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FACULTY OF ENGINEERING

1972 HANDBOOK

THE UNIVERSITY OF NEW SOUTH WALES

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FACULTY OF ENGINEERING

1972 HANDBOOK

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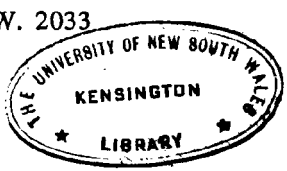

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FOREWORD

This handbook is primarily for undergraduate students in the Faculty of Engineering and aims to provide information concerning the requirements for admission, enrolment and re-enrolment, conditions for the award of the different Bachelor degrees in the Faculty and the subject matter of the courses offered, including text and reference books. *It is important that each student in the Faculty becomes well acquainted with the information presented here.* 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.

At the same time, it is appreciated that a student's choice in regard to course and other matters remains to be discussed with members of the academic staff. Many students will not make their final choice of degree course until well into their first year: some do not need to make their decision before the start of third year. Students should consult the Heads of Schools about this; where the Heads cannot be available, they have nominated colleagues to deal with enquiries.

P. T. FINK,

Dean,

Faculty of Engineering

TABLE OF CONTENTS

CALENDAR OF DATES FOR 1972

Session 1: March 6 to May 13
May Recess May 14 to May 21
May 22 to June 17
Midyear Recess June 18 to July 23
Session 2: July 24 to August 12
August Recess August 13 to August 27
August 28 to November 11

JANUARY	
Friday 21	Last day for acceptance of applications to enrol by new students and students repeating first year
Monday 31	Australia Day—Public Holiday
FEBRUARY	
Tuesday 1 to Saturday 12	Deferred examinations
Monday 21	Enrolment period begins for new students and students repeating first year
Monday 28	Enrolment Week commences for students re-enrolling (second and later years)
MARCH	
Monday 6	**Session 1 commences**
Friday 17	Last day of enrolment for new students (late fee payable)
Thursday 30	Last day for later year enrolments (late fee payable)
Friday 31 to Monday 3 April	Easter
APRIL	
Tuesday 25	Anzac Day—Public Holiday
MAY	
Sunday 14 to Sunday 21	May Recess
JUNE	
Monday 12	Queen's Birthday—Public Holiday
Saturday 17	**Session 1 ends**
Friday 30	Last day for acceptance of applications for re-admission after exclusion under rules governing re-enrolment

JULY

Monday 24	**Session 2 commences**
Thursday 27	Foundation Day

AUGUST

Sunday 13 to Sunday 27	August Recess

SEPTEMBER

Friday 15	Last day for acceptance of corrected enrolment details forms

OCTOBER

Monday 2	Eight Hour Day—Public Holiday
Friday 6	Last day for acceptance of corrected enrolment details forms (late fee payable)

NOVEMBER

Saturday 11	**Session 2 ends**
Tuesday 14	Examinations begin

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

Tuesday 30 to Saturday 10 Feb.	Deferred examinations

FEBRUARY

Monday 19	Enrolment Week commences for new students and students repeating first year
Monday 26	Enrolment Week commences for students re-enrolling (second and later years)

THE ACADEMIC YEAR

The academic year is divided into two sessions, each containing 14 weeks for teaching. There is a recess of five weeks between the two sessions. 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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The Department of Water Engineering encompasses the fields of Hydraulics, Hydrology, Public Health Engineering and Engineering Construction. The Public Health Engineering Laboratory is located at Kensington. The Hydrology research centre is also at Kensington, but a substantial amount of investigation is carried out in the field. The Water Research Laboratory is located at Manly Vale and is the centre for instruction and research in hydraulics.

The Department of Civil Engineering Materials includes the fields of Soil Mechanics, Rock Mechanics, Concrete Technology, Plastics and Timber. The Materials Laboratories are located at Kensington.

The Department of Structural Engineering covers the fields of Structures, Stress Analysis and Solid Mechanics. The Model Structures, Experimental Stress Analysis and Solid Mechanics Laboratories are at Kensington. The Heavy Structures Laboratory is at King Street, Randwick.

The Department of Structural Mechanics is concerned with the analysis of the static and dynamic behaviour, both linear and non-linear, of structures and structural components. The Department's Laboratory is located at Kensington.

SCHOOL OF ELECTRICAL ENGINEERING

The School of Electrical Engineering comprises five departments — Communications, Control Engineering, Electric Power Engineering, Electronic Computation, and Solid State Electronics.

Each department carries out research in its own field and offers lecture and laboratory courses at the undergraduate and postgraduate levels. Subjects of common interest are provided by the School as a whole.

Special laboratories are equipped for work in the areas of Microwaves, Plasmas, Computer Control, Machines and Acoustics. A Measurements Laboratory provides a calibrating service under certificate from the National Association of Testing Authorities, and an IBM 360/50 computer is installed in the School.

SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING

Full-time undergraduate courses leading to the degree of Bachelor of Engineering are offered in Mechanical, Industrial, and Aeronautical Engineering, and in Naval Architecture. Part-time courses leading to the degree of Bachelor of Science (Engineering) are offered in the same four fields. Either degree may be taken out by a combination of full-time/part-time study, subject to approval by the Head of School.

The first two years of the full-time degree, and the first four stages of the part-time degree are common to all courses within the School. Thus a final decision on the discipline to be followed need not be made until the end of Year 2 for full-time and Stage 4 for part-time students.

Formal postgraduate courses of study are available, with a wide choice of subjects, leading to the degree of Master of Engineering Science in Mechanical Engineering. There are special Master of Engineering Science courses in Refrigeration and Air Conditioning, and in Industrial Engineering. The Department of Industrial Engineering within the School offers a course leading to a Graduate Diploma.

Graduates with a good first degree may register for the higher degrees of Master of Engineering and Doctor of Philosophy. Current research fields are as follows—Aerodynamics, Agricultural Engineering, Applied Plasticity, Automatic Control, Bio-mechanics, Dynamics, Gas Dynamics, Heat Transfer, Fluid Mechanics, Metal Cutting, Naval Hydrodynamics, Refrigeration and Air Conditioning, and Two-phase Flow.

Undergraduates who are interested in working for a research degree should consult the Head of School towards the end of their final year. Advice will be given to all students during their third year so that each can select the best possible combination of final year elective subjects.

SCHOOL OF SURVEYING

On the 1st July, 1970, Surveying, previously a Department of the School of Civil Engineering, was established as a separate School. The School of Surveying offers a Bachelor of Surveying degree taken over four years of full-time study or seven years of part-time study. Subject to the approval of the Head of School, combinations of full and part-time study are also permissible. The graduate courses offered are Master of Surveying Science, a two year part-time or one year full-time course; and the research degrees Master of Surveying and PhD.

The School is housed in a building which is shared with Civil Engineering. Facilities include those for precise astronomical observations, well-equipped photogrammetry laboratories, specialized surveying equipment and an extensive programme library which is used on the University's IBM 360/50 computer.

Current research is in the fields of physical geodesy, photogrammetry, geometrical geodesy, error theory, gyrotheodolite theory and applications and computer applications.

SCHOOL OF HIGHWAY ENGINEERING

Postgraduate courses are offered, leading to the degree of Master of Engineering Science and to a Postgraduate Diploma, in which road location and geometrics, properties of road materials, construction techniques, bridge design and traffic engineering are studied.

The School has well-equipped laboratories for studying the properties of soils, road aggregates, bitumen and cement concrete, and active studies on these subjects are in progress. Members of the School use a 1620 IBM computer as part of their course, and studies are being made of its utilization in all phases of highway engineering. They also have access to a 360/50 computer.

SCHOOL OF NUCLEAR ENGINEERING

The School of Nuclear Engineering in the University of New South Wales was established in 1961. The School presently operates at the postgraduate level in the Faculty of Engineering. As from 1972, a fourth year undergraduate course in Nuclear Power Technology will be provided as an elective for other Schools.

In addition to the supervision of programmes of advanced study and research for candidates for the research degrees of Master of Engineering and Doctor of Philosophy, the School offers a formal graduate course leading to the degree of Master of Engineering Science. This formal course aims specifically at the education of engineers for the detailed understanding, analysis and assessment of nuclear reactors and nuclear power systems. Particular attention is given to the mathematical, numerical and computational techniques which are relevant to nuclear engineering.

Special research interests in the School include the general field of fluctuation phenomena and noise in nuclear reactors, the coupled thermomechanical, fluid dynamics and nuclear aspects of reactor fuel elements and coolant channels, and the subject of reactor utilization and reactor strategy.

The School is presently situated in the Electrical Engineering building at Kensington. Library, workshop, digital and analogue computing facilities are available. Special digital and analogue equipment for the analysis and recording of random signals has been acquired for experimental noise research. Through the Australian Institute of Nuclear Science and Engineering, the special facilities of the Australian Atomic Energy Commission's Research Establishment at Lucas Heights can be made available for research purposes. Close personal contact is maintained between members of the School and the Engineering Research Division at Lucas Heights.

SCHOOL OF TRAFFIC ENGINEERING

The School of Traffic Engineering is located at Randwick, and is associated with the School of Highway Engineering.

The establishment of the School followed the endowment of a Chair by the Australian Automobile Association, which had long been concerned with the need for a centre for training traffic engineers and specialists. The School is assisting this object by conducting courses in traffic and transport planning and control, and offering opportunities for research into the technical problems created by the tremendous growth in the use of the motor vehicle on the street and highway system, and also into its impact on other forms of transport and on land use activity.

The research activities of the School cover a wide range of transport and traffic phenomena, viz.: traffic flow theory — queueing, traffic stream structure, saturation flow, transportation planning — land use and transport interaction, system parameters, synthetic models for growth, distribution and assignment of desire lines; public enterprise economics; and human factors and road safety. Research in these fields can be undertaken for the ME, MSc, and PhD degrees. Formal courses, one year full-time and two years part-time, leading to the degree of Master of Engineering Science are also offered in Transport and Traffic. A part-time Transport Graduate course offered over six terms leads to a Graduate Diploma.

In addition to the academic research activities the School has an Applied Research Division which undertakes project research for national bodies and institutions. It has an active programme relating to freeway lighting, traffic flow and capacity of urban roads and arterials and traffic instruments.

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 1972 it will be necessary for the University to limit the number of students enrolling in all undergraduate courses.

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 recognised 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 recognised 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 recognised 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 prerequisites; or

   (b) the requirements regarding these particular Faculty, course or subject prerequisites, 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 PREREQUISITES
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 Jurisprudence/Law Combined Arts/Law Combined Commerce/Law	Nil Nil As for Arts As for Commerce
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 PREREQUISITES
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 IA 51.111—History I 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.

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.

FACULTY OF ENGINEERING ENQUIRY CENTRE

The Faculty Enquiry Centre is situated in the undercroft of the School of Electrical Engineering Building, Kensington (the corner of Engineering and Library Roads). Members of Academic Staff will be available to advise students about careers in the various fields of engineering and about undertaking a course in engineering in this University. The Centre will be open from 10.00 a.m. to 4.00 p.m. (closed 1.00 p.m. to 2.00 p.m.) from 12th to 21st January, 1972. Prospective students are advised to take advantage of this facility.

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 and an evening service is provided during the enrolment period.

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 FOR UNDERGRADUATE COURSES

In 1972 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 29th October, 1971.

(b) New South Wales residents qualifying for admission by the 1971 New South Wales Higher School Certificate Examination or the 1972 Sydney University Matriculation Examination and those who have attended a University in New South Wales in 1971 must apply for enrolment to the Metropolitan Universities Admissions Centre, 13-15 Wentworth Avenue, Sydney (P.O. Box 7049 G.P.O., Sydney) by 21st January, 1972.

