mining Engineering course may complete the requirements for the Bachelor of Engineering degree at Kensington after obtaining the approval of the Head of the School.

Details of the full-time and part-time courses at Wollongong are given in the Wollongong University College Handbook.

The courses within the School prepare graduates for employment in the mineral industries and in research institutions which are linked with those industries.

Since 1850 the mining industry has been a pioneering force in the development of Australia. Mining engineers who carry on this tradition realise that the problems of today are complex and require great technical skill. They are also aware that the future offers an increasing number of opportunities for mining engineers.

It is obvious that the mining industry will become, because of its rate of growth, an even greater influence in the development of this and neighbouring countries. Vigorous expansion faces the industry. For example, extensive and successful prospecting is taking place, particularly in those areas which in the past received little attention, and hidden, sub-surface deposits are being discovered. Following the discovery of a promising deposit there is a period of testing, proving and assessment followed by a period

of development and construction. Finally, there is the production period with which is associated some extension of activities which include smelting and the establishment of new industries.

314. Mining Engineering—Full-Time Course
Bachelor of Engineering

The first two years of the course are similar to the first and second years of the Civil Engineering course. The third year introduces Mining Engineering and Mineral Processing. The fourth year programme is concerned with the professional Mining Engineering subjects.

The aim of the training is to give students a thorough foundation in mining engineering and so permit them to enter "quarrying", "coal mining", "metalliferous mining" or the "petroleum industry", and to be employed in any of the phases of these industries, ranging from exploration to production in a technical or managerial role.

To cater for the varied needs of the industry and to develop the special talents of individual students, it is possible in the final year of the course to do advanced work in either Mining Engineering or Mineral Processing. In addition, during the final year of the course students are given a project linked with the mineral industry elective for which a thesis must be submitted.

For the award of Honours at the conclusion of the full-time course students will need to have distinguished themselves in the formal work, in other assignments as directed by the head of the school and in the final year project.

In the undergraduate course it is compulsory for students to gain practical experience in the mineral industry during successive long recesses. The minimum requirement of 100 days is to be completed prior to entering Year 4. Students are advised, however, to gain mining experience in excess of the minimum specification in order to facilitate fulfilment of experience requirements for the State Mines Departments, Mine Managers Certificate of Competency in both Coal and Metalliferous Mining.

The industrial training requirement should be completed in the recesses following completion of academic Years 1, 2 and 3.

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 exempt from parts of the relevant examination.

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 1		Lec.	Lab. Tut.	Lec.	Lab. Tut.
1.001 1.031 1.051	Physics I *or* Physics IAS *or* Physics IE	3	3	3	3
2.001	Chemistry I *or*	3	3	3	3
2.021	Chemistry IE	3	3	0	0*
5.001	Engineering I *or*	3	3	3	3
5.021	Engineering IB	4	2	6	5*
10.011 10.001	Higher Mathematics Mathematics I	4	2	4	2

* 5.021 Engineering IB will be taken with 2.021 Chemistry IE.

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	2	0	0
8.510	Hydraulics	2	2	0	0
10.022	Mathematics	2	2	2	2
25.101	Geology for Engineers*	0	0	2	2
29.441	Engineering Surveying	1½	1½	1½	1½
29.491	Survey Camp	0	0	0	0
	General Studies Elective	1	½	1	½
		12½	11	12½	11

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

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.

YEAR 3		Hours per week SESSION 1 Lec.	Lab. Tut.
7.023	Mining and Mineral Process Engineering—Parts 1 and 2	2	2
7.113	Mining Engineering I	4	4
7.213	Mine Surveying and Control Engineering	1	1
25.102	Geology for Mining Engineers*	4	3
	Two General Studies Electives	2	1
		13	11

* 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.

YEAR 4		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
7.124	Mining Engineering II*	3	3	3	3
7.134 *or* 7.324	Mining Engineering III *or* Mineral Processing II	1	3	0	0
7.144 *or* 7.334	Mining Engineering IV *or* Mineral Processing III	0	0	1	3
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†	2	0	2	0
		10	15	10	15

* 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	
STAGES 1 and 2*		Lec.	Lab. Tut.
1.001 / 1.031	Physics I *or* Physics IAS	3	3
2.001	Chemistry I	2	4
5.001	Engineering I	3	3
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4	2
		12	12

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

		Hours per week			
		SESSION 1		SESSION 2	
STAGE 3		Lec.	Lab. Tut.	Lec.	Lab. Tut.
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	Mathematics II—Parts 1 & 2	2	2	2	2
		6	4	7	5

		Hours per week for 2 Sessions	
STAGE 4		Lec.	Lab. Tut.
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	
STAGE 5		Lec.	Lab. Tut.
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	½
		7	6½

* 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	½
		5	6½

* 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*		Hours per week for 2 Sessions Lec.	Lab. Tut.
1.001 / 1.031	Physics I *or* Physics IAS	3	3
2.001	Chemistry I	2	4
5.001	Engineering I	3	3
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4	2
		12	12

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

STAGE 3		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
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	Mathematics—Parts 1 and 2	2	2	2	2
	General Studies Elective	1	½	1	½
		5½	6½	6½	7½

STAGE 4		Hours per week for 2 Sessions Lec.	Lab. Tut.
2.511	Analytical Chemistry I	1	3
7.023R	Mining and Mineral Process Engineering—Parts 1 and 2*	1	1
10.331	Statistics	1	1
25.1011	Geology for Engineers†	1	1
25.201	Mineralogy	1	1
		5	7

* 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.

		Hours per week for 2 Sessions	
STAGE 5		Lec.	Lab. Tut.
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
		6	6½

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
		5	7½

† 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 / 1.011	Physics I *or* Higher Physics I *	3	3
2.001	Chemistry I	2	4
5.001	Engineering I	3	3
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4	2
		12	12

* Students who **do not** intend to take the Textile Physics Option may substitute 1.031 Physics IAS.

TEXTILE CHEMISTRY

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

YEAR 3			
2.003A / 2.003B	Chemistry III	2	4
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
		13	12

TEXTILE PHYSICS

		Hours per week for 2 Sessions	
YEAR 2		Lec.	Lab. Tut.
1.112 / 1.122	Physics II *or* Higher Physics II	5	3
10.331	Statistics	1	1
10.911 / 10.921	Mathematics II *or* Higher Mathematics II	5	1
13.111	Textile Technology I	3	5
13.211	Textile Science I	2	1
	General Studies Elective	1	½
		17	11½
YEAR 3			
1.213 / 1.223	Physics III *or* Higher Physics III	4	3
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
		15	11

TEXTILE ENGINEERING

YEAR 2			
5.301	Engineering Mechanics*	1½	½
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	1	1
13.111	Textile Technology I	3	5
13.211	Textile Science I	2	1
	General Studies Elective	1	½
		11½	12

* One session only.

YEAR 3			
5.111	Mechanical Engineering Design	2	2
5.331	Dynamics of Machines	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
		15½	12½

TEXTILE MANUFACTURE

		Hours per week for 2 Sessions	
YEAR 2		Lec.	Lab. Tut.
10.331	Statistics	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	–‡
15.101	Economics I	3	1
	General Studies Elective	1	½
		17	8½

* 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
26.122	Psychology	1½	½
28.104	Marketing Models and Systems	4	0
	General Studies Elective*	1	½
		17½	8

* 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	2	0
		11½	13

* 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 will require 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 will provide the course in Wool and Pastoral Sciences (Education Option), previously offered under the title "Sheep and Wool Technology (Education Option)" within the Board of Vocational 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	
YEAR 1		Lec.	Lab. Tut.
2.001	Chemistry I	2	4
10.001 10.011 10.021	Mathematics I *or* Higher Mathematics I *or* Mathematics IT	4	2
17.001	General and Human Biology	2	4
27.001	Geography*	2	4
		10	14

* Students wishing to specialize in Wool Science or Wool Technology may substitute 1.031 Physics IAS, or 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	½
		12	15½

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 3		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
		11	10	10	9
	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	½	1	½

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	*Agronomy*	9.231	*Pastoral Agronomy*	9.232 43.101C 43.102E	Crop Agronomy Plant Physiology Environmental Botany
17.001	*General and Human Biology*	9.601 9.121	*Animal Physiology I* *Livestock Production I*	9.602 9.122 9.123 9.131	Anim. Physiol. II L'stck Prodn. II L'stck Prodn. III *Animal Health and Prev. Medicine I*	9.603 9.421 9.123 9.132	Anim. Physiol. III Anim. Nutrition L'stock Prodn. III Anim. Health and Prev. Medicine II
2.001	*Chemistry I*	9.411	*Agricultural Chemistry I*	41.101	*Biochemistry I*	9.412	Agric. Chemistry II
10.001 10.011 10.021	*Mathematics I*	10.331	*Statistics*	9.801	*Genetics I*	9.811 9.802	*Biostatistics* Genetics II
				9.311 9.312 9.313 9.314 9.316	*Agricultural Economics I* Agricultural Economics II Farm Management I Farm Management II Analysis of Rural Development Projects	9.312 9.313 9.314 9.315 9.316 9.901	Agric. Economics II Farm Management I Farm Management II Farm Management III Analysis of Rural Development Projects Rural Extension
1.001 1.011 1.031	Physics I	9.531	*Wool Technology I*	9.532 9.533 9.534	Wool Technology II Wool Technology III Wool Technology IV	9.535 9.536	Wool Technology V Wool Technology VI

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	
YEAR 3		Lec.	Lab. Tut.	Lec.	Lab. Tut.
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
		17	6	17	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 Educational Issues	0	2	0	2
	General Studies Advanced Elective	1	1	1	1
		14	8	14	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 Applied Geophysics, Corrosion Technology, Food Technology, Fuel Technology, Polymer Technology, Mineral Technology, Mining 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

Courses Requiring Attendance at Formal Lectures

Students wishing to enrol in Master of Applied Science or Graduate Diploma courses must make application on the appropriate form to the Registrar at least two months in the case of graduate diplomas and six weeks in the case of Master's degrees, before the commencement of the course. Applicants will be advised whether they are eligible to enrol in the course concerned and of the subsequent procedure to be followed.

Later year enrolments must be made during Enrolment Week in accordance with the special arrangements made by the individual Schools.

No enrolments will be accepted after March 31 without the express approval of the Registrar which will be given in exceptional circumstances only.

Students who have completed the final examinations but have a thesis or project still outstanding are required to enrol for the period necessary to complete the thesis and to pay the requisite fees.

Research Degrees

Details of the procedure to be followed in order to enrol for a research degree are given in the statement of the conditions of award of the various higher degrees as set out in the Calendar.

POSTGRADUATE COURSE FEES*

MASTER OF APPLIED SCIENCE AND GRADUATE DIPLOMA COURSES

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 authorization of course programme.

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 March 31* except with the express approval of the Registrar, which will be given in exceptional circumstances only.

Payment of Fees by Session

Students who are unable to pay their fees by the year may pay by the session in which case they are required to pay Session 1 course fees and other fees for the year within the first two weeks of Session 1. Students paying under this arrangement will receive accounts from the University for Session 2 fees. These fees must be paid within the first two weeks of Session 2.

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.

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

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

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 give year of study, state whether full-time or part-time, course in which the applicant wishes to enrol, the reasons why payment cannot be made and the extension sought, and must be lodged before the date on which a late fee becomes payable. Normally the maximum extension of time for payment of fees is until March 31 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 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.

No student is eligible to attend the annual examinations in any subject where any portion of his course fees for the year is outstanding after the end of the fourth week of Session 2 (17th August, 1973).

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.

Basis of Fee Assessment

Where course fees are assessed on the basis of session hours of attendance, the hours for each subject for purposes of fee assessment shall be those prescribed in the calendar. The granting of an exemption from portion of the requirements of a subject in which a student is enrolled does not carry with it any exemption from the payment of fees.

(a) Master of Applied Science Courses

(i) Registration Fee $8
(ii) Graduation Fee $11
(iii) Course Fee — calculated on the basis of a session's attendance at the rate of $14.50 per hour per week.

Thus the fee for a programme requiring an attendance of 24 hours per week for the session is 24 x $14.50 = $348 per session.

(iv) Thesis or Project Fee—$57 (an additional fee of $39* is payable by students who have completed their final examinations for the degree but have not completed the thesis or project for which they have been previously enrolled).

(v) Thesis or Project Resubmission Fee† $39

(b) Graduate Diploma Courses

(i) Registration Fee $8

(ii) Award of Diploma Fee $11

(iii) Course Fee — calculated on the basis of a session's attendance at the rate of $14.50 per hour per week. Thus the fee for a programme requiring an attendance of 24 hours per week for the session is 24 x $14.50 = $348 per session.