Completion of Enrolment

Students whose applications for enrolment are accepted will be required to complete their enrolment at a specified appointment time before the start of Session 1. 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.

Failure in First Year. First year students who failed more than half their programme at the 1971 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 and bring with them their notification of examination results for the previous year. This enrolment must be effected before or during the week before the commencement of Session 1 in accordance with the special arrangements made by the individual Schools.

Miscellaneous Subject Enrolments. Students may be accepted for enrolment in 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.

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.

Course details must be completed during the prescribed Enrolment Week. For details of fee requirements, including late fee provisions, see under Fees.

Final Dates for Completion of Enrolment. No enrolments will be accepted from **new students** after the end of the second week of Session 1 (17th March, 1972) 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*

COURSE FEES

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, irrespective of any variation from the prescribed hours which may be necessary in conducting the subject.

Fee determination for courses in the Faculty of Engineering is on a session basis. 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)—$231 per session.

(ii) Part-time Course Fee—over 6 hours and up to 15 hours' attendance per week—$115.50 per session.

(iii) Part-time Course Fee—6 hours' or less attendance per week—$57.50 per session.

(iv) Course Continuation Fee—A fee of $33 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.)

OTHER FEES

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

Matriculation Fee — $9 — payable at the beginning of first year.

Library Fee — annual fee — $16.

University Union — $20 — entrance fee.

*** Fees quoted are current at time of publication. The Council reserves the right to alter them at any time.**

Student Activities Fees:

University Union*	— $30	— annual subscription.
Sports Association*	— $4	— annual subscription.
Students' Union*	— $6	— annual subscription.
Miscellaneous	— $17	— annual fee.

Graduation or Diploma Fee — $9 — payable at the completion of the course.

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

Applied 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).

Anatomy Dissection Manual and Histology Slides deposit — $10 (refundable on return in satisfactory condition).

Pathology Instrument Kit — $10 (refundable on return in satisfactory condition).

SPECIAL EXAMINATION FEES

Deferred examination — $7 for each subject.

Examinations conducted under special circumstances — $9 for each subject.

Review of examination result — $9 for each subject.

LATE FEES

Session 1—First Enrolments

Fees paid at the late enrolment session and before the commencement of Session 1	$8
Fees paid during the 1st and 2nd weeks of Session 1	$16
Fees paid after the commencement of the 3rd week of Session 1 with the express approval of the Registrar and Head of the School concerned	$33

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

Session 1—Re-Enrolments

Failure to attend enrolment centre during enrolment week	$8
Fees paid after the commencement of the 3rd week of Session 1 to 31st March	$16
Fees paid after 31st March where accepted with the express approval of the Registrar	$33

Session 2—All Enrolments

Fees paid in 3rd and 4th weeks of Session 2 ..	$16
Fees paid thereafter	$33
Late lodgement of corrected enrolment details forms (late applications will be accepted for three weeks only after the prescribed dates)	$7

WITHDRAWAL FROM COURSE

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

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.

Where a student terminates for acceptable reasons a course of study before half a session has elapsed, one half of the session's course fees may be refunded. 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.

The Library fee is an annual fee and is not refundable where notice of withdrawal is given after the commencement of Session 1.

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.

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, thereafter no refund.

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

Miscellaneous — where notice is given prior to 30th April, $8.50, thereafter no refund.

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. 17th March, 1972), 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 the first session's 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

* The enrolment periods for Sydney students are prescribed annually in the leaflets "Enrolment Procedure for New Students" and "Enrolment Procedure for Students Re-enrolling".

complete their enrolment paying their own fees. A refund of fees will be made when the enrolment voucher or letter of authority is subsequently lodged with the Cashier.

Extension of Time

Any student who is unable to pay fees by the due date may apply in writing to the Registrar for an extension of time. Such application must give year or stage, whether full-time or part-time, and the course in which the applicant wishes to enrol, state 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 (18th August, 1972).

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 four weeks of Session 1 and three weeks of Session 2. Students are advised to consult noticeboards for details.

RULES RELATING TO STUDENTS

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.

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.

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 21st January. As quotas will operate on entry to all Faculties and the Board of Vocational Studies, failure to apply by 21st January 1972 will probably result in the application for transfer being unsuccessful.

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

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

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

CHANGES IN COURSE PROGRAMMES AND WITHDRAWAL FROM SUBJECTS

Students seeking approval to substitute one subject for another, add one or more subjects to their programme or discontinue part of their programme must make application to the Head of the School responsible for the course on a form available from School offices.

Any addition or substitution of subjects after 31st March will be accepted only with the express approval of the Registrar on the recommendation of the appropriate Head of School, and will be given in exceptional circumstances only.

In the case of students wishing to terminate their enrolment the application must be lodged at the Examinations and Student Records Section.

The Registrar will inform students of the decision. Approval of withdrawal from subjects is not automatic, each application being determined after considering the circumstances advanced as justifying withdrawal.

It is emphasized that:

1. withdrawal from a subject, tuition in which extends over the academic year, at any time after the May recess;
2. withdrawal from 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.

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 21st January, 1972. 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.

ANNUAL EXAMINATIONS

Most annual examinations take place in November-December although some are held in the mid-year recess. Timetables showing time and place at which individual examinations will be held are posted on the central notice boards which are in the Bio-Medical Building, Central Lecture Theatre Block, Chancellery, Dalton Building, Main Building and Western Grounds Area. Misreading of the timetable is not an acceptable excuse for failure to attend an examination. Examination results are posted to the term addresses of students. No results will be given by telephone.

All students will receive an enrolment details form by 30th August. It is not necessary to return this form, unless any information recorded there is incorrect. Amended forms must be returned to the Examinations Branch by 15th September. 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 will be payable. Amended forms returned to the Registrar will be acknowledged in writing within fourteen days.

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 examinations in the first 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 OR DIPLOMA

Applications for admission to a degree or diploma 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 or diploma, 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 apply retrospectively from 1st 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 shall, without showing cause, be permitted to continue a course unless all subjects of the first two stages of his course are completed 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 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 commitee, 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 appeal against 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 appeal the Appeal Committee, 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 Admissions Committee of the Professorial Board.

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, thesis 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 Registrar in writing of any change in their address as soon as possible. Failure to do this could lead to important correspondence or course information not reaching the student. The University cannot accept responsibility if official communications fail to reach a student who has not notified the Registrar of a change of address.

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: higher degree students (limited issue, annual fee $7.80); post-graduate, and senior undergraduate students who have completed three years of a full-time or part-time course. Permit will allow access to campus between 5 p.m. and 11 p.m. on weekdays and during library hours on Saturdays, Sundays and public holidays (annual fee $3.90). Applications should be made to the Business Manager (Property). It should be noted that increasing demand for parking space may require the imposition of further restrictions.

APPLICATION OF RULES

General

Any student who requiries information on the application of these rules or any service which the University offers may make inquiries from the Admissions Office, the Student Counselling Centre 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 located on the Upper Campus adjacent to the Chancellery, the Commerce Building and the Arts Building.

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 advertised times during Orientation Week and the first week of Session 1. The *Introduction* uses audio-visual 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.

Staff and students must use a machine readable identification card to borrow from the main University Library. Personal identification is required in the other libraries listed. For students a current union card is acceptable. Staff must apply to the Library for a library card.

THE UNIVERSITY UNION

The University Union is a common meeting ground for all students. Eating and general recreational facilities are available as well as a shop for stationery and other student requisites, branches of several banks, a pharmacy, branch of David Jones', and hairdressing facilities. Membership is compulsory for all registered students. The headquarters of the Union is located in the rectangular Union Building, which is adjacent to the circular building near Anzac Parade. The third building in the Union complex was completed in 1971.

STUDENT ACCOMMODATION

Residential Colleges

Accommodation for students is provided within the complex of the Residential Colleges of the University which comprises Basser College, Goldstein College and Philip Baxter College. The College complex houses 450 men and women students, as well as staff members. Tutors in residence provide tutorial assistance in a wide range of subjects. 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 accommodates over 100 students of whom half are Australian; the remaining half is made up of students from some eighteen 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. 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 1, Kensington, N.S.W., 2033, for information.

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

Warrane College is a residential college for men, directed by Opus Dei, a Catholic lay association. An eight-story building, it provides accommodation for 200 students, both undergraduate and postgraduate. Enquiries should be addressed to the Master, Warrane College, Box 123, Kensington, N.S.W., 2033.

Fees are $22 per week for The Kensington Colleges, $23.50 for International House, $24 for New College and $23 for Warrane.

Other Accommodation

Students requiring other than Residential College accommodation may make personal application to the Student Amenities Unit for assistance in obtaining suitable lodgings at recognised boarding houses, private homes, and in serviced and unserviced apartments. To accommodate the needs of the individual student it is essential that a personal interview be arranged with an officer of the Amenities Service.

STUDENT AMENITIES UNIT

The Student Amenities Unit was established to promote the physical, social and educational development of students through their leisure time activities.

The Amenities Unit, working in close liaison with the Sports Association and the University authorities, assists various recognized clubs by arranging and providing facilities essential to their general development, and by handling on their behalf all inquiries and applications for membership.

Concession Fares

Application forms for travelling concessions may be obtained at the Inquiry Office in the Chancellery, or at the Amenities Unit Offices, Kensington.

Location

The Student Amenities Unit at Kensington is located in Hut B at the foot of Basser Steps. ('Phone: 663-0351, Ext. 2235).

STUDENT EMPLOYMENT UNIT

Assistance is offered in finding vacation employment, giving course-related experience, or industrial training where this is a course requirement. Casual employment and odd jobs, full-time employment for evening students, and permanent employment after graduation. This service is located in the Chancellery on the ground floor.

CHAPLAINCY SERVICE

The Service is provided for the benefit of students and staff by five Christian Churches (Anglican, Roman Catholic, Methodist, Churches of Christ, Seventh-Day Adventist) and by the Jewish congregation. Chaplains are in attendance at the University at regular times.

STUDENT HEALTH UNIT

Director: M. A. Napthali, MB BS, *Syd.*

Medical Officer: Elaine R. Caplan, MB BS *Syd.*

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 forms of assistance are available. In the first, the University considers, in certain circumstances, deferment of the payment of fees; this scheme is not intended to replace the established procedure for granting deferment for short periods but rather to supplement it by making deferment over longer periods possible. Secondly, students in need may receive a cash loan not exceeding $300 from the Student Loan Fund established from

contributions made by the Students' Union and the University. Thirdly, a Students' Union donation has made possible urgent cash loans not exceeding $100 for a period of one month.

In all cases assistance is limited to students with reasonable academic records and whose financial circumstances warrant loans. Students granted assistance of either kind are required to give an undertaking to repay the loan under the conditions agreed upon.

Applications are made personally 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.

LOCATION OF LABORATORIES OUTSIDE KENSINGTON CAMPUS

Randwick

The Schools of Highway and Traffic Engineering and the Structures Laboratory of the School of Civil Engineering occupy new buildings on the site of the old Tramway Depot at King Street, Randwick.

Manly Vale

The Water Research Laboratory of the School of Civil Engineering.

UNDERGRADUATE SCHOLARSHIPS

Students undertaking courses in the Faculty of Engineering are eligible to apply for the following scholarships.

Except where otherwise specified, applications on the forms 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, within seven days of the publication of the award of Commonwealth University Scholarships. A separate application must be lodged for each category of scholarship.

In addition to those scholarships made available by the University and other bodies as set out below, cadetships or traineeships 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.

University Scholarships

The University annually awards up to fifteen scholarships tenable in degree courses 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 during the currency of the scholarship. Scholarships will be awarded in order of merit on Higher School Certificate Examination results. They may be held only by persons who do not hold another award and whose parents are permanent residents of Australia.