(iv) Thesis or Project Fee—$57 (an additional fee of $39* is payable by students who have completed final examinations for the diploma but have not completed the thesis or project for which they have been previously enrolled).

(v) Thesis or Project Resubmission Fee† $57

(c) Miscellaneous Subjects

Postgraduate subjects taken as "Miscellaneous Subjects" (i.e. not for a degree or diploma) or to qualify for registration as a candidate for a higher degree are assessed on the basis of a session's attendance at the rate of $14.50 per hour per week. Thus the fee for a subject requiring an attendance of 2 hours per week for the session is 2 x $14.50 = $29 per session.

Other Fees

In addition to the course fees set out above, students in categories (a) and (b) are required to pay:

Library Fee—

Annual Fee, $19.

University Union—entrance fee—$20.

* Students paying this fee who are not in attendance at the University are not required to pay the Student Activities Fees or the Library Fee.

† Candidates paying this fee are not required to pay the Student Activities Fees or the Library Fee.

Student Activities Fees—

University Union†—$30—annual subscription.
Sports Association†—$4—annual subscription.
Students' Union†—$7—annual subscription.
Miscellaneous—$17—annual fee.

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

Review of examination result—$11 for each subject.

Late Fees

First Session

Fees paid from commencement of third week of the session to March 31	$20
Fees paid after March 31 where accepted with the express approval of the Registrar (see above)	$40

Second Session

Fees paid in third and fourth weeks of the session	$20
Fees paid thereafter	$40
Late lodgement of corrected enrolment details form (Late applications will be accepted for three weeks only after the prescribed dates.)	$8

Withdrawal

1. Students withdrawing from a course are required to notify the Registrar in writing. Fees for the course accrue until a written notification is received.

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 other than registration fee will be made.

3. Where a student terminates for acceptable reasons a course of study within thirty days of the commencement of Session 1 a refund of fees paid, less a sum of $39, may be made in respect of all fees except the University Union entrance and membership fees, the University of New South Wales Students' Union fee and the University of New South Wales Sports Association fee, in regard to which fees refunds may be made as shown hereunder.

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

4. Where a student terminates for acceptable reasons a course of study: (1) after the lapse of thirty days and before the lapse of half of Session 1, one half of each of the course fees, and the library fee, and the miscellaneous (student activities) fee may be refunded; (2) before the lapse of half of Session 2 one half of the session's course fees may be refunded.

5. Where a student terminates a course of study after half a session has elapsed, no refund may be made in respect of that session's fees.

6. No portion of the registration fee is refundable on withdrawal.

7. On notice of withdrawal a partial refund of the University Union entrance fee is 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.

8. On notice of withdrawal a partial refund of the 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 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 30th April a full refund is made, thereafter no refund.

9. Where initial registration 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.

RESEARCH DEGREES — FEES

(a) Master of Science* and Master of Engineering*

Fees are payable from the commencement date of a candidate's registration and remain payable until the candidate's thesis is presented to the Examinations Branch.

(i) Qualifying Examination	$19
(ii) Registration Fee	$8

* Candidates registered under the conditions governing the award of this degree without supervision will pay the following fees: Registration fee $7; Examination of thesis $98. They are not required to pay the Student Activities Fees or the Library Fee.

(iii) Internal full-time student annual fee	$114
Internal full-time student session fee	$57
(iv) Internal part-time student annual fee	$57
Internal part-time student session fee	$28.50
(v) External student annual fee†	$39
(vi) Final Examination	$57
(vii) Thesis Resubmission Fee†	$57

(b) Doctor of Philosophy

(i) Qualifying Examination	$19
(ii) Registration Fee	$8
(iii) Annual Fee	$114
(iv) Final Examination	$77
(v) Thesis Resubmission Fee†	$77

(c) Doctor of Science

(i) Registration Fee	$120

(d) Research Degree

Continuation Fee* $39

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 before the end of the next session, may pay, in lieu of the normal fees, a Continuation Fee of $39. The payment must be accompanied by a statement from the candidate's Head of School certifying that his work for the degree has reached this stage. If the thesis has not been submitted by the end of the session for which the concession was given, registration will revert to part-time candidature as from the beginning of the year with consequential adjustment of fees.

(e) Miscellaneous Subjects

Postgraduate subjects taken as "Miscellaneous Subjects" (i.e. not for a degree or diploma) or to qualify for registration as a candidate for a higher degree are assessed on the basis of a session's attendance at the rate of $14.50 per

† Candidates paying this fee are not required to pay the Student Activities Fees or the Library Fee.

* Students paying this fee who are not in attendance at the University are not required to pay the Student Activities Fees or the Library Fee.

hour per week. Thus the fee for a subject requiring an attendance of 2 hours per week for the session is 2 x $14.50 = $29 per session.

Research

One day per week—$39 per annum.
Two or three days per week—$75 per annum.
Four or five days per week—$114 per annum.

OTHER FEES

In addition to the fees set out above, all students in the categories (a) and (b) are required to pay:

Library Fee—Annual fee, $19.
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.

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 March 31 .... $20
Fees paid after March 31 where accepted with the express approval of the Registrar $40

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

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 all three should be from people familiar with the applicant's academic and professional performance.

Unless otherwise stated, the annual stipend for all scholarships is $2,600 per annum and a dependants' allowance at the rate of $450 per annum for a dependent wife and child (or children).

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.

Commonwealth Postgraduate Course Awards

The Commonwealth 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. They receive a stipend of $2,600 paid over the academic year. Other allowances are identical with those contained in the General Conditions, page 121

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

Commonwealth Postgraduate Research Awards

The Commonwealth Government is providing each year a number of awards for postgraduate study and research. The awards will be tenable for one year but may be extended for a period of up to four years.

Persons permanently domiciled in Australia and who are University graduates or who will graduate in the current academic year, are eligible.

The General Motors-Holden's Postgraduate Research Fellowships

General Motors-Holden's Limited has agreed to provide annually eight post-graduate research fellowships throughout Australia, three to be tenable in universities in New South Wales and the Australian Capital Territory. Graduates in any Faculty may apply, but preference will be given to graduates in Engineering, Science, Commerce or Economics. Stipend ranges in value from $3,000 to $3,400 p.a.

Atmospheric Pollution Research Fellowships

Fellowships for research on atmospheric pollution, having an annual value of $2,600-$4,000 each, are available to graduates in Science or Chemical Engineering. The fellowships are tenable for one year but may be re-awarded for a second or third year.

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.

Environmental Pollution Control Scholarships

Envirotech Australia Pty. Ltd. and George Kent (A.N.Z.) Pty. Ltd. each provide a scholarship for students proceeding to the degree of Master of Applied Science in Environmental Pollution Control. The scholarships have a value of $850 and are normally tenable for one year of full-time study. However, the awards may also be granted to students doing the course in two years of part-time study, in which case the value is $425 per annum. 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.

The Broken Hill Pty. Co. Ltd. Postgraduate Research Scholarships in Metallurgy

These scholarships are designed to promote study and research for a higher degree at Kensington and Wollongong University College in some branch of Metallurgy which has a direct relation to the activities of the donor company. Graduates in Science or Engineering are eligible to apply. The award carries an annual stipend of $2,700 and a dependant's allowance of $500, and is tenable for one to four years.

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 Board Research Scholarships in Textile Technology

Several scholarships are provided by the Australian Wool Board 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 up to $2,800 per annum, plus fees and certain allowances and are tenable for a maximum of four years, subject to annual renewal.

Australian Wool Board Research Scholarships in Wool and Pastoral Sciences

Scholarships provided by the Australian Wool Board 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 up to $2,800 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.

Commonwealth Service Awards

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

C.S.I.R.O. Studentships

Studentships have a value of $2,800 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 $2,350 to $2,650, plus University fees. The Institute also provides awards for post-doctoral research for one year renewable. The value of these awards is $4,500 to $6,000 p.a.

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 $2,800 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 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 Applied Geophysics by the School of Applied Geology; 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 Engineering and in Mineral Technology 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 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. It is designed to provide a bridge between water engineering and geology for graduates who wish to study and work in the field of water resources.

The normal requirement for admission to the course is a degree of Bachelor with Honours with geology as a major subject. Other graduates with suitable academic and professional attainments may be permitted to register for the course.

The following programme may be completed in either one year on a full-time basis or two years on a part-time basis.

		Hours per week for 2 Sessions	
		Lec.	Lab. Tut.
8.555G	Hydrology I	1½	1½
8.558G	Groundwater Hydrology	1½	1½
25.401G	Groundwater Investigations	1½	1½
25.402G	Hydrogeology	1½	1½
25.403G	Project	0	9
27.901G	Geomorphology for Hydrologists	1	2
		7	17

500. Applied Geophysics Graduate Course (Graduate Diploma)

The aim of this course is to train suitable graduates in Applied Science, Science and Engineering who wish to become applied or exploration geophysicists. The pre-requisites for the course are Physics and a Mathematics to second-year level, and Geology to first year level, in a first degree in Applied Science, Science or Engineering.

The Graduate Diploma in Applied Geophysics (Grad. Dip.) will be awarded on the successful completion of one year of full-time study.

		Hours per week for 2 Sessions Lec./Lab.
6.168G	Potential and Systems Theory in Geophysics	2
6.841	Electronic Instrumentation	2
10.331	Statistics†	1½
25.341G	Geology	4
25.321G	Geophysics	6
25.0044	Engineering Surveying	1½
		17

† Students who have satisfactorily completed a statistics course equivalent to 10.331 may elect to take the statistics components of 10.061G in the Master of Engineering Science course in Electrical Engineering.

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

		Hours per week for 2 Sessions Lec./ Lab.
(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
	Theoretical 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.

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

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†
		10

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.

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

The course is a blend of formal lectures and laboratory work at the undergraduate and post-graduate levels. The Diploma in Food Technology (Grad. Dip.) 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
		18

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
42.201G	Principles of Biology	1
42.202G	Principles of Biochemistry	2½
42.203G	Biochemical Methods	1½
42.204G	Microbial Processes	1
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 post-graduate levels.

		Hours per week for 2 Sessions Lec./Lab.
A. Introductory Stage (up to nine hours per week)		
3.381	Principles of Fuel Technology	3
3.382	Combustion Engineering	3
3.383	Fuel Plant Evaluation and Assignments	3
		9
B. Advanced Stage (up to nine hours per week)		
3.390G	Post-graduate Seminar	1
	Advanced Electives*	8
		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

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
22.341G	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
22.342G	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 postgraduate 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 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 to 8
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 two postgraduate courses, one in Mineral Technology and the other in Mining Engineering, both leading to the award of a Graduate Diploma (GradDip).

504. Mineral Technology Graduate Course (Graduate Diploma)

The Graduate Diploma Course in Mineral Technology is designed to provide professional training for graduates in science, applied science or engineering who wish to specialize in the fields of mineral processing, including coal preparation. The course is concerned primarily with instruction in the scientific and engineering principles associated with the beneficiation of minerals and coal to convert them to marketable commodities.

The Graduate Diploma in Mineral Technology (Grad. Dip.) 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 either the beneficiation of minerals or the preparation of coal.

		Hours per week SESSION 1 Lec./Lab.	SESSION 2 Lec./Lab.
YEAR 1—PART-TIME			
7.023	Mining and Mineral Process Engineering, Parts 1 and 2	4	0
7.311G	Mineral Processing	0	5
25.201	Mineralogy, Parts 1 and 2	2	2
		6	7
YEAR 2—PART-TIME			
7.322G	Mineral Processing Technology	3	3
7.332G	Mineral Engineering—Laboratory	3	3
		6	6

When appropriate, up to 3 hours per week may be selected from approved courses offered by other Schools within the University.

505. Mining Engineering Graduate Course (Graduate Diploma)

The postgraduate course leading to a Graduate Diploma in Mining Engineering (GradDip.) has been established to provide graduates in the fields of engineering, surveying, and some areas of applied science with advanced training in the following aspects of mining engineering:

Tunnelling and quarrying.

Metalliferous and coal mining.

Petroleum engineering and other non-entry methods.

It should be noted that some degree of specialization will be possible in the mining engineering laboratory investigations.

The following programme may be completed in one year of full-time study or over two years on a part-time basis.

		Hours per week SESSION 1 Lec./Lab.	SESSION 2 Lec./Lab.
YEAR 1—PART-TIME			
7.023	Mining and Mineral Process Engineering, Parts 1 and 2	4	0
7.111G	Mining Engineering	0	6
7.213	Mine Surveying and Control Engineering	2	0
		6	6

YEAR 2—PART-TIME

7.122G	Mining Engineering Technology	4	4
7.132G	Mining Engineering Laboratory	3	3
		7	7

Where appropriate, up to three hours per week may be devoted to approved courses 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)

Undergraduate students in all faculties other than Arts are required to study a number of General Studies subjects. Text 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

For students taking 2 full years of Physics

Mechanics. Wave motion and sound. Physical optics. Electricity and magnetism.

TEXTBOOKS

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

Bueche, F. *A Workbook in Physics for Science and Engineering Students*, McGraw-Hill.

Dunlop, J. I., and Mann, K. *Introductory Electronics*. Clarendon.

Russell, G. J., Dunn, I & Higinbotham, J. *Laboratory Notes for Physics I*. U.N.S.W.

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

1.011 Higher Physics I

As for 1.001 but treated at greater depth.

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., Dunn, I. & Higinbotham, J. *Laboratory Notes for Physics I*. U.N.S.W.

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.

1.031 Physics I (For students taking only **one** year of Physics)

Mechanics I. Kinematics. Centripetal acceleration. Newton's laws of motion. Momentum. Impulse. Work, energy and power. Friction. Conditions of equilibrium. *Mechanics II.* Collisions. Coefficient of restitution. Moment of Inertia. Rotational dynamics. Conservation of angular momentum. Gravitation. Kepler's laws. Planetary motion. *Wave Motion.* Simple harmonic motion. Equation of wave motion. Longitudinal and transverse waves. Sound waves. Superposition of waves. Energy current. Stationary waves. Resonance. Beats, Doppler effect. *Optics.* Electromagnetic spectrum, Huygens' wave principle. Reflection. Plane and spherical mirrors. Refraction. Lenses. Dispersion. Aberrations. Optical instruments. Interference. Diffraction. Resolution. Grating. Plane polarized light. *Properties of Matter.* Hydrostatics. Pressure. Pascal's and Archimedes' principles. Hydrodynamics. Bernouilli's theorem. Viscosity. Surface tension. Elasticity. Young's, bulk and shear moduli. Poisson's ratio. *Electrostatics, Electromagnetism and D.C. Circuits.* Coulomb's Law. Electric field. Electric potential. Capacitance. Electrical energy sources. Conductors. Resistivity. Atomic view of conduction. EMF. Kirchhoff's Laws. Magnetic induction. Torque on a coil in magnetic field. Moving coil meter. Wheatstone's bridge. Potentiometer. Faraday's Law. Transient circuits. *A.C. circuits.* Series LRC circuits. Reactance and impedance. Power factor. Phase amplitude diagram and complex notation. Series and parallel resonance. Transformer. A.C. instruments. *Heat.* Temperature measurement. Heat capacity. First law of thermodynamics. Calorimetry. Atomic heat of solids. Kinetic theory. Non-ideal gases. Van der Waals' equation. P-V isotherms. Conduction and radiation of heat. Pyrometers.

TEXTBOOKS

Giutronich, J. E. *Electricity.* Clarendon.
Halliday, D., and Resnick, R. *Physics for Students of Science and Engineering.* Vol. I. Wiley, 1960.
Lishmund, R. E. *Introductory Physical and Geometrical Optics.* N.S.W.U.P.
Russell, G. J., Dunn, I. & Higinbotham, J. *Laboratory Notes for Physics I.* U.N.S.W.
Russell, G. J., and Mann, K. *Alternating Current Circuit Theory.* N.S.W.U.P.

1.112A Electromagnetism

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

TEXTBOOKS

Coster, H. G. L. *Experimental Physics.* U.N.S.W.
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.* U.N.S.W.

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
Crawford, P. S. *Waves.* McGraw-Hill, 1968.
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.
Coster, H. G. L. *Experimental Physics.* U.N.S.W.

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.
Coster, H. G. L. *Experimental Physics.* U.N.S.W.

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.

TEXTBOOKS

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

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

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

Wert, C. A. & Thomson, R. M. *Physics of Solids*. Int. Student ed. McGraw-Hill, 1964.

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

Ander, P., & Sonnessa, A. J. *Principles of Chemistry*. Collier-Macmillan, 1966.

Aylward, G. H., & Findlay, T. J. V. eds. *SI Chemical Data*. Wiley, 1971.

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

Chemistry I Laboratory Manual. N.S.W.U.P., 1971.

Hart, H. & Schuetz, R. D. *Organic Chemistry*. Houghton Mifflin, 1972.

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

Turk, A., Meislich, H., Brescia, F. & Arents, J. *Introduction to Chemistry*. Academic Press, 1968.

REFERENCE BOOKS

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. Longmans, 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*. 2nd ed. McGraw-Hill, 1966.

Shaw, D. J. *Introduction to Colloid and Surface Chemistry*. 2nd ed. Butterworth, 1970.

REFERENCE BOOKS

Alexander, A. E., & Johnson, P. *Colloid Science*. Oxford, 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 ed. Longmans, 1963.
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.

One of the following:

Cheronis, N. D., & Entrikin, J. B. *Identification of Organic Compounds*. Wiley International Edition.
Shriner, R. L., Fuson, R. C., & Curtin, D. Y. *Systematic Identification of Organic Compounds*. 5th ed. Wiley, 1964.
Vogel, A. I. *Elementary Practical Organic Chemistry*. Pt. II. Qualitative Organic Analysis. Longmans, 1957.

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

Barrow, G. M. *Physical Chemistry*. 2nd ed. McGraw-Hill, 1966.
Daniels, F. et al. *Experimental Physical Chemistry*. 7th ed. McGraw-Hill, 1970.
Dixon, R. N. *Spectroscopy and Structure*. Methuen, 1965.
Laidler, K. J. *Chemical Kinetics*. 2nd ed. McGraw-Hill, 1965.

REFERENCE BOOKS

Amdur, I., & Hammes, G. G. *Chemical Kinetics*. McGraw-Hill, 1966.
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.
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.
Golding, R. M. *Applied Wave Mechanics*. Van Nostrand, 1969.
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.

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.

One of the following:

Cheronis, N. D. & Entrikin, J. B. *Identification of Organic Compounds*. Wiley Int. ed.
Shriner, R. L., Fuson, R. C. & Curtin, D. Y. *Systematic Identification of Organic Compounds*. 5th ed. Wiley, 1964.
Vogel, A. I. *Elementary Practical Organic Chemistry*. Pt. II. Qualitative Organic Analysis. Longmans, 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. Longmans, 1971.
Whitham, G. H. *Alicyclic Chemistry*. Oldbourne Press.

2.022 Chemistry IIM

Units 2.002A (Physical Chemistry) and 2.002C (Inorganic Analytical Chemistry) of 2.002 Chemistry II.

2.211 Applied Organic Chemistry

Selected topics at advanced level of commercially important groups of organic materials.

Theoretical chemistry, physical properties, thermal and photo-initiated processes and methods of examination in an overall unit approach correlating structure with behaviour. Emphasis is placed on breakdown to model systems.

Theory of physical techniques, refractometry, polarimetry, etc., from basis of additivity, spectroscopy, visible and ultra-violet definitions and chromophores. Fatty acids with emphasis on unsaturation, thermal and oxidative polymerizations and alkyd resins, analysis of mixtures, isomerizations, clathrates, etc. Waxes, sterols. Essential oils, review of terpenoid materials, mono-, sesqui-, and diterpenoids, analytical chemistry, correlation of physical constants with composition, methods for individual classes of constituents. Alkaloids and fine chemicals, assays and basis of group separation procedures. Vitamins, synthesis, structural analysis, stability and determination. Antibiotics, treatment of commonly used materials, penicillin, etc. Chromatography of organic materials, theory of processes. Solvent-solute relationships. Synthetic and vegetable insecticides, e.g., pyrethrum and organophosphorus group. Synthetic resins and high polymers, polymerization processes—initiation and inhibitor efficiencies and measurements, thermal and photo degradation, identification and analysis problems. Sulphur in the vulcanization process. Mechanisms in sulphur chemistry. Ozone-processes. Anti-ozonants, mode of action.

REFERENCE BOOKS

Carney, T. P. *Laboratory Fractional Distillation.* Macmillan, 1949.
Flory, P. J. *Principles of Polymer Chemistry.* Cornell, 1953.
Heftmann, E. *Chromatography.* 2nd ed. Reinhold, 1967.
Kan, R. O. *Organic Photochemistry.* McGraw-Hill, 1966.
Kharasch, N. *Organic Sulphur Compounds.* Vol. I, 1961.
Lenz, R. W. *Organic Chemistry of Synthetic Polymers.* Interscience, 1967.
Markley, K. L. *The Fatty Acids.* 2nd ed. Interscience, 1960-67.
Pinder, A. R. *Chemistry of the Terpenes.* Chapman & Hall, 1960.
Pryor, W. A. *Mechanisms of Sulphur Reactions.* McGraw-Hill, 1962.
Schwarz, J. C. P. *Physical Methods in Organic Chemistry.* Oliver & Boyd, 1964.
Scott, G. *Atmospheric Oxidation and Antioxidants.* Elsevier, 1965.
Solomon, D. H. *Organic Film Formers.* Wiley, 1967.

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

Subject description, text and reference books as for 2.002A Chemistry II (Physical Chemistry).

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 Al. 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. Oxford, 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.)

SCHOOL OF CHEMICAL ENGINEERING

GENERAL

In addition to drawing instruments, set squares, protractor and scale-rules, which will be obtained as specified for subject 5.001 Engineering I, 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*) *Principles of Momentum Transfer*—Introduction and units. Classification of fluids—Newtonian and non-Newtonian flow, pressure gauges and manometers. Fluid pressure in pipes and cylinders. Fluid motion, critical velocity, Reynolds number. Bernoulli's theorem—flow in converging and diverging ducts. Orifice and venturi meters—weirs—rotameters. Flow of compressible and non-compressible fluids and Pitot tubes and gas flow measurement.

(*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.
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, psychometric 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

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.

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.* Oxford, 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.

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., 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. Brief outline of flexural considerations.

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. McGraw-Hill.
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.
B.S. 3274:1960 *Tubular Heat Exchangers.* British Standards Institution.

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.
Johns, V. B. *Introduction to Engineering Materials.* Macmillan, 1972.
Kern, D. *Process Heat Transfer.* McGraw-Hill, 1950.
Nelson, W. L. *Petroleum Refinery Engineering.* 4th ed. McGraw-Hill. Int. Student ed. 1958.
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.

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

Optimization methods. Computer programming and operating systems and mathematical modelling. An advanced treatment of combined heat, mass and momentum transfer. The equations of conservation from the transport phenomena viewpoint.

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.
Conte, S. D. *Elementary Numerical Analysis.* McGraw-Hill, 1965.

REFERENCE BOOKS

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. (*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. (*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.* Wiley, 1963.
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.

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.
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.
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

An advanced treatment of the principles of chemical engineering including stagewise operations, fluid and particle mechanics, diffusion and separation and heat transfer.

TEXTBOOKS

Bird, R. B., Stewart, W. E., & Lightfoot, E. N. *Transport Phenomena.* Wiley, 1962.
Hughes, W. F., & Brighton, J. A. *Fluid Dynamics.* Schaum, 1967.
Treybal, R. *Mass Transfer Operations.* McGraw-Hill, New York, 1968.

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.

TEXTBOOKS
As for 3.134 Advanced Chemical Engineering Principles.

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—nonmetallic:* 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.

3.190G 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
Duckworth, R. B. *Fruit and Vegetables.* Pergamon, 1966.

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.
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

Fluid flow and heat transfer — common with sections of the subject 3.111 Chemical Engineering I. A study of other unit operations relevant to food processing from the viewpoint of theory, equipment characteristics and materials of construction.

TEXTBOOKS

Earle, R. L. *Unit Operations in Food Processing.* Pergamon, 1966.
Brennan, J. G., Butters, J. R., Cowell, N. D. and Lilly, A. E. V. *Food Engineering Operations.* Elsevier, 1969.

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*. Butterworth.
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.

3.481G 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 Projects

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 soilds. 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 physicochemical 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

For the Mineral Processing section see under 7.023 (Part 2) Mining and Mineral Process Engineering (School of Mining Engineering).

Barrett, C. S. *Structure of Metals.* 3rd ed. McGraw-Hill.

Bodsworth, C. & Appleton, A. S. *Problems in Applied Thermodynamics.* Longmans.

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.

REFERENCE BOOKS

As for 4.001 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. *Physiochemical Measurements at High Temperatures.* Butterworth.

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.* Butterworth.
Stewart, D. & Tulloch, D. S. *Principles of Corrosion and Protection.* Macmillan.
Tetelmann, A. S. & McElivy, 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 p. C44.

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 p. C44.

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.* Butterworth.
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.* Inst. M.M., London.
Hinsley, J. F. *Non-Destructive Testing.* Macdonald and 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; scatter-

ing. 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 subjects 5.001 Engineering I and 5.011 Engineering IA.

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 and 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. 4. Wiley.

REFERENCE BOOKS

Azaroff, L. V. & Brophy, J. J. *Electronic Processes in Materials.* McGraw-Hill.