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, and who with their parents are permanent residents of Australia; **Second or Later Year Scholarships,** which are awarded on the results obtained in approved university courses, are available to students who have completed the equivalent of one year of a full-time course (age and residential requirements are the same as for Open Entrance); 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. Applicants should be permanent residents of Australia.

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 Officer-in-Charge, Sydney Office, Department of Education and Science, La Salle Building, 70 Castlereagh Street, Sydney, 2000, (Telephone 20323).

Bursaries

A number 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, P.O. Box R42 Royal Exchange, N.S.W. 2000.

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 Colleges Ltd. during the year of the award. 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 Colleges Ltd., Box 24, P.O., Kensington 2033 (Telephone 663-0651).

Joint Coal Board Scholarships

The Joint Coal Board is offering scholarships in full-time courses in Mining Engineering and Applied Geology. The value of these scholarships ranges from $700 to $1,200 per annum (including

allowance for books and instruments). These scholarships are awarded on the understanding that students 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 principals 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.

The A. E. Goodwin Memorial Scholarship

The Directors of A. E. Goodwin Ltd. provide a scholarship each year to students who are eligible to enrol in the second year of the Mechanical Engineering degree course. The total value of the scholarship is $360, payable in three equal amounts of $120 each at the beginning of the second, third and fourth years of the course. Applications should be lodged with the Registrar by 31st January each year.

The Tyree Electrical Company Scholarship in Electrical Engineering

The Tyree Electrical Company Pty. Ltd., has undertaken to provide scholarships for students enrolling in the full-time courses in Electrical Engineering. The value of the scholarships is between $500 and $1,500 per annum, payable in fortnightly instalments as a living allowance to students. They will normally be tenable for four years but may be extended to a fifth year when the holder intends to qualify for the two degrees, Bachelor of Science and Bachelor of Engineering. They may be held concurrently with any other scholarship.

The Fox Memorial Manufacturing Company Scholarship

The Company offers annually a scholarship to students in the first and later years of the full-time course in Mechanical Engineering.

Regent Scholarship in Engineering for Women Undergraduates

Mrs. G. O'Riordan and Mrs. J. Kouvelis provide annually a $200 scholarship for a female student enrolled in a full-time engineering course, and is normally tenable for four years. The award of the scholarship is based on the applicant's scholastic merit and financial need.

UNDERGRADUATE COURSES

The Faculty of Engineering consists of seven Schools—Civil, Electrical, Mechanical and Industrial, Highway, Nuclear, Traffic, and Surveying. The Schools of Civil, Electrical, and Mechanical and Industrial offer full-time courses leading to the degree of Bachelor of Engineering, and part-time courses leading to the degree of Bachelor of Science (Engineering). The School of Surveying offers a full-time and part-time course leading to the degree of Bachelor of Surveying. The Schools of Highway, Nuclear and Traffic Engineering offer graduate courses only.

All the postgraduate activities of the Faculty are co-ordinated under the Graduate School of Engineering. For full details of such activities please see the Graduate School of Engineering Handbook and the University Calendar, or contact the appropriate school.

Common First Year

The Schools of Civil, and Mechanical and Industrial Engineering have the same first year course in physics, mathematics, chemistry and engineering, thus making it possible for students to transfer from one Bachelor of Engineering course to another within these schools at the end of their first year without loss of standing.

The first year in Electrical Engineering is similar to the first year of courses in Science and Applied Science and transfers to or from these Faculties can usually be arranged at the end of first year without loss of standing. Also notwithstanding the fact that first year courses in the three Engineering schools are not identical, sympathetic consideration will be given to requests by students who have completed first year to transfer to an allied course without loss of standing. When such transfer is desired an application must be made to the Registrar.

Progression

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

(1) Course programmes will continue to be stated and timetabled by Year or Stage and it cannot be guaranteed that non-standard programmes can be completed in the minimum number of years.

(2) Students must satisfy the rules governing re-enrolment: in particular, these require all subjects of the first year to be completed by the end of two years of full-time (or four years of part-time) study.

(3) Before enrolling in any subject a student must have satisfied the relevant prerequisite and co-requisite requirements. This will usually necessitate a student completing or attempting all subjects of a particular Year or Stage before proceeding to a subject in the next part of a course. Further details are available from the appropriate School.

(4) Only in exceptional circumstances will a student be permitted to enrol in subjects extending over more than two years of the course or for more than twenty-eight hours of course work per week if a full-time student or fourteen hours per week if a part-time student.

Students repeating subjects are required to choose a programme which limits their hours of course work to twenty-two per week if a full-time student, and to eleven per week if a part-time student, unless they have the express permission of the Head of School to exceed these hours.

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

FULL-TIME COURSES

Full-time courses of four-years' duration are offered in Civil, Electrical, Mechanical, Industrial, and Aeronautical Engineering, and in Naval Architecture: all of these lead to the degree of Bachelor of Engineering. A four-year full-time course in Surveying is offered by the School of Surveying leading to the degree of Bachelor of Surveying.

The award of the degree of Bachelor of Engineering is recognized by the Institution of Engineers, Australia, as giving complete exemption from the examinations required for admission to the grade of Member. In nearly all cases substantial or complete recognition is accorded to these courses by overseas engineering institutions.

General Studies Programme

All undergraduates in Faculties other than Arts and Law are required to complete a General Studies programme. The general

pattern and course outlines in the Faculty of Engineering are listed in the Department of General Studies Handbook which is available, free of cost, to all students.

Industrial Training Requirements

All full-time engineering courses incorporate industrial training and reference should be made to the entries under each School heading for details of the arrangements applicable. All students are strongly recommended to gain further industrial experience in those long vacations where such training is not already prescribed.

The staff of the University will, where possible, assist students to obtain this employment, but it is emphasized that the primary responsibility for obtaining suitable industrial experience rests with each student. Progression to succeeding years of the course and the award of the degree are dependent on the completion of the requisite periods of industrial employment of a standard approved by the University.

PART-TIME COURSES

Since 1961 the Schools of the Faculty have offered six-year part-time courses in a variety of engineering fields leading to the degree of Bachelor of Science (Technology). From 1971 the name of this degree became Bachelor of Science (Engineering) but is not awarded retrospectively. Courses for the BSc(Eng) degree are offered in Civil, Electrical, Industrial and Mechanical Engineering and in Naval Architecture and Aeronautical Engineering (these last two being offered by the School of Mechanical and Industrial Engineering).

The General Studies programme is the same for part-time as for full-time students, except that part-time students do not do an Advanced Elective.

The award of the degree of BSc(Eng) is recognized by the Institution of Engineers, Australia, as giving complete exemption from the examinations required for admission to the grade of Member.

Recognition by overseas engineering institutions varies in the different branches of engineering, and particular enquiries on this matter should be addressed to the head of the appropriate School.

A student completing the BSc(Eng) degree course and wishing to qualify for the corresponding BE degree may, on the recommendation of the Head of the School, transfer to the corresponding full-time BE course provided he does not take out the BSc

(Eng) degree. Further, provided he continues as a registered student on transfer from one course to the other, he may retain any concession granted in the BSc(Eng) degree course.

Holders of the BSc(Eng) award are eligible to proceed to the degree of Master of Engineering, Master of Engineering Science or Master of Surveying Science subject to the conditions for the award of these degrees set out in Section C of the University Calendar.

Courses leading to the BSc(Eng) award are basically part-time and the prescribed industrial experience should be gained concurrently with the course of study (a minimum of three years of suitable engineering experience is required). Students transferring from full-time courses must, therefore, also satisfy these industrial experience requirements before being admitted to the degree of BSc(Eng).

The BSc(Eng) degree programme may in some cases be accelerated by a student attending for one or more years full-time. For example, in all courses of the Faculty it is possible to take the equivalent of the first two part-time years in the full-time first year.

The School of Surveying offers a part-time course of seven years' duration for the degree of Bachelor of Surveying.

FACULTY OF APPLIED SCIENCE

The Faculty of Applied Science offers courses to students desiring a career in a specialized technology with an engineering element. These courses are as follows:

	Full-time	*Part-time*
Chemical Engineering	BE	BSc(Tech)
Ceramic Engineering	BSc	BSc(Tech)
Metallurgy*	BSc	BSc(Tech)
Mining Engineering	BE	BSc(Tech) or BSc(Eng)†
Textile Engineering	BSc	—

Entrance to these courses, which are of four years' duration full-time (pass or honours) and six years' duration part-time, is conditional upon completion of the full subject Chemistry I. Except in the case of Mining Engineering, transfer should be made at the end of first year to achieve maximum standing. Full-time Engineering students may enter the Mining Engineering course after the

* A part-time course is also available at Wollongong.

† A part-time course leading to the award of the BSc(Tech) degree is available at Wollongong, and leading to the award of the degree of BSc(Eng) at Broken Hill.

second year of courses in Mechanical, Electrical or Civil Engineering without loss in standing of subjects completed.

Part-time engineering students may enter the courses offered by the Schools of Chemical Engineering, Chemical Technology and Metallurgy after the second stage part-time or the full-time first year. They may enter the Mining Engineering course after the fourth stage. In all cases the requirements for the degree of BSc(Tech) demand three years approved concurrent industrial training.

Holders of the degrees of BE (pass or honours) and BSc(Tech) in Chemical Engineering and in Mining Engineering are recognized by the Institution of Engineers of Australia as being eligible for Corporate Membership without further examination.

Ceramic Engineering

Ceramics are inorganic, non-metallic materials which usually require the use of high temperatures in their processing. Products of the industry include glass, refractories, bricks, tiles, pipes, abrasives, cement, plaster, nuclear ceramics, whitewares, enamels and electric insulators, dielectrics and magnetic materials. The ceramic engineer is concerned with the relationship between the atomic and crystal structure of materials and their chemical, physical and engineering properties, as well as the methods of their manufacture and fabrication into useful shapes.

Graduates in Ceramic Engineering take positions in the fields of research and development, production control, product evaluation and technical service.

Chemical Engineering

Chemical Engineering is the application of the principles of the physical sciences, together with 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.

Metallurgy

Metallurgy deals with the nature, production, properties and uses of metals. Its importance today is associated with the demands for better materials for aircraft, rockets, and nuclear reactors, as well as the more conventional engineering structures, machines and appliances. Metallurgists are also closely involved with the development of new and more efficient processes for extracting metals from their ores and contributing to mineral production.

The School of Metallurgy is located at Kensington, and also has a department in Wollongong. It has excellent facilities for teaching and research. Emphasis in these courses is on the application of science to technological problems and in this respect there is a close relationship between metallurgy and engineering. Information on the Metallurgy courses and on opportunities for postgraduate work for engineering graduates in the School of Metallurgy may be obtained from the University Calendar, or from Professor Hugh Muir at the School of Metallurgy.

Mining Engineering

The aim of the training is to give students a thorough foundation in Mining Engineering and so permit them to enter 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.

During the undergraduate course, students will spend portion of the long vacations obtaining practical experience in mining. Mining companies prepare programmes so that the students obtain a comprehensive experience in many aspects of the profession. This experience is important and it is related to the academic training received in the School. Practical experience in mining, gained as a student, can contribute to the experience record of mining engineers when making application for a statutory certificate of competency from one of the Australian State Government Departments of Mines.

The School of Mining Engineering offers part-time courses in Mining Engineering and Mineral Processing at Broken Hill, the former leading to the degree of Bachelor of Science (Engineering), and the latter course leading to the degree of Bachelor of Science (Technology).

Textile Engineering

The textile industry, being a manufacturing one, depends on many types of machinery and engineering services to produce its products. In order to cope with technological problems in production, quality control and research, a competent textile engineer must have a good understanding of the fundamental sciences and extensive theoretical and practical knowledge of the applied textile and engineering sciences.