Pfann, W. G. *Zone Melting.* 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 electrodeposits; 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

5.001 Engineering I

A. *Introduction to Engineering*

(i) *Engineering Technology*: *Materials*. Classification of materials in common use, occurrence of raw materials, processing of raw materials, refinements and properties of materials.

(ii) *Computers—Introduction and Concepts*: Introduction to computers to follow the computer work in Mathematics I. To develop:—(a) familiarity with algorithms; (b) the use of procedure oriented languages; and (c) an introduction to computing equipment.

Systems—Introduction and Concepts: Concepts and Introduction to Systems. To give students an appreciation of some of the concepts used in engineering, to relate the concepts to phenomena within their experience, and to illustrate them by case histories and engineering examples. Quantities. Concepts. Components. Systems.

(iii) *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.

TEXTBOOKS

Karbowiak, A. & Huey, R. M. eds. *Information, Computers, Machines and Humans*. N.S.W.U.P.

Harrisberger, L. *Engineersmanship*. Wadsworth.

or

Krick, E. V. *Introduction to Engineering and Engineering Design*. Wiley.

B. *Engineering Mechanics*

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.

TEXTBOOK

Meriam, J. L. *Statics*. Wiley.

C. *Engineering Drawing*

Fundamental concepts of descriptive geometry, including reference systems, representation of point, line and plane; fundamental problems of position and of 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.

TEXTBOOKS

Robertson, R. G. *Descriptive Geometry*. Pitman.

Thomson, R. *Exercises in Graphic Communications*. Nelson.

5.011 Engineering IA

A. *Introduction to Engineering*

(i) (a) *Engineering Technology: Materials.* Classification of materials in common use, occurrence of raw materials, processing of raw materials, refinements and properties of materials.

(b) *Manufacture:* Description and appraisal of the processes classified as: forming from liquid or solid, material removal, material joining. *Machines.* Analysis of the primary functions of the machine tools and an appraisal of their limitations. Principles of operation of common machine tools and illustration of their use.

(ii) *Engineering Design:* Engineering method, problem identification, creative thinking, mathematical modelling, computer aided design, materials and processes, communication of ideas, engineering in society.

(iii) As for 5.001 Engineering I, Part A, (ii).

TEXTBOOKS

As for 5.001, together with:

De Garmo, E. P. *Materials and Processes in Manufacturing.* Macmillan.

B. *Engineering Mechanics*

(i) *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.

(ii) *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.

TEXTBOOKS

Meriam, J. L. *Dynamics.* Wiley.

Meriam, J. L. *Statics.* Wiley.

C. *Descriptive Geometry*

Fundamental concepts of descriptive geometry, including reference systems, representation of point, line and plane; fundamental problems of position and of 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.

TEXTBOOK

Robertson, R. G. *Descriptive Geometry.* Pitman.

5.021 Engineering IB

A. *Introduction to Engineering*

(i) *Introduction to materials:* Traditional and new engineering materials. Structure of crystaline and amorphous solids. Phase diagrams. Transformations on constant temperature and constant cooling rate. Mechanical properties of materials. Experimental techniques. Effect of temperature on material behaviour. Polymers. Elastomers.

(ii) *Engineering Design:* As for 5.011 Engineering IA, Part A (ii).

(iii) *Mechanics of Solids I:* Statics of bars. Free-body diagrams, bending moment, shear force, axial force. Direct stress and strain. Hooke's Law. Poisson's Ratio. Compound bars. Flexibility and stiffeners. Simple theory of bending. Shear flow and shear stress. Torsion. Strain energy. Mohrs circle of stress and strain. Combined stresses.

TEXTBOOKS
Hall, A. S. *Introduction to the Mechanics of Solids.* Wiley, 1968.
Harrisberger, L. *Engineersmanship.* Wadsworth.
or
Krick, E. V. *Introduction to Engineering and Engineering Design.* Wiley.
Richards, C. W. *Engineering Materials Science.* Chapman & Hall.

B. *Engineering Mechanics*

As for 5.011 Engineering IA, Part B.2.

TEXTBOOKS
Meriam, J. L. *Dynamics.* Wiley.
Meriam, J. L. *Statics.* Wiley.

C. *Descriptive Geometry*

As for 5.011 Engineering IA, Part C.

5.111 Mechanical Engineering Design I

Prerequisite: 5.011. 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., 1966.
De Garmo, E. P. *Materials and Processes in Manufacturing.* Macmillan.
Faires, V. M. *Design of Machine Elements.* Collier-Macmillian.

5.301 Engineering Mechanics

Prerequisites: 1.051, 5.001. Co- or prerequisite: 10.001.

Kinematics and kinetics of the plane motion of particles. Rectilinear, curvilinear and relative translational motion; work and energy; impulse and momentum.

TEXTBOOK
Meriam, J. L. *Dynamics.* Wiley, 1966.

5.311 Engineering Mechanics

Prerequisites: 1.051, 5.011. 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: 1.051, 5.011, 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: 1.051, 5.011, 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.* 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.

6.841 Electronic Instrumentation

Fundamentals of electronic instrumentation, in particular the operation and use of equipment at audio and sub-audio frequencies for the measurement and recording of small signals in the presence of noise. The laboratory course comprises mainly demonstration experiments.

TEXT AND REFERENCE BOOKS

To be advised in class.

6.168G Potential and Systems Theory in Geophysics

Two strands: (i) potential theory, exploited by the use of analogies with the electric transmission line; (ii) linear systems theory as developed for use by the electrical engineer with some bias towards applications to mechanical and elastic problems and to electronic circuits. The latter strand is largely covered by attendance at 6.801, parts A and C. Tutorial and laboratory work as appropriate.

TEXTBOOK

Lynch, W. A., and Truxal, J. G. *Signals and Systems.* 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 1966.* 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.

7.023 and 7.023R Mining and Mineral Process Engineering

1. Mining Engineering: a technical introduction to mining engineering, further definitions and principles, types of mineral deposits. Prospecting. Classification of mining methods, applications to underground and surface; 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 processes. Liberation, comminution, particle size analysis: gravity, magnetic, electrostatic separation: froth flotation dewatering. Process design, flowsheets. Tutorial exercises, demonstrations or visits to plants.

TEXTBOOKS

Gaudin, A. M. *Principles of Mineral Dressing.* McGraw-Hill.
Lewis, R. S. & Clark, G. B. *Elements of Mining.* Wiley.

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.
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 Australia 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.

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.
Myers, *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

Metcalfe, 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.* Butterworth.
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.

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.* Butterworth.
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.

7.411 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.

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. *Interfacial Phenomena in Mineral Processing*

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 structure, electrical double layer interaction. Adsorption mechanisms.

12. *Advanced Flotation Theory*

Sulphide mineral flotation, xanthate chemistry, oxide mineral flotation, salt mineral flotation, calcium mineral flotation.

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.

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 ENGINEERING GRADUATE SUBJECTS

7.111G Mining Engineering

I. Rock mechanics, behaviour and control of extraction openings in metalliferous, coal and non-entry mining. Techniques in deep mining.

II. Non-entry methods of mineral production, sub- surface horizons, conditioning of extraction horizon, fluid thermal and chemical factors.

TEXTBOOKS

Baxter, C. H. & Parks, R. D. *Examination and Valuation of a Mineral Property*. Addison-Wesley.
Fox, A. F. *The World of Oil*. Pergamon.
Jaeger, J. C. *Elasticity, Fracture and Flow*. Science Paperback, 1971.
Lewis, R. S. & Clark, G. B. *Elements of Mining*. Wiley.
Peele, R. *Mining Engineers Handbook*. 3rd ed. Vols I and II. Wiley.

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; and application of analogues.

2. Materials handling: fundamental concepts. Surface and underground haulage systems; design problems in conveyors and locomotives; mine hoisting, design criteria, problems.

3. Mineral economics: fluctuations in mineral and metal markets; mine contract systems; labour force requirements. International economics of mineral production. Management of resources applied to mineral development. Derivation of supply and demand prediction techniques. Practical use of mine programming techniques.

4. Mine design: separation of functions for maximum efficiency; application of analogue and digital computers. Rock fragmentation techniques in the mining industry.

TEXTBOOKS

As for 7.111G Mining Engineering.

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.

TEXTBOOKS

As for 7.111G Mining Engineering.

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. Each student will write a critical review of the operations which have been analyzed.

MINERAL TECHNOLOGY GRADUATE SUBJECTS

7.311G Mineral Processing

Processing economics: mineral processing and its integration with mining, metallurgical and chemical operations. Applied mineralogy, gravity separation processes, electrostatic and magnetic separation. Particle size distribution and analysis. Mathematical analysis of the technology of comminution.

TEXTBOOKS

Cameron, E. N. *Ore Microscopy*. Wiley.
Rose, H. E. & Sullivan, R. M. *Ball Tube and Rod Mills*. Constable.
Taggart, A. F. *Handbook of Mineral Dressing*. Wiley.

7.322G Mineral Processing Technology

Surface chemistry of mineral particles, flotation, flocculation. Chemical processing and extraction. Fluid mechanics of particle and fluid systems, thickening classification. Material handling. Coal preparation technology, Process engineering, selection and design, flow sheets, plant design.

TEXTBOOKS

Arbiter, N. *Milling Methods in the Americas*. Gordon & Breach Sci. Pub.
Gaudin, A. M. *Flotation*. 2nd ed. McGraw-Hill.

REFERENCE BOOKS

As for 7.334 Mineral Processing III

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 bearing fluids.

TEXTBOOK

Taggart, A. F. *Handbook of Mineral Dressing*. Wiley.

7.442G Mineral Industry Analysis

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. Each student will write a critical review of the operations which have been analyzed.

SCHOOL OF CIVIL ENGINEERING

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. *Introduction to Mechanics of Solids.* Wiley, 1968.

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.

8.243 Soil Mechanics

History and development of soil mechanics. Determination of simple soil properties. Formation of soils. Classification tests. Soil sampling and field assessment. Clay mineralogy. Soil compaction. Permeability. Darcy's Law, laboratory determinations, seepage flow. Compression of soils, laboratory methods, consolidation phenomena, settlement analysis. Retaining walls, classical theories. Slope stability.

TEXTBOOKS

Lambe, T. W. & Whitman, R. V. *Soil Mechanics.* Wiley, 1969.

Terzaghi, K. & Peck, R. B. *Soil Mechanics in Engineering Practice.* 2nd ed. Wiley.

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

Richards, C. W. *Engineering Materials Science.* Chapman & Hall.

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.

8.555G Hydrology I

Scope of hydrology, the hydrologic and runoff cycles, water and energy balances, radiation, atmospheric moisture, precipitation, evaporation, ground-water. Streamflow: streamgauging, hydrograph analysis, loss rates, storm rainfall-runoff relations, design storms, unitgraphs, rational method, flood frequency analysis. Yield: water balance, rainfall-runoff relations, streamflow correlations storage-yield analysis. Collection and processing of hydrologic data.

TEXTBOOK
Linsley, R. K., Kohler, M. A. & Paulus, J. L. H. *Hydrology for Engineers.* McGraw-Hill, 1958.

8.558G Groundwater Hydrology

Occurrence and distribution of groundwater. Mechanics of flow in saturated porous materials. Confined and unconfined aquifers, aquifer characteristics. Steady and unsteady radial flow to wells, constant discharge and constant drawdown conditions. Leaky aquifers, partial penetration, multiple aquifer boundaries, delayed yield from storage, step drawdown analysis, safe yield. Analogue and digital models of groundwater systems. Surface water-groundwater relationships. Recharge of groundwater. Water movement in the unsaturated zone, instrumentation, hydrologic characteristics of unsaturated soil, infiltration, drainage, computer solutions. Groundwater quality, salinity. Sea water intrusion. Introduction to conformal transformation solutions.

TEXTBOOKS
Childs, E. C. *An Introduction to the Physical Basis of Soil Water Phenomena.* Wiley, 1969.
Walton, W. C. *Groundwater Resource Evaluation.* McGraw-Hill, 1970.

REFERENCE BOOKS
De Wiest, R. J. M. *Geohydrology.* Wiley, 1965.
Johnson, E. E. *Ground Water and Wells.* E. E. Johnson, 1966.

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

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.
Leeper, G. W. ed. *The Australian Environment.* 4th ed. M.U.P.

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.
Frandson, 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.* Butterworth.

9.122 Livestock Production II

Uses of cattle in the tropics and sub tropics. Adaptation of Bos indicus and B. taurus. Breeds of beef cattle and cross breeding, heterosis.

Types of beef cattle enterprise, size of units and capital costs; herd composition. Selection of breeding stock, and performance recording. Production of beef and veal, quality concepts.

Calendar of operations for beef breeding herds, and year round management, sale of stock.

TEXTBOOK

Cole, V. G. *Beef Cattle (Production) Guide.* Grazcos.

REFERENCE BOOKS

Beattie, W. A. *Beef Cattle Breeding and Management.* Pastoral Review.
Beattie, W. A. *Beef Cattle Industry of Australia.* C.S.I.R.O.

Belschner, H. G. *Cattle Diseases.* A. & R.
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. Longmans.
Phillips, R. W. *Breeding Animals Suited to Unfavourable Environments.* F.A.O.
Proceedings of Refresher Course for Veterinarians on Beef Production. Postgrad. Committee in Vet. Sci., Univ. of Syd.

9.123 Livestock Production III

The dairying and pig industries of Australia; patterns and trends. Principal breeds and their uses. Performance recording. 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.

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.

Carcase 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. *Carcase 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.
Barndard, C. S., Halley, R. J. & Scott, A. H. *Milk Production.* Butterworth.
Barton, R. A. *Quality Beef.*
Butterfield, R. M. & May, N. D. S. *Muscles of the Ox.* Q'ld. U.P.
Falconer, I. R. *Lactation.* Butterworth.
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.* Butterworth.
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; Deficiences; 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.* S.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. Insectides, 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.* Butterworth, 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.

REFERENCE BOOK

Ryder, M. L. & Stephenson, S. K. *Wool Growth.* Academic.

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.

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.

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.

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.

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.

TEXTBOOKS

Henderson, A. E. *Growing Better Wool.* A. H. & A. W. Reed.
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

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.
Nalbandov, A. V. *Reproductive Physiology.* 2nd ed. Freeman.
Richardson, G. S. *Ovarian Physiology.* Little Brown.
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. Butterworth.

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. Butterworth.
Richardson, G. S. *Ovarian Physiology.* Little Brown.
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 mamalian 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, interrelationships, genetics and livestock improvement.

TEXTBOOKS

Falconer, D. S. *Introduction to Quantitative Genetices.* 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 correlates 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.

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.
Kelly, G. M. *Introduction to Linear Algebra and Vector Geometry.* Reed Education, 1971.
Tetra, B. C. *Basic Linear Algebra.* Harper & Row.
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.
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.
Shields, P. C. *Elementary Linear Algebra.* Worth.
Smith, W. K. *Limits and Continuity.* Collier-Macmillan.
Spivak, M. *Calculus.* Benjamin.
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.

TEXTBOOKS

Blatt, J. M. *Introduction to Fortran IV Programming.* Prentice-Hall.
Fagg, S. V. *Differential Equations.* E.U.P.
Kelly, G. M. *Introduction to Linear Algebra and Vector Geometry.* Reed Education, 1971.
Spivak, M. *Calculus.* Benjamin.
Tetra, B. C. *Basic Linear Algebra.* Harper & Row.

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 IT

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

Kreyszig, E. *Advanced Engineering Mathematics.* Wiley.

REFERENCE BOOKS

Hildebrand, F. B. *Advanced Calculus for Applications.* Prentice-Hall.
Keane, A. & Senior, S. A. *Mathematical Methods.* Science.
Pipes, L. A. & Harvill, L. R. *Applied Mathematics for Engineers and Physicists.* 3rd ed. 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

Spiegel, M. R. *Advanced Mathematics for Engineers and Scientists.* McGraw-Hill.

REFERENCE BOOKS

Grove, W. E. *Brief Numerical Methods.* Prentice-Hall.
Hildebrand, F. B. *Advanced Calculus for Applications.* Prentice-Hall.
Keane, A. & Senior, S. A. *Mathematical Methods.* Science.
Pipes, L. A. & Harvill, L. R. *Applied Mathematics for Engineers and Physicists.* 3rd ed. McGraw-Hill.
Wylie, C. R. *Advanced Engineering Mathematics.* 3rd ed. McGraw-Hill.

10.032 Mathematics

Vector calculus; special functions; convolution theorem and application to integrals and integral equations; 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.

10.033 Electrical Engineering Mathematics III

Selections from the following topics:—Inversion theorem for Laplace transforms. Step and pulse functions and their transforms. Fourier transforms. Transmission line problems. Potential theory. Electromagnetic theory. Wave equations, orthonormal functions. Calculus of variations. Lagrangian and Hamiltonian mechanics.

TEXTBOOKS

Carslaw, H. S.. and Jaeger, J. C *Operational Methods in Applied Mathematics.* Dover.
Pipes, L. A. *Applied Mathematics for Engineers and Physicists.* 2nd ed. McGraw-Hill.

REFERENCE BOOKS

Churchill, R. V. *Fourier Series and Boundary Value Problems.* 2nd ed. McGraw-Hill.
Danese, A. E. *Advanced Calculus, Vol. I.* Allyn & Bacon.
Hague, B. *An Introduction to Vector Analysis.* Methuen.
Slater, J. C. & Frank, N. H. *Electromagnetism.* McGraw-Hill.
Tralli, N. *Classical Electromagnetic Theory.* McGraw-Hill.
Tranter, C. J. *Integral Transforms.* Methuen.

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

Morgan, C. T., & King, R. A. *Introduction to Psychology.* 4th ed. McGraw-Hill, 1971.

Hebb, D. O. *Textbook of Psychology.* 2nd ed. Saunders, London, 1966. (Recommended as an additional textbook for intending Honours students.)

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.

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 & Butterworth, London, 1960.
Howell, H. G., Mieszkis, K. W. & Tabor, D. *Friction in Textiles*. Butterworth, 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.
Schick, M. J. *Non-Ionic Surfactants*. Vols I & II. Arnold, 1967.
Schwarz, A. M. & Perry, J. W. *Surface Active Agents*. Intersci., 1958.
Vickerstaff, T. *The Physical Chemistry of Dyeing*. Oliver & Boyd, 1954.
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.* Butterworth, 1967.
Seydel, P. V. *Warp Sizing.* Smith Pub. Co., 1958.
Watson, W. *Advanced Textile Design.* 3rd ed. Longmans, 1955.
Watson, W. *Textile Design and Colour.* 6th ed. Longmans, 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.* Butterworth, 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.* Butterworth, 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.* Butterworth, London & Textile Inst., Manchester, 1964.
Manual of Cotton Spinning. Vol. III. *Carding.* Vol. V. *The Principles and Theory of Ring Spinning.* Butterworth, London & Textile Inst., Manchester, 1965.
Studies in Modern Yarn Production. Papers of the Textile Inst. Annual Conf. Textile Inst., Manchester, 1968.
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.

REFERENCE BOOKS FOR TEXTILE SCIENCE I and II

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.* Oxford, 1933.
Astbury, W. T. *Textile Fibres under the X-rays.* I.C.I.
Barrow, G. M. *The Structure of Molecules.* Benjamin, 1964.
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.
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.* Butterworth, 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. Oxford, 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. Merrow, 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.* Butterworth, 1954.
American Cotton Handbook. 2 Vols. 3rd ed. Wiley, 1965.

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.

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.
Staniar, 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

14.501 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, elementary computer programming and applications.

TEXTBOOKS

Carrington, A. S., and Battersby, G. B. *Accounting—Concepts, Systems, Applications.* Australian ed. Whitcombe & Tombs, 1971.
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, and an introduction to basic elements of taxation and auditing.

TEXTBOOKS

As for Accounting and Financial Management IA.

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.

PRELIMINARY READING

Halford, D. R. C. *Business Planning.* Pan, 1968.
Wasson, C. R. *The Economics of Managerial Decision.* Appleton-Century-Crofts, 1968.

TEXTBOOKS

Helfert, E. A. *Techniques of Financial Analysis.* Rev. ed., Irwin, 1967.
Weston, J. F. & Brigham, E. F. *Essentials of Managerial Finance and related Students Study Guide.* 2nd ed. Holt, Rinehart & Winston, 1971.

15.101 Economics I

Macroeconomic analysis related to the Australian economy, covering national income and product, introduction to macroeconomics, money and banking, theories of consumption, investment, liquidity preference and interest, the Keynesian model of income determination, economic growth.

Microeconomic analysis related to the Australian economy covering the concept of market demand, the theory of costs and production, supply and demand analysis including the determination of exchange rates and the effects of taxes, tariffs, subsidies and quotas, the firm and its reaction to economic and technological change, price and output determination under competitive monopolistic market structures, introduction to distribution theory and resource allocation.

Introduction to quantitative methods including elementary statistical inference, two-variable regression and matrix algebra.

TEXTBOOKS

Commonwealth of Australia. *Australian National Accounts: National Income and Expenditure 1970-71.* Commonwealth Bureau of Census and Statistics, Canberra, 1972.
Lipsey, R. G. *An Introduction to Positive Economics.* 3rd ed. Weidenfeld & Nicolson, 1971.
Rowan, D. C. *Output Inflation and Growth.* Macmillan, 1968.
Stilwell, J. A. & Lipsey, R. G. *Workbook to Accompany an Introduction to Positive Economics.* 2nd ed. Weidenfeld & Nicolson, 1971.
Throsby, C. D. ed. *Agricultural Policy.* Penguin, 1972.

15.102 Economics II

In 1973 only. Subsequently replaced by 15.122 Economics II or 15.142 Economics IIN.

SESSION 1

Unemployment and inflation; goals of macroeconomic policy; introduction to monetary, fiscal and incomes policies; money, credit and financial institutions; monetary policy in Australia; theory of fiscal policy; fiscal policy in Australia; Commonwealth-State financial relations.

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.
Runcie, N. *Economics of Instalment Credit.* Univ. of London Pub., 1969.
Runcie, N. ed. *Australian Monetary and Fiscal Policy.* Univ. of London Pub., Sydney, 1971.

SESSION 2

The application of microeconomic theory to pricing and investment decisions of firms. The nature and effects of oligopolistic competition, technological change, international trade and international corporations. Nature of benefit-cost analysis and its application to public investment decisions.

TEXTBOOKS

Findlay, R. *Trade and Specialization.* Penguin, 1970.
Lamberton, D. M. ed. *Industrial Economics.* Pelican, 1972.
McColl, G. D. ed. *Overseas Trade and Investment.* Pelican, 1972.
Needham, D. *Economic Analysis and Industrial Structure.* Holt, Rinehart & Winston, 1969.
Pearce, D. W. *Benefit-Cost Analysis.* Macmillan, 1971.

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

Livingstone, I. ed. *Economic Policy for Development.* Penguin, 1972.
Seers, D. & Joy, L. eds. *Development in a Divided World.* Penguin, 1971.
Sutcliffe, R. B. *Industry and Underdevelopment.* Addison-Wesley, 1971.

15.023 Economics IIIB

Theory and empirical evidence relating to international trade and investment, the balance of international payments, external balance, the international monetary system, tariffs, foreign investment, and multilateral and regional approaches to the expansion of international trade.

TEXTBOOKS

Cohen, B. *Balance of Payments Policy.* Penguin, 1969.
Dunning, J. H. ed. *International Investment.* Penguin, 1972.
McColl, G. D. ed. *Overseas Trade and Investment.* Pelican, 1972.
Robson, P. ed. *International Economic Integration.* Penguin, 1971.
Sodersten, B. *International Economics.* Macmillan, 1970.

15.412 Quantitative Economic Techniques A

Regression analysis including multiple regression and problems in simultaneous equation estimation.

TEXTBOOK

Walters, A. A. *An Introduction to Econometrics.* Papermac, 1968.

15.422 Quantitative Economic Techniques B

Linear programming, input-output analysis, difference equations and applications in economics.

TEXTBOOK

Puckett, R. H. *Introduction to Mathematical Economics.* Heath, 1971.

BIOLOGICAL SCIENCES

17.001 General and Human Biology

Characteristics of living organisms. Properties of living matter. Cell structure and function. Life cycles. An introduction to biochemistry, ultrastructure, genetics and cytology. Plant structure and function. Anatomy and physiology of vertebrate animals, human biology and variation. The biology of microorganisms. Evolution. Introductory Ecology. Practical work to illustrate the lecture course.

TEXTBOOKS

Abercrombie, M., Hickman, C. J. & Johnson, M. A. *A Dictionary of Biology*. Penguin, 1967.

Keeton, W. T. *Biological Science*. Norton, New York, 1967.

Kelly, P. J. ed. *Evidence and Deduction in Biological Science*. Penguin, 1970.

REFERENCE BOOKS

A. Books which cover some area of the course in greater detail than the text.

Aust. Acad. Sci. *Biological Science: The Web of Life*. Canberra, 1967.

Carter, C. O. *Human Heredity*. Penguin, 1962.

Galston, A. W. & Davies, P. J. *Control Mechanisms in Plant Development*. Prentice-Hall, 1971.

Jensen, W. A. & Park, R. B. *Cell Ultrastructure*. Wadsworth, 1967.