There are many challenging positions for textile engineers in industry and research.

Full details of the above courses may be obtained from the University Calendar or the Faculty of Applied Science Handbook.

HIGHER DEGREES AND GRADUATE COURSES

Research Degrees

The higher degrees of Master of Engineering, Master of Surveying, and of Doctor of Philosophy are awarded on the presentation of a thesis, satisfactory to the examiners, which embodies the results of an original investigation or design. Candidates for these degrees must possess a bachelor's degree in an appropriate field and meet the conditions governing the award of these degrees. The full conditions are set out in the University Calendar and in the Handbook of the Graduate School of Engineering.

The degree of Doctor of Science is also awarded for a contribution of distinguished merit in the field of engineering.

Courses of Study for Graduate Awards

In addition to the research degrees listed above, the Faculty offers courses of instruction at the graduate level leading to the award of the degree of Master of Engineering Science, Master of Surveying Science or to a graduate diploma.

Courses for the Degree of Master of Engineering Science

Engineering Construction, Public Health Engineering, Structural Engineering, Water Engineering (School of Civil Engineering); Electrical Engineering (School of Electrical Engineering); Highway Engineering (School of Highway Engineering); Industrial Engineering (Operations Research), Mechanical Engineering, Refrigeration and Air Conditioning (School of Mechanical and Industrial Engineering); Nuclear Engineering (School of Nuclear Engineering); and Transport and Traffic (School of Traffic Engineering).

Course for the Degree of Master of Surveying Science

The School of Surveying offers courses leading to the degree of Master of Surveying Science.

Courses for Graduate Diplomas

Highway Engineering, Human Communication, Industrial Engineering and Transport.

Full details of all these courses are given in the section on postgraduate study in the University Calendar, in the Handbooks of the appropriate Schools, and in the Handbook of the Graduate School of Engineering.

The Faculty of Engineering also supervises the Graduate Diploma course in Human Communications, offered by the Division of Postgraduate Extension Studies.

Special Courses

Short, intensive graduate and special courses are provided throughout each year designed to keep practising engineers in touch with the latest developments in their various fields. The programmes of such courses for this year are published separately.

OUTLINES OF UNDERGRADUATE COURSES

SCHOOL OF CIVIL ENGINEERING

Civil engineering is broad in its scope, utilizing other specialized branches of engineering in planning, co-ordinating and constructing national works such as water supply and conservation projects, hydro-electric development, roads, railways, bridges, tunnels, large buildings, and irrigation, sewerage, and harbour and river development. The civil engineer adapts the forces of nature for the use and convenience of mankind. His academic training must include a study of science and of engineering practice and he must bring to his work experience and judgment and the knowledge and personality necessary to control large organizations of workers. The Civil Engineering profession offers to a young man a considerable variety of types of work ranging from specialized research and investigations, through design and construction work to higher positions which are often largely managerial and organizational in their nature.

The School of Civil Engineering offers two courses in Civil Engineering: a four year full-time or equivalent part-time course leading to the degree of Bachelor of Engineering (B.E.) and a six year part-time course leading to the degree of Bachelor of Science (Engineering) (B.Sc.(Eng.)). In the full-time course, a period of forty working days of industrial training must be completed between Years 3 and 4 and it is strongly recommended that further industrial experience be gained in the long vacation between Years 2 and 3. Part-time students are required to gain a minimum of three years of suitable engineering experience concurrently with the University course. Students enrolled in the final year of either course may be required to present a seminar and attend a prescribed number of seminar sessions as part of their programme.

A student who has completed the requirements for the award of the B.Sc.(Eng.) degree in Civil Engineering but has not taken out the degree by formal graduation may apply to the Head of School for enrolment on a part-time basis in the B.E. degree course. It is anticipated that, in normal cases, the additional requirements for the B.E. degree may be completed in one year of part-time study.

The degree of Bachelor of Engineering may be conferred as a Pass degree or as an Honours degree. There are two classes of Honours, Class 1, and Class 2 in two divisions, and the award and grade of Honours are made in recognition of superior performance throughout the course. The degree of Bachelor of Science (Engineering) may be awarded with Merit in recognition of superior performance throughout the course.

CIVIL ENGINEERING—FULL-TIME COURSE

Bachelor of Engineering

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 1		Lec.	Lab. Tut.	Lec.	Lab. Tut.
1.051	Physics IE	3	3	3	3
2.021	Chemistry IE	3	3	0	0
5.011	Engineering IA	4	2	6	5
10.001 10.011	Mathematics I *or* Higher Mathematics I	4	2	4	2
		14	10	13	10

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 2					
4.941	Materials†	0	0	1	1
5.711	Thermodynamics†	0	0	1	1
6.801	Electrical Engineering	1	2	1	2
8.151	Mechanics of Solids	2	1	2	1
8.250	Properties of Materials†	2	2	0	0
8.260	Soil Mechanics†	1	1	0	0
8.510	Hydraulics†	2	2	0	0
8.621	Engineering Construction	1½	½	1½	½
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		—		—
		13	12	12	11

*Two one-day Geology excursions are an essential part of this subject.
†Normally offered in both sessions as a complete course. At enrolment students are grouped into the appropriate session.

YEAR 3					
8.010	Projects	0	3	0	3
8.152	Structures	3	1	3	1
8.161	Engineering Mathematics	1½	1½	1½	1½
8.252	Civil Engineering Materials	1½	½	1½	½
8.301	Systems Engineering	1	1	1	1
8.531	Water Engineering	2½	1½	2½	1½
	Two General Studies Electives	2	1	2	1
		11½	9½	11½	9½
YEAR 4					
8.012	Engineering Electives	2	2	2	2
8.153	Structures	3	2	3	2
8.253	Civil Engineering Materials	3	3	3	1
8.532	Water Engineering	1½	1½	1½	1½
8.631	Civil Engineering	3	½	3	½
	Two General Studies Electives*	2	1	2	1
		14½	10	14½	8

*One elective must be advanced; as an alternative to it, students may take the Sociology IIIA (53.113) option "Science, Technology and Society."

CIVIL ENGINEERING—PART-TIME COURSE

Bachelor of Science (Engineering)

		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
STAGE 1					
1.051	Physics IE	3	3	3	3
10.001	Mathematics I *or*	4	2	4	2
10.011	Higher Mathematics*				
		7	5	7	5

*There will be no evening lectures in this subject in 1972.

STAGE 2					
2.021	Chemistry IE	3	3	0	0
5.011	Engineering IA	4	2	6	5
	General Studies Elective	1	½	1	½
		8	5½	7	5½
STAGE 3					
4.941	Materials†	1	1	0	0
8.151	Mechanics of Solids	2	1	2	1
8.250	Properties of Materials†	0	0	2	2
10.022	Mathematics	2	2	2	2
29.441	Engineering Surveying*	1½	0	1½	0
29.491	Survey Camp		—		—
		6½	4	7½	5

*42 hours of Saturday fieldwork is an essential part of this subject.

†Normally offered in both sessions as a complete course. At enrolment students are grouped into the appropriate session.

STAGE 4					
5.711	Thermodynamics†	0	0	1	1
6.801	Electrical Engineering	1	2	1	2
8.260	Soil Mechanics†	1	1	0	0
8.510	Hydraulics†	2	2	0	0
8.621	Engineering Construction	1½	½	1½	½
25.101	Geology for Engineers* †	0	0	2	2
	General Studies Elective	1	½	1	½
		6½	6	6½	6

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

†Normally offered in both sessions as a complete course. At enrolment students are grouped into the appropriate session.

		Hours per week			
		SESSION 1		SESSION 2	
			Lab.		Lab.
STAGE 5		Lec.	Tut.	Lec.	Tut.
8.152	Structures	3	1	3	1
8.161	Engineering Mathematics	1½	1½	1½	1½
8.301	Systems Engineering	1	1	1	1
8.531	Water Engineering	2½	1½	2½	1½
		7½	4½	7½	4½
STAGE 6					
8.154	Structures	2	2	2	2
8.252	Civil Engineering Materials	3	1	0	0
8.254	Civil Engineering Materials	0	0	2	4
8.632	Civil Engineering	1½	0	1½	0
	General Studies Elective	1	½	1	½
		7½	3½	6½	6½

SCHOOL OF ELECTRICAL ENGINEERING

The School consists of the Departments of Electric Power Engineering, Communications, Control Engineering, Electronic Computation and Solid-State Electronics and is well-suited to offer undergraduate and postgraduate training in all branches of the profession of electrical engineering. The School's teaching and research programmes are constantly under review to meet the ever changing challenges of present and future needs.

The School offers a full-time course of four years' duration leading to the degree of Bachelor of Engineering, and a six-year part-time course for the degree of Bachelor of Science (Engineering). The courses may also be completed by a combination of part-time and full-time study. Graduate courses are described elsewhere.

The degrees of Bachelor of Engineering and Bachelor of Science (Engineering) are recognized by the Institution of Engineers, Australia, the Institution of Radio and Electronics Engineers, Australia, and the Institution of Electrical Engineers, London, as giving complete exemption from the examinations required for admission to Graduate or Corporate membership.

Electrical engineering, perhaps more than most other branches of engineering, is closely linked with the pure sciences, and requires a scientific outlook and approach for a proper understanding of its problems.

In the early years of the electrical engineering courses, students concentrate on acquiring knowledge of the basic sciences, particularly mathematics and physics, with an engineering component which increases progressively to the final year, when students elect, with the approval of the Head of the School, to study in specialized fields of electrical engineering. At the same time they take subjects common to all students in electrical engineering. A list of available electives (which may vary from year to year) is given in the course description. Students in doubt as to which programme patterns are desirable or permissible should consult the Head of the School.

Each student in the full-time course is required to work on an individual or group project under the guidance of members of the lecturing staff. Generally, the project will involve the design and construction of experimental apparatus together with laboratory tests. Where possible the projects will be related to the research programme of the School and chosen to develop the student's initiative. Each student is required to deliver a seminar paper and to prepare a thesis or take part in the preparation of a group thesis based on the results of the project work.

In the Bachelor of Engineering course the same formal programme is offered to both pass students and to those aiming at honours. Honours will be awarded for meritorious performance over the course: special attention is paid to a candidate's performance in the final year thesis project. A student with a creditable performance in the Bachelor of Science (Engineering) course may be awarded a degree with Merit.

ELECTRICAL ENGINEERING—FULL-TIME COURSE

The full-time course is of four years' duration and leads to the degree of Bachelor of Engineering (pass or honours). Each of the four years of the course requires full-time day attendance at the University for twenty-eight weeks. All students are strongly recommended to complete two periods of industrial training, one of forty-five working days between Years 2 and 3, and the other of forty-five working days between Years 3 and 4. They are also advised to obtain practical experience during the long vacation between Years 1 and 2.

		Hours per week for 2 sessions	
YEAR 1		Lec.	Lab. Tut.
* 1.001	Physics I	3	3
2.001	Chemistry I	3	3
5.001	Engineering I	4	2
*10.001	Mathematics I	4	2
		14	10
YEAR 2			
* 1.112 A	Electromagnetism	1½	1½
* 1.112 B	Modern Physics	1½	1½
* 1.112 C	Waves and Thermodynamics	1½	1½
6.021	Electrical Engineering II	3	3
8.111	Civil Engineering	2	1½
*10.111 A	Pure Mathematics II (Algebra)	1½	½
*10.111 B	Pure Mathematics II (Analysis)	1½	½
*10.211 A	Applied Mathematics II (Mathematical Methods)	1½	½
	One General Studies subject	1	½
		14½	10½

*Students who have achieved a certain standard may attempt similar material at a higher level.

YEAR 3			
5.661	Mechanical Engineering III	2	1
10.033	Mathematics III	2	0
10.361	Statistics	1	½
	Electrical Engineering III		
6.031 A	Systems and Circuit Theory	2	2
6.031 B	Machines and Transformers	2	2
6.031 C	Electronic Circuits and Signal Processing	2	2
6.031 D	Computing	1	1
6.031 E	Electron Physics and Devices	2	0
	Two General Studies subjects	2	1
		16	9½
YEAR 4			
	Electrical Engineering IV‡ (6 units)		
6.911	Thesis *or* } ‡		
6.931	Group Thesis }		
	One General Studies subject†	1½	½

†At least one General Studies advanced elective is required.

‡See overleaf for details.

Electrical Engineering IV

A number of general topics are offered and each Department offers specialized electives. Approximately half of each programme is common to all students. Not all electives will be offered every year nor will the compulsory subjects remain the same. Students will be advised each year which electives are available and which units are compulsory.

In 1972, four units are taken in Session 1 and two (6.041 and 6.042) in Session 2.

The list of units is:

		Hours per week for 1 session. Lec.	Lab./Tut.
6.041	Fields and Measurements	3	3
6.042	Circuits, Signals and Information Theory	3	0
6.202	Power Systems	3	3
6.212	Machines	3	3
6.303	Communication Electronics	3	3
6.313	Wave Radiation and Guidance	3	3
6.322	Electronics	3	3
6.333	Communication Systems	3	3
6.383	Biomedical Engineering	3	3
6.412	Automatic Control	3	3
6.422	Computer Control	3	3
6.512	Advanced Semiconductor Device Theory	3	3
6.522	Transistor and Integrated Circuit Design	3	3
6.612	Computer Systems Engineering	3	3
6.622	Computer Application and Software	3	3

The programme selected by each student must be approved by the Head of School.

Thesis or Group Thesis

This year, in Session 1 two hours per week and in Session 2 three clear days per week are devoted to directed laboratory and research work on an approved subject with special reading and study associated with the presentation of a seminar and the preparation of a thesis. The thesis must be submitted by the first Monday in December.

ELECTRICAL ENGINEERING—PART-TIME COURSE

Bachelor of Science (Engineering)

The six-year part-time course in Electrical Engineering leads to the degree of Bachelor of Science (Engineering).

		Hours per week for 2 sessions	
		Lec.	Lab. Tut.
STAGE 1			
2.001	Chemistry I	3	3
*10.001	Mathematics I	4	2
		7	5
STAGE 2			
* 1.001	Physics I	3	3
5.001	Engineering I	4	2
		7	5

*Students who have achieved a certain standard may attempt similar material at a higher level.

STAGE 3			
1.112C	Waves in Continuous Media and Thermodynamics	1½	1½
6.021	Electrical Engineering II	3	3
10.111B	Pure Mathematics II (Analysis)	1½	½
10.211A	Applied Mathematics II (Mathematical Methods)	1½	½
		7⅓	5⅓
STAGE 4			
1.112A	Electromagnetism	1⅓	1⅓
1.112B	Modern Physics	1⅓	1⅓
6.031	Electrical Engineering III Unit A: Systems and Circuit Theory	2	2
10.111A	Pure Mathematics II (Algebra)	1½	½
	One General Studies subject	1	½
		7⅙	5⅓

		Hours per week for 2 sessions	
STAGE 5*		Lec.	Lab. Tut.
4.921	Materials Science	1	0
6.043	Measurements	1	1
	Two General Studies subjects	2	1
Communications Option			
6.031	Electrical Engineering III		
	Unit C: Electronic Circuits and Signal Processing	2	2
	Unit E: Electron Physics and Devices	2	0
Power and Control Option			
6.031	Electrical Engineering III		
	Unit B: Machines and Transformers	2	2
	Unit D: Computing	1	1
		8/7	4/5

*In Stage 5 students take either the Communications *or* the Power and Control Option. Whichever option is chosen must be continued in Stage 6, where Power and Control Students choose different electives and substitute 5.661 Mechanical Engineering for 6.031 Unit E (Electron Physics and Devices).

STAGE 6

Communications Option			
6.031	Electrical Engineering III		
	Unit B: Machines and Transformers	2	2
	Unit D: Computing	1	1
	Two Communications Electives*	3	3
		6	6
Power and Control Option			
6.031	Electrical Engineering III		
	Unit C: Electronic Circuits and Signal Processing	2	2
5.661	Mechanical Engineering	2	1
	Two Power and Control Electives*	3	3
		7	6

*The list of electives to be offered will largely correspond to those in the Electrical Engineering IV list (see the B.E. programme) but will be offered as 28-week courses. The full range of electives will not be offered in the B.Sc.(Eng.) course: students who can arrange day attendance may be permitted to substitute Electrical Engineering IV electives.

ELECTRICAL ENGINEERING—
COMBINED FULL-TIME/PART-TIME COURSES

The subjects of the B.Sc.(Eng.) course are each identical with a subject of the B.E. programme and the requirements of these subjects could be completed by either day or evening study in most cases. Timetables will be arranged to suit the preferred yearly programmes given above. Provided prerequisites are met and the programme can be timetabled, a student in either course may, with the approval of the Head of the School, complete the requirements by a combination of full-time and part-time study.

ELECTRICAL ENGINEERING—
SUBSTITUTION OF SUBJECTS

To suit the special abilities or needs of individual students a limited amount of substitution is permitted within each course. Any such substitution *must have prior approval of the Head of School* who will ensure that:

1. The replacement subject is *at least* of the same length and level as the prescribed subject it replaces; and

2. The resulting overall programme of study is suited to the award of either the B.E. or B.Sc.(Eng.) as applicable.

It is not envisaged that such substitutions will be commonplace but examples are:

(a) Replacement of two General Studies subjects by an approved Arts subject;

(b) Replacement of one or two General Studies subjects by an approved (by the Head of the Department of General Studies) subject from areas such as:

Life Sciences;
Earth Sciences;
Accounting and Business Administration;
Law;
Economics;
Industrial Management.

(c) In the case of students proposing to attempt the B.Sc., B.E. pattern, if they include additional Applied Mathematics in their Second Year Electrical Engineering Programme they open up a wider choice of subjects in their Science Third Year. This could be substituted for 8.111 or the General Studies courses. If the B.Sc. programme is completed these courses would be put back into the student's Third Year of Electrical Engineering;

(d) The normal Fourth Year of the B.E. programme includes 6 units of Electrical Engineering IV. Students may substitute for ONE of these units, a subject of suitable level and difficulty from an area outside the School of Electrical Engineering.

DOUBLE DEGREE OF B.SC., B.E. IN ELECTRICAL ENGINEERING

Students in Electrical Engineering may qualify for this double degree in five years of full-time study. Having completed the first and second years of the Electrical Engineering course, students transfer to Science (this is subject to the recommendation of the Head of the School of Electrical Engineering and the approval of the Deans of the Faculties of Engineering and Science) and do the appropriate General Studies subjects and four Level III units chosen from related disciplines and no less than four other units of either Level II or Level III chosen in accordance with the Science Course regulations. In their fourth year the students revert to the Faculty of Engineering. Depending on the programme followed in their year in Science they will have already completed parts of the normal third year programme of the Electrical Engineering course, and they will be required to omit these from their programme and to include an equivalent amount of other courses chosen with the approval of the Head of School. In their fifth year they will complete the fourth year of the Electrical Engineering course.

SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING

The courses in this School are planned to provide the appropriate academic training for the professional engineer in the fields of aeronautical, industrial and mechanical engineering, and for the naval architect.

The study of the basic sciences—Mathematics, Physics and Chemistry—together with an introduction to Engineering, comprises the first year. In the second year further mathematical studies are undertaken together with a study of the Engineering Sciences—Thermodynamics, Fluid Mechanics, Engineering Mechanics, Mechanics of Solids and their application in the field of Design.

The full-time courses of Mechanical, Industrial and Aeronautical Engineering and of Naval Architecture have common subjects for the first two years. The third and fourth years contain a number of common core subjects together with specific departmental requirements. In the fourth and final year, in addition to core subjects and departmental requirements, provision is made for a limited degree of specialization in one or more elective subjects. Each full-time student is required to present a thesis at the end of his final year and to deliver a short paper on the subject of his thesis. General studies form a regular part of all courses. In certain instances and with permission from the Head of the School students may substitute an Arts subject in lieu of two General Studies subjects.

Industrial experience is an integral part of the full-time courses. All students enrolled in the School must complete forty working days of approved industrial training between Years 3 and 4, and, irrespective of their specialization, are strongly recommended to gain as much industrial training as possible between Years 1 and 2.

The full-time courses in Aeronautical, Industrial and Mechanical Engineering and in Naval Architecture are of four years' duration and lead to the degree of Bachelor of Engineering (B.E.).

All students will be considered for the award of Honours which will be granted for meritorious performance in the course with particular emphasis on the later years. With the approval of the Head of School, students may proceed to the B.E. degree via a combination of full-time and part-time study.

Part-time courses of six years' duration leading to the degree of Bachelor of Science (Engineering) are offered in the same four fields as the full-time courses.

Part-time courses may also be completed by a combination of part-time and of full-time study.

A student who has successfully completed the first two stages of any of the Bachelor of Science (Engineering) courses mentioned above may transfer to the second year of any of the full-time B.E. courses offered by the School. A part-time student will be able to transfer at the end of Stage 4 of his course to the third year of the corresponding B.E. course. The B.Sc.(Eng.) degree may be awarded 'With Merit' to students whose performance in the course is superior.

The Institution of Engineers, Australia, grants full exemption from examinations for admission to the grade of Member to holders of the degree of B.E. or B.Sc.(Eng.) in any of the undergraduate courses offered by the School.

MECHANICAL ENGINEERING—FULL-TIME COURSE

Bachelor of Engineering

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
YEAR 1					
1.051	Physics IE	3	3	3	3
2.021	Chemistry IE	3	3	0	0
5.011	Engineering IA	4	2	6	5
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4	2	4	2
		14	10	13	10
YEAR 2					
5.032	Experimental Engineering II	1	1	1	1
5.061	Technical Orientation	½	0	½	0
5.111	Mechanical Engineering Design I	2	2	2	2
5.311	Engineering Mechanics*	0	0	1½	1
5.611	Fluid Mechanics/Thermodynamics I	2	2	2	2
6.801	Electrical Engineering	1	2	1	2
8.151	Mechanics of Solids	2	1	2	1
8.259	Properties of Materials	2	1	2	1
10.022	Mathematics	2	2	2	2
	General Studies Elective	1	½	1	½
		13½	11½	15	12½

*Students who have completed 5.001 Engineering I should take in addition 5.301 Engineering Mechanics, which will be offered in Session 1 (1 — 1).

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 3		Lec.	Lab. Tut.	Lec.	Lab. Tut.
5.033	Experimental Engineering III	1	½	1	½
5.071	Engineering Analysis	2½	1	2½	1
5.112	Mechanical Engineering Design II	1½	1½	1½	1½
5.331	Dynamics of Machines I	1½	½	1½	½
5.412	Mechanics of Solids I	1½	½	1½	½
5.612	Fluid Mechanics/Thermodynamics II	2½	1	2½	1
6.802	Electrical Engineering*	2	1	2	1
18.011	Industrial Engineering IA *or*	1	1	1½	½
18.021	Industrial Engineering IB	1½	½	1½	½
	General Studies Elective	2	1	2	1

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

YEAR 4					
5.051	Thesis	0	6	0	6
5.062	Communications	2	0	2	0
5.324	Automatic Control Engineering	2	1	2	1
	General Studies Elective	1	½	1	½
Plus 12 hours from the following Technical Electives:					
4.913	Materials Science	2	1	2	1
5.113	Mechanical Engineering Design III	1½	4½	1½	4½
5.332	Dynamics of Machines II	2	1	2	1
5.413	Mechanics of Solids II	2	1	2	1
5.613	Fluid Mechanics/Thermodynamics III	4	2	4	2
18.012	Industrial Engineering IIA	2	1	2	1
18.022	Industrial Engineering IIB	2	1	2	1
18.431	Design for Production	2	1	2	1
18.551	Operations Research	2	1	2	1
23.057	Nuclear Power Technology	2	1	2	1

MECHANICAL ENGINEERING—PART-TIME COURSE

Bachelor of Science (Engineering)

This course is of six years' duration, and leads to the degree of Bachelor of Science (Engineering).