Kershaw, K. A. *Quantitative and Dynamic Ecology*. Arnold, 1964.

Loewy, A. G. & Siekevitz, P. *Cell Structure and Function*. 2nd ed. Holt, Rinehart & Winston, 1970.

Marshall, P. T. & Hughes, G. M. *The Physiology of Mammals and Other Vertebrates*. C.U.P., 1967.

Phillipson, J. *Ecological Energetics*. Arnold, 1966.

Postgate, J. *Microbes and Man*. Penguin, 1969.

Sutcliff, J. *Plants and Water*. Arnold, 1968.

Wilson, C. L. & Loomis, W. E. *Botany*. 4th ed. Holt, Rinehart & Winston, 1967.

Young, J. Z. *The Life of Mammals*. O.U.P., 1966.

Young, J. Z. *An Introduction to the Study of Man*. Clarendon, 1971.

B. Books which provide much relevant material for reference and general reading.

Baker, J. J. W. & Allen, G. E. *Matter, Energy and Life*. 2nd ed. Addison-Wesley, 1970.

Baldwin, E. *The Nature of Biochemistry*. 2nd ed. C.U.P., 1967.

Bold, H. G. *The Plant Kingdom*. 3rd ed. Prentice-Hall, 1970.

Buchsbaum, R. *Animals without Backbones*. Penguin, 1963.

Burnett, A. L. & Eisner, T. *Animal Adaptation*. Holt Rinehart & Winston, 1964.

Fogg, G. E. *Growth of Plants*. Penguin, 1963.

Galston, A. W. *The Life of the Green Plant*. Prentice-Hall, 1964.

Hanson, E. D. *Animal Diversity*. Prentice-Hall, 1964.

Harrison, G. A. et al. *Human Biology*. O.U.P., 1964.

Howell, F. C. *Early Man*. Time-Life, 1966.

Kennedy, D. ed. *From Cell to Organism*. Freeman, 1967.

Laughlin, W. S. & Osborne, R. H. eds. *Human Variation and Origins*. Freeman, 1967.

McElroy, W. D. *Cell Physiology and Biochemistry*. 2nd ed. Prentice-Hall, 1970.

Romer, A. S. *Man and the Vertebrates*. Penguin, 1963.

Sawson, C. P. *The Cell*. 3rd ed. Prentice-Hall, 1970.
Schmidt-Nielsen, K. S. *Animal Physiology*. 3rd ed. Prentice-Hall, 1970.
Weiner, J. S. *Man's Natural History*. Weidenfeld & Nicolson, 1971.
Wessells, N. K. ed. *Vertebrate Adaptations*. Freeman, 1969.

Requirements for Practical Work

A list of equipment required for practical work will be posted on the notice board in the ground floor of the Biological Sciences Building. Students must purchase this material *before* the first practical class.

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, interrelationships and information flow. Sampling techniques in quality control, control charts. *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

TEXTBOOK

Taha, H. A. *Operations Research: An Introduction.* Macmillan, 1971.

REFERENCE BOOKS

Gass, S. L. *Linear Programming.* 2nd ed. McGraw-Hill, 1964.

Hanssmann, 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—fermentation, cellulose, acetylene, polymers, methanol and formaldehyde, sugar.

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.

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.
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.* Butterworth.
Margerison, D. & East, G. C. *Introduction to Polymer Chemistry.* Pergamon.
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.
Ryshkewitch, E. *Oxide Ceramics: Physical Chemistry and Technology.* Academic.
Salmang, H. *Ceramics: Physical and Chemical Fundamentals.* Butterworth.
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 equipment to the analysis of process streams.

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.

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; tubular reactors; fixed-bed catalytic reactors; moving bed catalytic reactors; optimization; and scale-up of reactors.

REFERENCE BOOKS

Garner, W. E. ed. *Chemistry of the Solid State.* Butterworth.
Griffith, R. H. & Marsh, J. D. *Contact Catalysis.* Butterworth.
Hinshelwood, C. H. *Kinetics of Chemical Change.* O.U.P.
Rees, A. L. G. *Chemistry of the Defect Solid State.* Methuen.
Rietema, K. ed. *Chemical Reaction Engineering.* Pergamon.
Levenspiel, O. *Chemical Reaction Engineering.* Wiley, 1963.
Trotman-Dickinson, A. F. *Gas Kinetics.* Pergamon.

22.133 Data Processing

Application of the principles of statistics to chemical problems (Z test, t test, F test and x^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 BOOK

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.

22.154 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 Principles of Chemical Ceramics

Introduction; basic principles of firing procedures (thermodynamics, phase equilibria, reaction rates, nucleation and growth of phases), fired properties and the quality control of finished products; stoichiometry; calculation of the physical properties of ceramic materials.

TEXTBOOKS
Ford, W. F. *Institute of Ceramics Text Book Series, IV. Effect of Heat on Ceramics.* Maclaren, 1967.
Griffiths, R. & Radford, C. *Calculations in Ceramics.* Maclaren, 1965.
Worrall, W. E. *Institute of Ceramics Text Book Series, I. Raw Materials.* Maclaren, 1964.

REFERENCE BOOKS
American Ceramic Soc. *Phase Diagrams for Ceramists.*
Andrews, A. I. *Ceramic Tests and Calculations.* Wiley.
Andrews, A. I. *Porcelain Enamels.* Garrard.
Findley, A., Campbell, A. N. & Smith, N. O. *The Phase Rule and Its Applications.* Dover.
Ford, R. W. *Institute of Ceramics Textbook Series, III. Drying.* Maclaren, 1964.
Moore, F. *Institute of Ceramics Textbook Series, V. Rheology of Ceramic Systems.* Maclaren, 1965.
Norton, F. H. *Elements of Ceramics.* Addison-Wesley.
Parmelee, C. W. *Ceramic Glazes.* Industrial Publications.
Salmang, H. & Francis, M. *Ceramics—Physical and Chemical Fundamentals.* Butterworth.

22.214 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
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.
McKenzie, J. D. *Modern Aspects of the Vitreous State.* Butterworth.
Sinnott, M. J. *Solid State for Engineers.* Wiley.
Smoluchowski, R. *Phase Transformations in Solids.* Wiley.
Stanworth, J. E. *Physical Properties of Glass.* Clarendon.

22.223 Applied Chemical Ceramics

Structural principles; crystal chemistry; kinetics of solid-state reactions; chemistry of ceramics in relation to the periodic table. A systematic treatment of a range of ceramic products in the light of the above principles.

REFERENCE BOOKS
Andrews, A. J. *Porcelain Enamels.* Garrard.
Campbell, I. E. & Sherwood, E. M. *High Temperature Materials and Technology.* Wiley.
Chesters, J. *Steelplant Refractories.* United Steel Co.
Eitel, W. *Physical Chemistry of the Silicates.* Chicago U.P.
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 Ceramic Engineering

A detailed study of the mechanical properties of ceramic materials and a comparison of these with those of metals and plastics. A detailed fundamental treatment of the unit operations concerned with the handling of ceramic materials; production of high temperatures; unsteady-state heat transfer and firing. Ceramic engineering design.

REFERENCE BOOKS
Coulson, J. M. & Richardson, J. F. *Chemical Engineering.* Vol. 2. Pergamon.
Etherington, H. & Etherington, G. *Modern Furnace Technology.* Charles Griffin.
Kern, D. Q. *Process Heat Transfer.* McGraw-Hill.

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.
Shand, E. B. *Glass Engineering Handbook*. McGraw-Hill.
Skelland, A. H. P. *Non-Newtonian Flow and Heat Transfer*. Wiley.
Trinks, W. & Mawhinney, M. H. *Industrial Furnaces*. Vols 1 and 2. Wiley.
Wilkinson, W. L. *Non-Newtonian Fluids*. Pergamon.

22.233 Ceramic Equipment

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.

22.313 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
Margerison, D. & East, G. C. *Introduction to Polymer Chemistry*. Pergamon.

REFERENCE BOOKS
Kappelmeier, C. P. A. ed. *Chemical Analysis of Resin Based Coating Materials*. Wiley.
Kline, G. M. *Analytical Chemistry of Polymers*. Part 1. Wiley.

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.

22.323 Physical Chemistry of Polymers I

Molecular weight applied to macromolecules, number, weight, viscosity and 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*.

22.324 Physical Chemistry of Polymers II

Structure/property relationships, polymer solutions.

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.* Longmans.
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. Part IX.
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.
Margerison, D. & East, G. C. *Introduction to Polymer Chemistry.* Pergamon.

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. Dekker.
Long, R. *The Production of Polymer and Plastics Intermediates from Petroleum.* Butterworth.
Schildknecht, C. A. *Vinyl and Related Polymers.* Wiley.

22.312G Polymer Processes II

Polymers containing backbones other than carbon: phosphorus, arsenic, sulphur; polysilicanes.

Instrumental analytical methods, U.V. and I.R. spectroscopy, endgroup analysis, vapour phase chromatography; degradation; X-rays, radioisotopes; stereoisomers, chemical methods.

REFERENCE BOOK

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.* Butterworth.
Flory, P. J. *Principles of Polymer Chemistry.* Cornell U.P.

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 BOOK

Meares, P. *Polymers: Structure and Bulk Properties.* Nostrand.

22.341G 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; calendering; 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.

22.342G 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.* Longmans.

Houwink, R. *Elastomers and Plastomers.* Vols I & II. Elsevier.

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

Black, R. M. *Elements of Palaeontology*. C.U.P., 1970.
Holmes, A. *Principles of Physical Geology*. N.A.P. *or*
Longwell, C. R., Flint, R. F. & Sanders, J. E. *Introduction to Physical Geology*. Wiley, 1969.
Rutley, F. *Elements of Mineralogy*. Ed. H. H. Read, Murby, 1970.
Tyrrell, 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.
Kostov, I. *Mineralogy*. Oliver & Boyd, 1968.
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 microscopic 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 Fosstls.* McGraw-Hill, 1952.

Stratigraphy

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

Spencer, E. W. *Introduction to the Structure of the Earth.* McGraw-Hill, 1969.
Ragan, D. M. *Structural Geology—An Introduction to Geometrical Techniques.* Wiley, 1968.

REFERENCE BOOKS

Mineralogy

Deer, W. A., Howie, R. A. & Zussman, J. *An Introduction to the Rock Forming Minerals.* Longmans, 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

Bayly, B. *Introduction to Petrology.* Prentice-Hall, 1968.
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 biogenetic 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.

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.

Geophysics

Garland, G. D. *The Earth's Shape and Gravity.* Pergamon, 1964.
Howell, B. *Introduction to Geophysics.* McGraw-Hill, 1959.
Stacey, F. P. *Physics of the Earth.* Wiley, 1969.

Igneous Petrology

Deer, W. A., Howie, R. A., and Zussman, J. *Rock Forming Minerals.* Longmans, 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.* Univ. of Michigan, 1962.

Stratigraphy

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 and Hudson, 1970.

REFERENCE BOOKS

Geophysics

Howell, B. *Introduction to Geophysics.* McGraw-Hill, 1959.

Vertebrate Palaeontology

Von Koenigswald, G. H. R. *The Evolution of Man.* University of Michigan, 1962.

Stratigraphy II

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, Parts I, II, III, IV and V

25.0041 Engineering Geology

An introduction to rock mechanics. The strength, deformability, permeability and chemical stability of rocks. Discontinuities in rock masses. Mass movement and stability of slopes. An introduction to hydrogeology. The application of geology to engineering practice. A compulsory field tutorial which includes inspection of civil engineering projects.

25.0042 Exploration Geophysics

The theory, interpretation and practice of geophysical methods in exploration, including and extending beyond 25.013 Geology III (Supplementary) *Exploration Geophysics*.

25.0043 Exploration and Mining Geology and Petroleum Engineering

Exploration and Mining Geology—Selection of prospecting areas, methods of mineral search, assessment of new discoveries and subsequent development as underground or open cut mines, re-evaluation of old mines. The work of a geologist in operating mines, ore prediction, exploratory drilling. Evaluation of coalfields. Mine geology of leading Australian mines. *Laboratory:* Solution of mining geology problems involving drill core assays and developmental procedures. Exercises in geochemical prospecting.

Petroleum Engineering—Chemistry of drilling fluids, design of casing strings. Reservoir assessment and computation of reserves. Petroleum production techniques, artificial lift and secondary recovery methods. Drill stem testing, reservoir stimulation techniques including acidising, hydraulic fracturing. Controlled directional drilling.

25.0044 Engineering Surveying

Ordinary levelling, angle measurements, linear measurements (tapes), theodolite traversing, tacheometry, areas and volumes, contour and detail surveys.

25.0045 Project

TEXTBOOKS

Mining and Petroleum Geology

Lawrence, L. J. ed. *Exploration and Mining Geology*. Aus. I.M.M. Melbourne, 1965.