		Hours per week			
		SESSION 1		SESSION 2	
		Lec.	Lab. Tut.	Lec.	Lab. Tut.
STAGE 1					
1.051	Physics IE	3	3	3	3
10.001 / 10.011	Mathematics I *or* Higher Mathematics I*	4	2	4	2
		7	5	7	5

*There will be no evening lectures in this subject in 1972.

STAGE 2					
2.021	Chemistry IE	3	3	0	0
5.011	Engineering IA	4	2	6	5
		7	5	6	5
STAGE 3					
5.311	Engineering Mechanics*	1	½	1	½
8.151	Mechanics of Solids	2	1	2	1
8.259	Properties of Materials	2	1	2	1
10.022	Mathematics	2	2	2	2
	General Studies Elective	1	½	1	½
		8	5	8	5

*Students who have completed 5.001 Engineering I should take in addition 5.301 Engineering Mechanics, which will be offered in Session 1 (1 — 1).

STAGE 4					
5.032	Experimental Engineering II	1	1	1	1
5.111	Mechanical Engineering Design I	2	1	2	1
5.611	Fluid Mechanics/Thermodynamics I	2	2	2	2
6.801	Electrical Engineering	1	2	1	2
	General Studies Elective	1	½	1	½
		7	6½	7	6½
STAGE 5					
5.071	Engineering Analysis	2½	1	2½	1
5.112	Mechanical Engineering Design II	1½	1	1½	1
5.331	Dynamics of Machines I	1½	½	1½	½
5.412	Mechanics of Solids I	1½	½	1½	½
5.612	Fluid Mechanics/Thermodynamics II	2	1	2	1
	*General Studies Elective	1	½	1	½
		10	4½	10	4½

*1972 only.

		Hours per week			
		SESSION 1		SESSION 2	
STAGE 6		Lec.	Lab. Tut.	Lec.	Lab. Tut.
5.324	Automotive Control Engineering	2	1	2	1
	General Studies Elective	1	½	1	½
	Plus 9 hours from Mechanical Engineering Electives:				
4.913	Materials Science	2	1	2	1
5.113	Mechanical Engineering Design III	1½	4½	1½	4½
5.332	Dynamics of Machines II	2	1	2	1
5.413	Mechanics of Solids II	2	1	2	1
5.613	Fluid Mechanics/Thermodynamics III	4	2	4	2

AERONAUTICAL ENGINEERING—FULL-TIME COURSE

Bachelor of Engineering

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

YEAR 3					
5.033	Experimental Engineering III	1	½	1	½
5.071	Engineering Analysis	2½	1	2½	1
5.303	Mechanical Vibrations	1	½	0	0
5.412	Mechanics of Solids I	1½	½	1½	½
5.800	Aircraft Design	1½	1	0	0
5.811	Aerodynamics I	2	1	2	1
5.822	Analysis of Aerospace Structures I	2	0	2	0
6.802	Electrical Engineering*	2	1	2	1
18.011	Industrial Engineering IA *or*	1	1	1½	½
18.021	Industrial Engineering IB	1½	½	1½	½
	General Studies Elective	2	1	2	1

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

YEAR 4					
5.051	Thesis	0	6	0	6
5.062	Communications	1	1	1	1
5.801	Aircraft Design	2	2	2	2
5.812	Aerodynamics II	2	1	2	1
5.823	Analysis of Aerospace Structures II	1	1	1	1
5.831	Aircraft Propulsion	1½	½	1½	½
	General Studies Elective	1	½	1	½
	Plus one technical elective from:—				
4.913	Materials Science				
5.324	Automatic Control Engineering	2	1	2	1
18.022	Industrial Engineering IIB				
18.551	Operations Research				
		10½	13	10½	13

AERONAUTICAL ENGINEERING—PART-TIME COURSE

Bachelor of Science (Engineering)

This course is of six years' duration and leads to the degree of Bachelor of Science (Engineering). The first four stages are identical with the Mechanical Engineering part-time course.

		Hours per week			
		SESSION 1		SESSION 2	
STAGE 5		Lec.	Lab. Tut.	Lec.	Lab. Tut.
5.071	Engineering Analysis	2½	1	2½	1
5.303	Mechanical Vibrations	1	½	0	0
5.412	Mechanics of Solids I	1½	½	1½	½
5.811	Aerodynamics I	2	1	2	1
5.822	Analysis of Aerospace Structures I	2	0	2	0
	*General Studies Elective	1	½	1	½
		10	3½	9	3

*1972 only.

STAGE 6					
5.801	Aircraft Design	2	2	2	2
5.812	Aerodynamics II	2	1	2	1
5.823	Analysis of Aerospace Structures II	1	1	1	1
5.831	Aircraft Propulsion	1½	½	1½	½
	General Studies Elective	1	½	1	½
		7½	5	7½	5

NAVAL ARCHITECTURE—FULL-TIME COURSE

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

		Hours per week			
		SESSION 1		SESSION 2	
YEAR 3		Lec.	Lab. Tut.	Lec.	Lab. Tut.
5.033	Experimental Engineering III	1	½	1	½
5.071	Engineering Analysis	2½	1	2½	1
5.303	Mechanical Vibrations	1	½	0	0
5.412	Mechanics of Solids I	1½	½	1½	½
5.911	Naval Architecture	2½	1½	2½	1½
5.921	Ship Structures	1½	½	1½	½
5.931	Principles of Ship Design IA	1	½	0	0
5.932	Principles of Ship Design IB	0	0	1	½
5.951	Hydrodynamics	1	½	0	0
18.021	Industrial Engineering IB	0	0	3	1
	General Studies Elective	2	1	2	1
		14	6½	15	6½
YEAR 4					
5.051	Thesis	0	6	0	6
5.062	Communications	1	1	1	1
5.922	Ship Structures	1	0	1	0
5.933	Principles of Ship Design	2	1	2	1
5.934	Ship Design Project	0	3	0	3
5.941	Ship Propulsion and Systems	3	2	3	2
	General Studies Elective	1	½	1	½
	Plus one elective from:—				
4.913	Materials Science	2	1	2	1
18.022	Industrial Engineering IIB				
18.551	Operations Research				
		10	14½	10	14½

NAVAL ARCHITECTURE—PART-TIME COURSE

Bachelor of Science (Engineering)

This course is of six years' duration and leads to the degree of Bachelor of Science (Engineering). The first four stages are identical with the Mechanical Engineering part-time course.

		Hours per week			
		SESSION 1		SESSION 2	
STAGE 5		Lec.	Lab. Tut.	Lec.	Lab. Tut.
5.071	Engineering Analysis	2½	1	2½	1
5.303	Mechanical Vibrations	1	½	0	0
5.412	Mechanics of Solids I	1½	½	1½	½
5.911	Naval Architecture	2½	1½	2½	1½
5.921	Ship Structures	1½	½	1½	½
5.932	Principles of Ship Design IB	0	0	1	½
	*General Studies Elective	1	½	1	½
		10	4½	10	4½

*1972 only.

STAGE 6					
5.922	Ship Structures	1	0	1	0
5.933	Principles of Ship Design	2	1	2	1
5.934	Ship Design Project	0	3	0	3
5.941	Ship Propulsion and Systems	3	2	3	2
	General Studies Elective	1	½	1	½
		7	6½	7	6½

DEPARTMENT OF INDUSTRIAL ENGINEERING

The Department of Industrial Engineering offers a full-time and a part-time course in industrial engineering leading to the degree of Bachelor of Engineering and Bachelor of Science (Engineering) respectively. These courses are designed for students with engineering ability whose interests lie in the planning, developing and control of manufacturing operations.

The first two years of the full-time course and the first four years of the part-time course provide the student with a sound foundation in the basic science and engineering subjects, and this knowledge is used and extended in the later years in the study of the industrial subjects. Finally, the problems associated with the practical economics of manufacturing operations are studied. These three fields of study provide the student with the training necessary to carry out an industrial job and to examine it critically in the light of economic efficiency.

Traditional engineering courses do not embrace the problems which are characteristic of industrial engineering. These problems include the analysis of a product to ensure satisfactory functioning with regard to methods and sequence of manufacturing operations; the disposition of buildings and of equipment in relation to buildings to permit efficient handling of materials; the avoidance or elimination of bottlenecks; the related problems of quality and cost control, testing and inspection; labour and personnel relations; and, finally, the problem of distribution and sales.

The financial and economic aspects are studied as the problem in manufacturing has not been solved until the final translation of the product into money has been accomplished successfully. While it is not intended to develop an expert in accounting practice or economics, it is intended to produce an engineer with an appreciation of the problems of cost and one who can apply considerations of ultimate economy to all industrial problems.

All full-time students must obtain industrial training for two periods, each of forty working days, the first between Years 2 and 3 and the second between Years 3 and 4. They are also strongly advised to obtain further experience during the long vacation between Years 1 and 2.

The Work of the Industrial Engineer

The industrial engineer may initially be employed in any of the following major areas of industrial activity:

(a) **Industrial Economic Analysis**

One of the principal functions of industrial engineering is to analyse a product, project or process from the economic point of view to ensure that an adequate profit can be obtained from it. A general working knowledge of economics and management skill has to be directed towards the making of decisions on how to operate an enterprise most efficiently. The basis for such decisions is furnished largely by the logical application of mathematics and statistics.

(b) **Planning and Control of Production**

Manufacturing processes and operations must be planned in detail throughout an enterprise to ensure that they proceed smoothly and economically. Functions in this field include the establishment of production standards, the setting of production targets and, finally, control of quality.

The ultimate responsibility of those in charge of the planning and control of production is to ensure that the goods, as orginally specified, perform satisfactorily and are produced when required at an optimum cost. Modern electronic computers may be called upon to help achieve this.

(c) **Product and Process Design**

The design interest of the industrial engineer goes beyond normal mechanical design to develop a product that will not only function effectively but also have a pleasing appearance.

Further, the product has to be adapted to suit existing manufacturing equipment, or a manufacturing process has to be developed by means of which an existing product can be manufactured at the right price and of the right quality. The design work of the industrial engineer incorporates also problems of equipment selection and application for both economy and performance.

Fundamental scientific studies of manufacturing processes such as metal machining, forming and casting are continually being made to improve their efficiency.

(d) **Methods Engineering**

Methods engineering is particularly concerned with the coordination of men, materials and machines, so that an enterprise will run at maximum efficiency. A considerable knowledge of engineering in general, as well as an understanding of human factors and materials science, is necessary for methods engineering work. Time and motion study is part of methods engineering.

In many cases the methods engineer works in close co-operation with the design department and executives engaged in industrial economic analysis.

(e) Operations Research

This is the attack of modern science on complex problems arising in the direction and management of large systems of men, machines, materials and money in industry, business, government, and defence. The distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as chance and risk, with which to predict and compare the outcomes of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically.