Geophysics

Dobrin, N. B. *Introduction to Geophysical Prospecting*. McGraw-Hill, 1960.

Grant, F. S., and West, G. F. *Interpretation Theory in Applied Geophysics*. McGraw-Hill, 1964.

Parasnis, D. S. *Principles of Applied Geophysics*. Methuen, 1962.

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 photointerpretation.

Mathematical Geology—Measurement scales—probability statements—basic parametric and non-parametric statistics—measurement errors—line and surface fitting—classification procedures—sampling theory—frequency analysis—filter theory.

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 conoscopic, 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

Siegel, S. *Nonparametric Statistics for the Behavioural Sciences.* McGraw-Hill, 1956.

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*. Univ. of Texas, 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*. Wiley, 1970.

Krumbein, W. C. & Graybill, F. A. *An Introduction to Statistical Models in Geology*. McGraw-Hill, 1965.

Miller, R. L. & Kahn, J. S. *Statistical Analysis in the Geological Sciences*. Wiley, 1962.

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.

25.101 Geology for Engineers

An introduction to geology with emphasis on the mechanical properties of rock and soil. Rock-forming minerals, clay minerals and the classification of rocks. The properties of rock. An introduction to the processes of orogenesis, epeirogenesis, denudation and weathering of rocks, vulcanicity, intrusion of plutonic rocks, sedimentation and metamorphism. Groundwater, the formation of soils, landforms and the stability of slopes. Review of the application of geology and geophysics in engineering practice. Laboratory work consists of the examination and the identification of common rock-forming minerals and rock types, and the preparation and interpretation of simple geological maps and sections. Two geological field tutorials of one day duration are a compulsory part of the course, and satisfactory field tutorial reports are to be submitted.

TEXTBOOK

Blyth, F. G. *Geology for Engineers*. 4th ed. 1960.

25.102 Geology for Mining Engineers

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))

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, coalfield 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 mineragraphy. 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, parageneses, 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

25.341G Geology

A series of special courses in aspects of geology which have particular relevance to geophysics: structural geology, stratigraphy, petroleum geology, engineering geology, petrology, economic mineralogy, geochemistry, air-photo interpretation and field methods.

25.321G Geophysics

The physics, shape, structure and constitution of the earth. Extensive treatment of the theory, interpretation, instrumentation, practice and applications of geophysical methods in exploration: seismic, electric, electromagnetic, gravity, magnetic, radioactive and well logging. Laboratory requirements include projects in model experimentation, and field requirements include three weeks ot field tutorials on the practice of geophysical methods.

TEXTBOOKS

Grant, F. S., and West, G. F. *Interpretation Theory in Applied Geophysics*. McGraw-Hill, 1965.
Keller, H. B., and Frischkenect, F. C. *Electrical Methods in Geophysical Prospecting*. Pergamon, 1966.

25.401G Ground Water Investigations

Geological factors influencing the occurrence of groundwater, role of structural and physical geology in groundwater studies, influence of rocks on groundwater quality. Exploration, evaluation and development of groundwater, well-logging techniques. Groundwater problems in semi-arid and arid zones. Groundwater geophysics, geophysics applied to groundwater exploration and assessment, geophysical methods utilized in well-logging. Drilling equipment and well development. Hydrogeologic maps and their interpretation. Field tutorials will be conducted.

TEXTBOOK

Davis, S. N., and De Wiest, R. J. *Hydrogeology*. Wiley, 1966.

25.402G Hydrogeology

The exploration and evaluation of groundwater, borehole samples and geological well-logging techniques, geological factors influencing the occurrence of groundwater, preparation of hydrogeologic maps. Further studies in arid zone geohydrology. Practical work will cover the preparation of hydrogeologic maps, the classification of borehole samples and the evaluation of the water balance. Field tutorials will be included.

TEXTBOOK

Davis, S. N., and De Wiest, R. J. *Hydrogeology*. Wiley, 1966.

25.403G Project (Hydrogeology Graduate Course)

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. 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 airphotos. Elementary map-making. Methods of describing soils, vegetation and land systems.

The course includes three compulsory one-day field tutorials.

TEXTBOOKS

Barry, R. G., and Chorley, R. J. *Atmosphere, Water and Climate.* Methuen.
Corbett, J. R. *The Living Soil.* Martindale Press.
Twidale, C. R. *Geomorphology.* Nelson. Paperback.

REFERENCE BOOKS

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.
Leeper, G. W. *Introduction to Soil Science.* M.U.P.
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. *Physical Geography.* Wiley.
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. Geographic significance of population growth components in modernizing and advanced countries—natural increase, fertility and mortality patterns and internal and international migration. Patterns and structures of systems of agriculture, manufacturing and tertiary production. Includes an urban field tutorial of one day.

TEXTBOOK

Cole, J. P. & King, C. A. M. *Quantitative Geography.* Wiley.

REFERENCE BOOKS

Abler, R., Adams, J. S. & Gould, P. *Spatial Organisation.* Prentice-Hall.
Broek, J. O. M. *Geography: Its Scope and Spirit.* Merrill. Paperback.
Chisholm, M. *Rural Settlement and Land Use.* Hutchinson.
Dohrs, F. E. & Sommers, L. M. eds. *Introduction to Geography: Selected Readings.* Crowell. Paperback.
Estall, R. C., & Buchanan, R. O. *Industrial Activity and Economic Geography.* Hutchinson.

McCarty, H. H., & Lindberg, J. B. *A Preface to Economic Geography*. Prentice-Hall.
Mayer, H. H., & Kohn, C. F. eds. *Readings in Urban Geography*. Chicago U.P.
Morrill, R. L. *The Spatial Organisation of Society*. Wadsworth.
Mountjoy, A. B. *Industrialisation and Underdeveloped Countries*. Hutchinson.
Pollard, A. H. *Demography: An Introduction*. Pergamon.
Rose, A. J. *Patterns of Cities*. Nelson.
Rutherford, J., Logan, M. I. & Missen, G. I. *New Viewpoints in Economic Geography*. Martindale.
Taaffe, E. J. *Geography*. Prentice-Hall. Paperback.
Toyne, P. & Newby, P. T. *Techniques in Human Geography*. Macmillan.
Wilson, M. G. A. *Population Geography*. Nelson.

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. & Houghton, F. E. *Geographic Perspectives on Urban Systems*. Prentice-Hall.
Breese, G. ed. *The City in Newly Developing Countries*. Prentice-Hall.
Breese, G. ed. *Urbanisation in Newly Developing Countries*. Prentice-Hall. Paperback.
Chapin, F. S. *Urban Land Use Planning*. Illinois U.P.
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.
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.

TEXTBOOKS

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.

REFERENCE BOOKS

Cole, J. P., & King, C. A. *Quantitative Geography*. Wiley.
Dixon, N. J., & Massey, F. J. *Introduction to Statistical Analysis*. McGraw-Hill.
Kalton, G. *Introduction to Statistical Ideas*. Chapman & Hall.

King, L. J. *Statistical Analysis in Geography.* Prentice-Hall.
Moroney, M. J. *Facts from Figures.* Pelican.

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

Classes throughout the year dealing with methods and the interpretation of geographic data; research design, data sources, field methods; collection, classification, and analysis of data, stressing multivariate techniques and computer library programs. Complements all third-year Geography options. Up to five days' field tutorials involving studies related to the options listed above.

TEXTBOOKS

Veldman, D. J. *Fortran Programming for Behavioural Sciences.* Holt, Rinehart & Winston.

REFERENCE BOOKS

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.

Siegal, S. *Nonparametric Statistics for the Behavioural Sciences.* McGraw-Hill.

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

Spatial and temporal distribution of atmospheric components of special relevance to the exchange of energy and water at the earth surface. 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. Present and past world climatic patterns in relation to energy and water balance principles. 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, and toward 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.

27.203 Biogeography

The history and distribution of Australian fauna and flora in relation to world patterns. Ecosystems, their structure and microclimates, energy, water and nutrient balances with particular reference to Australian examples. Management of ecosystems and associated land use. Vegetation survey and sampling techniques and airphoto interpretation.

Up to three days' field tutorial is an essential part of this course.

REFERENCE BOOKS

Beadle, N. C. W., Evans, O. D. & Carolin, R. L. *Flora of the Sydney District.* Reed.

Costin, A. B. *A Study of the Ecosystems of the Monaro Region of New South Wales.* N.S.W. Govt. Printer.

Detwyler, T. R. *Man's Impact on the Environment.* McGraw-Hill.

Darlington, P. J. *Biogeography of the Southern End of the World.* Harvard U.P.

Eckardt, F. E. ed. *Montpellier Symposium. Methodology of Plant Ecophysiology.* UNESCO.

Greig-Smith, P. *Quantitative Plant Ecology.* 2nd ed. Butterworth.

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.

Moore, R. M. ed. *Australian Grasslands.* A.N.U. Press.

Rodin, L. E. & Bazilevich, N. I. *Production and Mineral Cycling in Terrestrial Vegetation.* Oliver & Boyd.

Slatyer, R. O. *Plant-water Relationships.* Academic.

Slatyer, R. O. & Perry, R. A. eds. *Arid Lands of Australia.* A.N.U. Press.

Van Dyne, G. M. *The Ecosystem Concept in Natural Resource Management.* Academic.

Watts, D. *Principles of Biogeography.* McGraw-Hill.

27.204 Advanced Biogeography

A study of the factors controlling biomass accumulation and their manipulation in land use and conservation. Production ecology: the efficiency of vegetation in using the environment; microclimate, energy, carbon dioxide and water vapour fluxes and how they control the rates of production; nutrient cycling, the distribution of chemical elements in selected ecosystems, rates of cycling and the role of fire in nutrient cycling; spatial relationships, species area, area of influence, stand density, leaf area index, and root/shoot ratios. Vegetation expression of environmental gradients; vegetation response to changes in environment with particular reference to grazing, soil erosion and forest management. Vegetation cover and the hydrologic cycle. Administrative and legal aspects of conservation. Laboratory sessions supporting the lectures: experimental methods and data collection and collation in biomass, microclimatic, nutrient cycling and spatial relationship studies; visits to projects on conservation and land management.

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.

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

In Session 1 topics include the formulation of economic models in an interregional framework, linear programming and activity analysis, growth models, growth pole concepts, the spatial transmission of economic growth, and the spatial pattern of short term economic interaction, with emphasis on North America. In Session 2 students attend a series of seminars on the general development of geographic thought and ideas.

TEXTBOOK

Richardson, H. *Regional Economics*. Weidenfeld & Nicolson.

REFERENCE BOOKS

Beckmann, M. *Location Theory*. Random House.
Friedmann, J. *Regional Development Policy*. M.I.T. Press.
Friedmann, J. & Alonso, W. *Regional Development and Planning*. M.I.T. Press.

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.
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.* Instit. of Business & Economic Research, University of California, Berkeley.
Engel, J. F. ed. *Consumer Behaviour: Selected Reading.* American Marketing Association.
Fisk, G. *Marketing Systems.* Harper.
Garner, B. J. *The Internal Structure of Retail Nucleations.* Northwestern University Studies in Geography, No. 12.
Lewis, E. H. *Marketing Channels: Structure and Strategy.* McGraw-Hill. Paperback.
Mueller, W. F. & Garoian, L. *Changes in the Market Structure of Grocery Retailing.* Wisconsin U.P.
Myers, J. G. *Consumer Image and Attitude.* Inst. of Business and Econ. Research, University of Calif., Berkeley.
Revzan, D. *Wholesaling in Marketing Organisation.* Wiley.
Simmons, J. *The Changing Pattern of Retail Location.* University of Chicago, Dept. of Geography, Research Paper No. 92.
Simmons, J. *Toronto's Changing Retail Complex.* University of Chicago, Dept. of Geography, Research Paper No. 104.
Vance, J. E. *The Merchant's World: The Geography of Wholesaling.* Prentice-Hall.

27.333 Agricultural Geography

Rent theory in relation to agricultural systems. Systems of agriculture at different levels of economic development, and in relation to cultural and institutional factors. Effect on agriculture of rural-urban competition for resources. Examples will be drawn from Australasia and South East Asia. Laboratory classes include case studies.