Employment in any of these fields may well lead to a position of responsibility in industrial management if the engineer is so inclined.

INDUSTRIAL ENGINEERING—FULL-TIME COURSE

Bachelor of Engineering

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

		Hours per week			
		SESSION 1		SESSION 2	
			Lab.		Lab.
YEAR 3		Lec.	Tut.	Lec.	Tut.
5.033	Experimental Engineering III	1	½	1	½
5.071	Engineering Analysis	2½	1	2½	1
5.112	Mechanical Engineering Design II	1½	1½	1½	1½
5.331	Dynamics of Machines I	1½	½	1½	½
5.412	Mechanics of Solids I	1½	½	1½	½
14.001	Introduction to Accounting	1½	0	1½	0
18.011	Industrial Engineering IA	1	1	1½	½
18.021	Industrial Engineering IB	1½	½	1½	½
	General Studies Elective	2	1	2	1
		14	6½	14½	6

		Hours per week			
		SESSION 1		SESSION 2	
			Lab.		Lab.
YEAR 4		Lec.	Tut.	Lec.	Tut.
5.051	Thesis	0	6	0	6
5.062	Communications	1	1	1	1
5.324	Automatic Control Engineering	2	1	2	1
18.012	Industrial Engineering IIA	2	1	2	1
18.022	Industrial Engineering IIB	2	1	2	1
18.551	Operations Research	2	1	2	1
	General Studies Elective	1	½	1	½
	Plus one elective from:—				
4.913	Materials Science				
5.332	Dynamics of Machines II	2	1	2	1
5.413	Mechanics of Solids II				
18.431	Design for Production				
		12	12½	12	12½

INDUSTRIAL ENGINEERING—PART-TIME COURSE

Bachelor of Science (Engineering)

This course is of six years' duration and leads to the degree of Bachelor of Science (Engineering).

For outline of the first four stages see the Mechanical Engineering part-time course.

STAGE 5					
5.071	Engineering Analysis	2½	1	2½	1
5.112	Mechanical Engineering Design II	1½	1	1½	1
5.331	Dynamics of Machines I	1½	½	1½	½
14.001	Introduction to Accounting	1½	0	1½	0
18.011	Industrial Engineering IA	1½	½	1½	½
18.021	Industrial Engineering IB	1½	½	1½	½
	*General Studies Elective	1	½	1	½
		11	4	11	4

*1972 only.

STAGE 6					
18.012	Industrial Engineering IIA	2	1	2	1
18.022	Industrial Engineering IIB	2	1	2	1
18.431	Design for Production	2	1	2	1
18.551	Operations Research	2	1	2	1
	General Studies Elective	1	½	1	½
		9	4½	9	4½

SCHOOL OF SURVEYING

The School of Surveying offers a four-year full-time course and a seven-year part-time course, each leading to the degree of Bachelor of Surveying. The degree can also be attained through a combination of part-time and full-time study.

The course is designed to provide the appropriate academic training for a professional surveyor working in any of the many branches of surveying. Since these branches cover a wide range, the course is broad in its scope. First and second years are concerned mainly with the basic sciences. Basic surveying is also included and in the third year the major surveying subjects appear: geodesy, photogrammetry, astronomy and cadastral surveying. With the addition of some applied sciences, these are continued into fourth year. A feature of the course is the inclusion of General Studies in the later years and stages. The graduate can take up cadastral or property surveying, engineering surveying, geodetic surveying, photogrammetry, cartography or hydrographic surveying.

Throughout the course the theory is illustrated by means of practical applications in field or laboratory exercises. The field work enables the student to use modern optical and electronic instruments. Full-time students must attend a survey camp for two weeks during each of Years 2 and 3 of their course and part-time students must attend a two-week survey camp during each of Stages 4 and 6 of their course. In addition, all full-time students are required to engage in approved training for a period of not less than forty days after the completion of Year 2 and for a further period of not less than forty days after the completion of Year 3. Part-time students are required to obtain a minimum of three years of approved practical experience concurrently with their course of study. The Bachelor of Surveying degree may be awarded as a Pass degree, Honours Class I, or Honours Class II in two divisions. Honours are awarded in recognition of superior performance throughout the course.

Students wishing to become Registered Surveyors after graduation are also strongly advised to gain practical experience under a Registered Surveyor. Some reduction in the period of practical experience required before registration may be sought because of practical experience gained during a student's course of study, provided the Board of Surveyors has given prior agreement to the recognition of this experience. Details are obtainable from the Registrar, Board of Surveyors, Department of Lands.

The degree of Bachelor of Surveying confers exemption from all written examinations of the Board of Surveyors.

SURVEYING—FULL-TIME COURSE

Bachelor of Surveying

		Hours per week for 2 sessions	
		Lec.	Lab. Tut.
YEAR 1			
1.041	Physics IC	3	3
5.001	Engineering I	3	3
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4	2
29.801	Surveying I	2	4
		12	12
YEAR 2			
2.212	Physics IIT	1½	1½
8.711	Engineering for Surveyors	2½	½
10.022	Mathematics	2	2
10.341	Statistics	1½	0
25.131	Geology for Surveyors†	1	1½
29.802	Surveying II	2	2½
29.841	Surveying Computations	1½	1
29.892	Survey Camp*	—	—
	General Studies Elective	1	½
		13	9½

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

*Students must attend a two-week survey camp which is held during October.

YEAR 3

8.712	Engineering for Surveyors	2	0
29.803	Surveying III	1½	1½
29.821	Geodesy I	2½	1½
29.831	Astronomy I	2	½
29.842	Surveying Computations	1	1
29.851	Photogrammetry I	1½	1½
29.881	Land Law, Utilization and Valuation†	3	0
29.893	Survey Camp*	—	—
	Two General Studies Electives	2	1
		15½	7

*Lectures cease in Session 2 for three weeks when students must attend the survey camp (29.893).

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

YEAR 4		Hours per week SESSION 1 Lec.	Lab. Tut.	SESSION 2 Lec.	Lab. Tut.
6.811	Electronic Instrumentation for Surveyors	1	0	1	0
25.303	Geophysics for Surveyors*	3	0	0	0
29.081	Thesis	3	0	3	0
29.822	Geodesy II	2	1½	2	2½
29.832	Astronomy II	1½	1	1½	1
29.852	Photogrammetry II	1	3½	1	3½
29.882	Cadastral Surveying	1½	½	1½	½
36.411	Town Planning	1½	1½	0	0
	General Studies Elective	1	½	1	½
		15½	8½	11	8

*A one-day Geophysical field tutorial is an essential part of this subject (Session 1 only).

SURVEYING—PART-TIME COURSE
Bachelor of Surveying

STAGE 1		Hours per week for 2 sessions Lec.	Lab. Tut.
1.041	Physics IC	3	3
10.001 / 10.011	Mathematics I *or* Higher Mathematics I*	4	2
		7	5

*There will be no evening lectures in this subject in 1972.

STAGE 2			
5.001	Engineering I	3	3
29.801	Surveying I	2	4
		5	7

STAGE 3			
1.212	Physics IIT	1½	1½
8.711	Engineering for Surveyors	2½	½
10.022/1	Mathematics II, Part I	1	1
29.841	Surveying Computations	1½	1
	General Studies Elective	1	½
		7½	4½

		Hours per week for 2 sessions	
STAGE 4		Lec.	Lab. Tut.
10.022/2	Mathematics II, Part II	1	1
10.341	Statistics	1½	0
25.131	Geology for Surveyors†	1	1½
29.802	Surveying II	2	2½
29.892	Survey Camp*		—
	General Studies Elective	1	½
		6½	5½

†Two one-day field tutorials are an essential part of the course.
*Students must attend a two-week survey camp which is held during October.

STAGE 5			
8.712	Engineering for Surveyors	1½	0
29.803	Surveying III	1½	1
29.831	Astronomy I	1½	½
29.842	Surveying Computations	1	½
29.881	Land Law, Utilization and Valuation*	2½	0
	General Studies Elective	1	½
		9	2½

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

		Hours per week			
		SESSION 1		SESSION 2	
STAGE 6		Lec.	Lab. Tut.	Lec.	Lab. Tut.
6.811	Electronic Instrumentation for Surveyors	1	0	1	0
25.303	Geophysics for Surveyors†	3	0	0	0
29.821	Geodesy I	1½	1½	1½	1½
29.851	Photogrammetry I	1½	1	1½	1
29.882	Cadastral Surveying	1½	½	1½	½
29.893	Survey Camp*		—		—
	General Studies Advanced Elective	1½	0	1½	0
		10	3	7	3

†A one-day Geophysical field tutorial is an essential part of this subject (Session 1 only).
*During Session 2 students must attend the three-week survey camp (29.893). The camp must be attended in the year in which the student completes the last subject in the group 29.803, 29.821, 29.831 and 29.851.

STAGE 7					
29.822	Geodesy II	2	1½	2	2½
29.832	Astronomy II	1½	1	1½	1
29.852	Photogrammetry II	1	3½	1	3½
36.411	Town Planning	1½	1½	0	0
		6	7½	4½	7

DESCRIPTIONS OF SUBJECTS

TEXT AND REFERENCE BOOKS

(For General Studies subjects see the Department of General Studies Handbook.)

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

Harrisberger, L. *Engineersmanship.* Wadsworth.

or

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

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

REFERENCE BOOKS

Aitchison, L. *A History of Metals.* Vols. I & II. McDonald & Evans.

Dennis, W. H. *Extractive Metallurgy.* Pitman.

or

Gilchrist, J. D. *Extractive Metallurgy.* Pergamon.

or

Newton, J. *Extractive Metallurgy.* Wiley.

Edel, D. H. *Introduction to Creative Design.* Prentice-Hall.

Guy, A. G. *Physical Metallurgy for Engineers.* Addison-Wesley.

McCormick, E. J. *Human Engineering.* McGraw-Hill.
Roget's *Thesaurus.*
Street, A. *Metals in the Service of Man.* Penguin.
Timoshenko, S. *History of the Strength of Materials.* Van Nostrand.

B. 1 *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.

REFERENCE BOOKS
Beer, F. P. & Johnston, E. R. *Statics and Dynamics.* Vector ed. McGraw-Hill.
Higdon, A. & Stiles, W. B. *Engineering Mechanics.* Vector ed. Prentice-Hall.
Meriam, J. L. *Dynamics.* 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. *Reading Exercises in Engineering Drawing.* 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:

Pare, E. Francis, L. & Kimbrell, J. *Introduction to Engineering Design.* Holt, Rinehart & Winston.

REFERENCE BOOKS

As for 5.001, together with:
Dixon, J. R. *Design Engineering.* McGraw-Hill.
Levens, A. S. *Graphics—Introduction to Conceptual Design.* Wiley.
Ryder, F. L. *Creative Engineering Analysis.* Prentice-Hall.

B. 2. *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.

REFERENCE BOOKS

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.

5.032 Experimental Engineering II

A series of lectures, demonstrations and experiments designed to show the theory and techniques of instrumentation in Mechanical Engineering.

5.033 Experimental Engineering III

A series of experiments and associated lectures to illustrate some common problms in experimental work.

5.051 Thesis

For students in the full-time courses in the School of Mechanical and Industrial Engineering.

5.061 Technical Orientation

Designed to inform students of the art and technique of technical communication, the forms of engineering professional work and the nature of the courses of instruction. A major objective is to bring staff and students together in an atmosphere of discussion and enquiry. May include one or two visits to special establishments.

TEXTBOOK

Cooper, B. M. *Writing Technical Reports.* Pelican.

REFERENCE BOOKS

Roget's Thesaurus.
The Concise Oxford Dictionary.
Ulman, J. N., Jr. *Technical Reporting.* Holt, Rinehart & Winston, 1952.