REFERENCE BOOKS

Barlowe, R. *Land Resource Economics.* Prentice-Hall.
Barnard, A. ed. *The Simple Fleece: Studies in the Australian Wool Industry.* M.U.P.
Brookfield, H. C. & Brown, P. *Struggle for Land: Agriculture and Group Territories among the Chimbu of the New Guinea Highlands.* O.U.P.
Chisholm, M. *Rural Settlement and Land Use.* Hutchinson.
Courtenay, P. P. *Plantation Agriculture.* Bell.
Davidson, B. R. *The Northern Myth.* M.U.P.
Davidson, B. R. *Australia Wet or Dry?* M.U.P.
Dunn, E. S. Jr. *The Location of Agricultural Production.* Florida U.P.
Dumont, R. *Types of Rural Economy.* Methuen.
Fisher, C. A. *South East Asia.* Methuen.
Gourou, P. *The Tropical World.* Longmans.
Gregor, H. G. *Geography of Agriculture: Themes in Research.* Prentice-Hall.
Heady, E. O. *Economics of Agricultural Production and Resource Use.* Prentice-Hall.
Hoover, E. M. *The Location of Economic Activity.* McGraw-Hill.
Laut, P. *Agricultural Geography.* Vols. 1 and 2. Nelson.
Nourse, H. O. *Regional Economics.* McGraw-Hill.
Rutherford, J. & Langford-Smith, T. *Water and Land: Two Case Studies in Irrigation.* A.N.U. Press.
Rutherford, J., Logan, M. I. & Missen, G. J. *New Viewpoints in Economic Geography.* Martindale.
Slatyer, R. O. & Perry, R. A. *Arid Lands of Australia.* A.N.U. Press.
Symons, L. *Agricultural Geography.* Bell.
Wadham, S., Wilson, R. K. & Wood, J. *Land Utilisation in Australia.* M.U.P.

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. 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.
Scheidegger, A. E. *Theoretical Geomorphology.* 2nd ed. Springer-Verlag.
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.

27.423 Pedology

Morphologic, physical and chemical properties of soil, including colour, texture, consistence, structure, aeration, moisture, reaction and nutrients. Physical and chemical aspects of soil fertility; soil erosion and conservation; soil-landscape relationships and periodicity. The soil-forming processes of the major Great Soil Groups and their management problems; soil classification. Laboratory classes include particle size grading, specific gravity and moisture content of soils, soil reaction determination, loss on ignition; soil profile description; soil survey and mapping; analysis of soil maps.

TEXTBOOK

Corbett, J. R. *The Living Soil.* Martindale.

REFERENCE BOOKS

Baver, L. D. *Soil Physics.* Wiley.
Bear, F. E. ed. *The Chemistry of the Soil.* Arnold.
Black, C. A. ed. *Methods of Soil Analysis.* Amer. Soc. Agron. Inc.
Dasmann, R. F. *Environmental Conservation.* Wiley.
Kohnke, H. *Soil Physics.* McGraw-Hill.
Jenny, H. *The Factors of Soil Formation.* McGraw-Hill.
Leeper, G. W. *Introduction to Soil Science.* M.U.P.
Robinson, G. W. *Soils, their Origin, Constitution and Classification.* Murby.
Rose, C. W. *Agricultural Physics.* Pergamon.
Russell, E. W. *Soil Conditions and Plant Growth.* Longmans Green.
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. Press.
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.

27.504 Projects in Applied Geography

Biogeography: study of the vegetation in an area, and detailed consideration of a problem arising from this survey, preferably with an applied aspect. *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

General concepts of landscape evolution; geomorphic aspects of overland and channel flow; lithologic and structural controls of surface drainage;

stream channels in cross-section, plan and long profile; floodplain characteristics; hillslopes; geomorphic relationships of surficial deposits; catchment morphometry; landscape features due to underground water; landforms and processes of the main morphogenetic zones; drainage types in Australia; vigil and representative catchments; the land-system approach to water resource assessment; air photo and map analysis of characteristic landforms and drainage features; geomorphic and land system mapping; field study of a vigil catchment.

TEXTBOOKS

Leopold, L. B. Wolman, M.G., and Miller, J. P. *Fluvial Processes in Geomorphology*. Freeman.
Morisawa, M. *Streams: their Dynamics and Morphology*. McGraw-Hill. Paperback.
Thornbury, W. D. *Principles of Geomorphology*. International edition. Wiley.

REFERENCE BOOKS

Chorley, R. J. ed. *Water, Earth and Man*. Methuen.
Chorley, R. J. & Haggett, P. eds. *Models in Geography*. Methuen.
Chow, Ven Te. *Handbook of Applied Hydrology*. McGraw-Hill.
Dury, G. H. ed. *Essays in Geomorphology*. Heinemann.
Dury, G. H. ed. *Rivers and River Terraces*. Macmillan.
Haggett, P. & Chorley, R. J. *Network Analysis in Geography*. Methuen.
Jennings, J. N. & Mabbutt, J. A. eds. *Landform Studies from Australia and New Guinea*. A.N.U. Press.
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.

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 sensitvity 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. *Sydneyside 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.

SCHOOL OF MARKETING

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.

28.012 Marketing Systems

An introduction to marketing systems through the study of marketing structures, organisation and behaviour. The development of distribution systems, marketing institutions and channels. Policies and methods in the distribution of consumer and industrial goods and services. Costs and efficiency in the distribution of goods and services.

TEXTBOOK

Fisk, G. *Marketing Systems.* 2nd ed. Harper & Row.

REFERENCE BOOKS

Enis, B. M. G. & Cox, K. K. eds. *Marketing Classics.* Allyn & Bacon, 1969.

Scott, R. A. & Marks, N. E. *Marketing and the Environment: Some Issues and Perspectives.* Wadsworth, 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.* Butterworth, 1969.

SCHOOL OF TOWN PLANNING

36.471 Planning Law and Administration

The purpose of town planning legislation and its evolution in the United Kingdom. The N.S.W. Local Government Act, 1919 (and relevant Ordinances), in particular Parts XI, XII, XIIA: residential district proclamations, subdivision regulations; preparation, approval and implementation of planning schemes. Interim development control, compensation, betterment, resumption, appeals. The State Planning Authority Act, 1963. Nature of legislation in other States.

TEXTBOOK

N.S.W.—Parliament—Statutes. *Local Government Act 1919.* Govt. Printer. Sydney, 1966.

REFERENCE BOOKS

Blundell, L. A. & Dobry, G. *Town and Country Planning.* Sweet & Maxwell.

Cullingworth, J. B. *Town and Country Planning in England and Wales.* 2nd ed. rev. Allen & Unwin, 1967.

Every-Burns, J. W. *Local Government Law Affecting Property.* Butterworth.

Heap, D. *Introducing the Land Commission Acts.* Sweet & Maxwell.

Heap, D. *An Outline of Planning Law.* 5th ed. Sweet & Maxwell, 1969.

Heap, D. *Encyclopedia of the Law of Town and Country Planning.* Sweet & Maxwell.

Jennings, W. I. *The Law Relating to Town and Country Planning.* 2nd ed. Charles Knight, 1946.

Megarry, R. E. *Lectures on the Town and Country Planning Act, 1947.* Stevens.

Starke, J. G. *Town and Country Planning in New South Wales.* Butterworth.

Wilcox, M. R. *The Law of Land Development in New South Wales.* Law Book Co.

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.

Montgomery, R. & Swenson, C. A. *Quantitative Problems in the Biological Sciences.* Freeman, 1969.

White, A., Handler, R. & Smith, E. L. *Principles of Biochemistry.* 4th ed. McGraw-Hill, 1968.

REFERENCE BOOK

Loewy, A. G. & Siekevitz, P. *Cell Structure and Function.* 2nd ed. Holt, Rinehart & Winston, 1969.

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.

TEXT AND REFERENCE BOOKS
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.

TEXT AND REFERENCE BOOKS
As for 41.101A.

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.

Kerridge, D. & Tipton, K. *Biochemical Reasoning.* 1st ed. Benjamin, 1972.

White, A., Handler, R. & Smith, E. L. *Principles of Biochemistry.* 4th ed. McGraw-Hill, 1968.

Wold, F. *Macromolecules: Structure and Function.* 1st ed. Prentice-Hall, 1971.

The Molecular Basis of Life. An Introduction to Molecular Biology. Readings from *Scientific American.* Freeman, 1968.

REFERENCE BOOKS

Bernhard, S. *The Structure and Function of Enzymes.* Benjamin, 1968.

Mahler, H. R. & Cordes, F. H. *Biological Chemistry.* 2nd ed. Harper & Row, 1971.

Watson, J. W. *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.

TEXT AND REFERENCE BOOKS

As for 41.102A above.

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 microorganisms; 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 standardization of products: process optimization; 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.

TEXTBOOK
Casida, L. E., Jr. *Industrial Microbiology*. Wiley, 1968.

BIOLOGICAL TECHNOLOGY GRADUATE SUBJECTS

42.201G Principles of Biology

The principal characteristics of living systems, in respect of structure, fine structure and function, metabolism, bioenergetics, growth, cell division, genetics, and some aspects of adaptation and evolution.

TEXTBOOKS
Aiba, S., Humphrey, A. E. & Millis, N. F. *Biochemical Engineering*. 2nd ed. Academic Press, New York, 1972.
Loewy, A. G., and Siekevitz, P. *Cell Structure and Function*. 2nd ed. Holt, Rinehart & Winston, 1969.

42.202G Principles of Biochemistry

A condensed treatment of biochemistry including: the properties of biological molecules, the pathways, catalysis, energetics and regulation of metabolism; the chemical mechanism of inheritance.

TEXTBOOKS
Ambrose, E. J. & Easty, D. M. *Cell Biology*. Nelson, 1970.
Mahler, H. R. & Cordes, E. H. *Biological Chemistry*. Harper int. ed. 1968.

42.203G Biochemical Methods

A laboratory course, augmented with tutorial classes, in the techniques and application of practical biochemistry.

TEXTBOOK
No specified textbook.

42.204G Microbial Processes

A short treatment of the principal factors involved in the operation of microbial processses on an industrial scale; an examination of the more salient features of selected fermentation processes involved in chemical, pharmaceutical and food production.

TEXTBOOK
Casida, L. E., Jr. *Industrial Microbiology*. Wiley, 1968.

SCHOOL OF BOTANY

43.101A/45.101A Genetics & 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. Field excursions are an integral part of the course.

TEXTBOOKS

Beadle, N. C. W., Carolin, R. C., and Evans, O. D. *Handbook of the Vascular Plants of the Sydney District and Blue Mountains.* 1962.
Billings, W. D. *Plants and the Ecosystem.* Macmillan, 1964.
Esau, K. *Anatomy of Seed Plants.* Wiley, 1960.

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.

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; Stanier *et al.*, if the 3rd year units do not include 44.102D; Hawker & Linton if 44.102D is to be taken.

44.102A Basic General Microbiology: Nature of Microorganisms

Systems for the identification and taxonomic description of bacteria; more detailed treatment of the fine structure, cytochemistry, genetics, and antigenicity of microorganisms (including viruses).

Prerequisites: 44.101, 43.101A, 41.101A and 41.101B.

TEXTBOOK

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.
or
Davis, B. D., Dulbeco, R., Eisen, H. N., Ginsberg, H. S. & Wood, W. B. *Principles of Microbiology and Immunology.* Harper & Row, 1968.

Hawker & Linton is recommended when unit 44.102D is also to be taken. Stanier *et al* is available in a paperback edition. Davis *et al* is also available as a larger text entitled *Microbiology* and is only recommended if 44.102E (Medical Microbiology) is programmed.

44.102B Basic General Microbiology: Microbial Physiology and Ecology

The metabolic requirements of microorganisms; relationship between the microorganism and its environment: growth, inhibition, death; energy-yielding and biosynthesising systems; genotypic and phenotypic control systems.

TEXTBOOK AND PREREQUISITES
As for 44.102A.

44.102D General Applied Microbiology

Endeavours to relate basic facts about microorganisms to practical conditions affecting the occurrence, importance, activity and control of microorganisms in soil, air, water, in their relationship to higher organisms (other than Man); their relationship to the manufacture, preservation and spoilage of food, including dairy products; and their industrial application.

TEXTBOOK
Hawker, L. E. & Linton, A. H. eds. *Micro-organisms: Function, Form and Environment.* Arnold, 1971.

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.

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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					

PLEASE TEAR HERE

HELP IMPROVE YOUR HANDBOOK

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.

If you would like to discuss any aspect of the Calendar or handbooks personally, please contact Mr Douglas Howie, Room 307, The Chancellery, or phone extension 3340.

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 TO HAVE THEM	UNNECESSARY
Calendar of dates	☐	☐	☐
List of academic staff	☐	☐	☐
Course outlines or rules governing course	☐	☐	☐
Descriptions of subjects	☐	☐	☐
Textbook lists	☐	☐	☐
Reference book lists	☐	☐	☐
Requirements for admission	☐	☐	☐
Admission and enrolment procedures	☐	☐	☐
Course fees	☐	☐	☐
Rules relating to students	☐	☐	☐
Student services	☐	☐	☐
Scholarships	☐	☐	☐
Student activities	☐	☐	☐
Examination procedures	☐	☐	☐
Timetables	☐	☐	☐

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.....
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