5.062 Communications

The mathematical theory of communication, followed by the basic techniques of communication by various media, as required by the professional man. Drawings as a means of communication, pictorial sketches and drawings as illustrations, instructions and visual aids. Basic photographic techniques, the grammar of cine film and of television. Library searching, collation of information, preparation of a seminar and relevant visual aids. Techniques of public speaking and chairmanship. Preparation of a technical paper and its illustrations including graphs, charts and tables of data. The work of an editor. Methods of reproducing information. Copyright and fair copying. Computerized data storage.

Production of a short cine film, videotape and slide sequence; pictorial illustrations. Participation in a seminar and writing of a thesis.

TEXTBOOK

Rosenstein, A. B. et al. *Engineering Communications.* Prentice-Hall.

REFERENCE BOOKS

Davis, D. *The Grammar of T.V. Production.* Barrie.
McLuhan, M. *Understanding Media.* Sphere.
Willis, A. H. *The Technical Lecture.* Quest.

5.071 Engineering Analysis

Digital Computer Programming: *Numerical Methods* — Roots of non-linear equations. Systems of linear equations. Finite differences; numerical differentiation and integration. Solution of ordinary differential equations — series and stepwise methods. Solution of partial differential equations — finite difference and iterative methods. Emphasis to be placed on the use of digital computers. *Statistics* — An introduction to probability theory. Random variables and distribution functions; the binomial, Poisson and normal distributions in particular. Standard sampling distributions, including those of X^2, t and F. Estimation by moments and maximum likelihood; Confidence interval estimation. The standard tests of significance based on the above distributions, with a discussion of power where appropriate. An introduction to linear regression. Least squares adjustment of data.

TEXTBOOKS

Freund, J. E. *Mathematical Statistics.* Prentice-Hall.
Southworth, R. W. & De Leeuw, S. L. *Digital Computation and Numerical Methods.* McGraw-Hill.
Statistical Tables.

REFERENCE BOOKS

Derman, C. & Klein, M. *Probability and Statistical Inference for Engineers.* O.U.P.
Freeman, H. *Introduction to Statistical Inferences.* Addison-Wesley.
Hald, A. *Statistical Theory with Engineering Applications.* Wiley.
Nielsen, K. L. *Methods in Numerical Analysis.* Macmillan.
Plumb, S. C. *Introduction to Fortran Programming.* McGraw-Hill.
Salvadori, M. G. & Baron, M. L. *Numerical Methods in Engineering.* Prentice-Hall.

5.111 Mechanical Engineering Design I

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.
Faires, V. M. *Design of Machine Elements.* Collier-Macmillan.
Pare, E., Francis, L., & Kimbrell, J. *Introduction to Engineering Design.* Holt, Rinehart & Winston.

REFERENCE BOOKS

B.S. 1916. *Limits and Fits for Engineering.* B.S.I., 1953.
Dixon, J. R. *Design Engineering.* McGraw-Hill.
Edel, D. H. *Introduction to Creative Design.* Prentice-Hall.
Harrisberger, L. *Engineersmanship.* Wadsworth.
Krick, E. V. *Introduction to Engineering & Engineering Design.* Wiley.
Matousek, R. *Engineering Design.* Blackie.
McCormick, E. J. *Human Engineering.* McGraw-Hill, 1957.
Parker, S. *Drawing and Dimensions.* Pitman.
Ryder, F. L. *Creative Engineering Analysis.* Prentice-Hall.
Vidosic, J. P. *Elements of Design Engineering.* Ronald.

5.112 Mechanical Engineering Design II

Design for Production — Principles of tolerance specification, standard procedures for gauging, dimensioning and surface finish specification. *Design of Machine Elements* — Application of fundamental principles to the design of common machine elements, such as shafts, springs, bearings, power transmission devices.

Text and Reference Books as for 5.111, together with:

TEXTBOOKS

Matousek, R. *Engineering Design.* Blackie.
S.A.A. 1969. *B249. Design of Shafts for Cranes & Hoists.*

REFERENCE BOOKS

B.S. 2517. Definitions for Use in Mechanical Engineering. B.S.I., 1959.
Dobrovolsky, V. et al. *Machine Elements.* Foreign Language Publications, Moscow.
Kent, R. T. *Mechanical Engineer's Handbook — Design and Production.* Wiley.
Oberg, E. & Jones, F. D. *Machinery Handbook.* Machinery Pub.
Shigley, J. E. *Mechanical Engineering Design.* McGraw-Hill.
Woodson, T. T. *Introduction to Engineering Design.* McGraw-Hill.

5.113 Mechanical Engineering Design III

Design Theory and Technique — Fundamental concepts of the design process, decision theory. Process and technique of optimization. Principles of material selection. Special analytical and experimental techniques of engineering design. *Design Practice* — Minor and major creative design projects, application of sophisticated design techniques in major fields of mechanical engineering.

TEXTBOOKS

As for 5.112, together with:

Asimow, M. *Introduction to Design.* Prentice-Hall.
Gosling, W. *The Design of Engineering Systems.* Heywood & Co.
Johnson, R. *Optimum Design of Mechanical Elements.* Wiley.

REFERENCE BOOKS

As for 5.112, together with:

Andersen, B. W. *The Analysis and Design of Pneumatic Systems.* Wiley.
Goodwin, A. B. *Power Hydraulics.* Cleaver-Hume Press.
Juvinall, R. C. *Engineering Consideration of Stress, Strain & Strength.* McGraw-Hill.
Levens, A. S. *Graphical Methods in Research.* Wiley.
Marin, J. *Mechanical Behaviour of Engineering Materials.* Prentice-Hall.
Pippenger, J. & Koff, R. M. *Fluid Power Controls.* McGraw-Hill.
Polakowski, N. M. & Rapling, E. J. *Strength & Structure of Engineering Materials.* Prentice-Hall.
Spotts, M. F. *Mechanical Design Analysis.* Prentice-Hall.
Thoma, J. *Hydraulic Power Transmissions.* Trade & Tech.

5.301 Engineering Mechanics

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

TEXTBOOK

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

REFERENCE BOOK

Beer, F. P. & Johnston, E. *Mechanics for Engineers: Dynamics.* Vector ed. McGraw-Hill.

5.303 Mechanical Vibrations

Periodic motion, Fourier analysis, simple harmonic motion. Laplace Transform and phasor methods. Single degree-of-freedom system (free and forced vibrations). Some vibration-measuring instruments. Vibration insolation.

Introduction to matrix methods for multi-degree-of-freedom systems. Systems with negligible damping, Dunkerley's formula. Introduction to beam vibrations.

TEXTBOOK

Thomson, W. T. *Vibration Theory and Applications.* Prentice-Hall.

REFERENCE BOOK

Church, A. H. *Mechanical Vibrations.* Wiley.

5.311 Engineering Mechanics

Kinematics and kinetics of the plane motion of rigid bodies including reference to particles and streams of particles. Absolute motion, relative translational motion and relative angular motion; dynamic equilibrium; work and energy; impulse and momentum.

TEXTBOOK

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

REFERENCE BOOK

Beer, F. P. & Johnston, E., *Mechanics for Engineers: Dynamics.* Vector ed. McGraw-Hill.

5.324 Automatic Control Engineering

Block diagrams and Laplace transform methods for system analysis. Transfer functions. Response functions. The general criterion for stability. Routh's criterion. Electronic Analogue Computer and its use in system simulation. Nyquist criterion and Nyquist diagrams. Bode diagrams and frequency response analysis. Root locus methods. Types of controller action and their effects on system response. Optimum settings, ultimate period method and maximum gain method. Analysis of several types of pneumatic controllers and other control system components. Application of automatic control to typical mechanical systems.

TEXTBOOK

Raven, F. H. *Automatic Control Engineering.* 2nd ed. McGraw-Hill.

REFERENCE BOOKS

Chestnut, H. & Mayer, R. W. *Servomechanisms and Regulating System Design.* Vol. 1. Wiley.

Dransfield, P. *Engineering Systems & Automatic Control.* Prentice-Hall.

McCallum, P. A. & Brown, B. F. *Laplace Transform Tables & Theorems.* Holt, Rinehart & Winston.

5.331 Dynamics of Machines I

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.

TEXTBOOK

Hirschhorn, J. *Dynamics of Machinery.* Nelson.

REFERENCE BOOK

Church, A. H. *Mechanical Vibrations.* Wiley.

5.332 Dynamics of Machines II

Dynamic Response: Vibration of multiple degree of freedom systems. Time domain analysis of single and multiple degree of freedom systems.

Rigid Body Dynamics: Dynamic effects in machinery. Angular momentum and inertia properties in spatial systems. Equations of motion of spatial systems.

Kinematic Synthesis: An introduction to the synthesis of planar mechanisms.

TEXTBOOK

Church, A. H. *Mechanical Vibrations.* Wiley.

REFERENCE BOOKS

Burton, R. *Vibrations and Impact.* Addison-Wesley.
Den Hartog, J. P. *Mechanical Vibrations.* McGraw-Hill.
Hartenberg, R. S. & Denavit, J. *Kinematic Synthesis of Linkages.* McGraw-Hill.
Hirschhorn, J. *Kinematics and Dynamics of Plane Mechanisms.* McGraw-Hill.
Holowenko, A. R. *Dynamics of Machinery.* Wiley.
Mabie, H. H. & Ocvirk, F. W. *Mechanics and Dynamics of Machinery.* Wiley.
Thomson, W. T. *Vibration Theory and Applications.* Prentice-Hall.

5.412 Mechanics of Solids I

Theories of failure. Unsymmetrical bending of beams, composite beams. Analysis of statically indeterminate systems. Energy methods of analysis. Three-dimensional stress and strain, principal values, plane stress, plane strain. Buckling of columns, combined loadings. Torsion of prisms and thin-walled sections of beams, frames and rings. Stress distribution in thick-walled cylinders. Shear centre. Membrane analogy. Experimental stress analysis, photoelasticity, strain gauges, analogues.

TEXTBOOK

Seely, F. B. & Smith, J. O. *Advanced Mechanics of Materials.* Wiley.

REFERENCE BOOKS

Den Hartog, J. P. *Advanced Strength of Materials.* McGraw-Hill, 1952.
Higdon, A. et al. *Mechanics of Materials.* Wiley.
Shanley, F. R. *Mechanics of Materials.* McGraw-Hill.
Timoshenko, S. *Strength of Materials.* Parts I and II. Van Nostrand.

5.413 Mechanics of Solids II

Continuum Mechanics — Stress and strain, equilibrium and compatibility, constitutive equations. *Materials Science* — Dislocation theory for crystalline materials. Structure and deformation of polymers. Composite materials.

Together with a selection from:—

Applied Elasticity — Plates and shells, rotating discs, contact stresses, torsion. *Plane Stress Analysis* — Airy stress function, solution by polynomials, complex variable, strain energy methods. *Inelastic Response* — Non-linear response of materials, analysis of structural elements, pressure vessels etc. *Theory of Plasticity* — Slip line field theory, velocity fields, stress fields, upper and lower bounds. *Applied Plasticity* — Analysis of forming and machining processes.

TEXTBOOK

Ford, H. *Advanced Mechanics of Materials.* Longmans.

REFERENCE BOOKS

Den Hartog, J. P. *Advanced Strength of Materials.* McGraw-Hill, 1952.

Freudenthal, A. M. *Introduction to the Mechanics of Solids.* Wiley.

Jaeger, J. C. *Elementary Theory of Elastic Plates.* Pergamon.

Johnson, W. J. & Mellor, R. S. *Plasticity for Mechanical Engineers.* Van Nostrand.

Seely, F. B. & Smith, J. O. *Advanced Mechanics of Materials.* Wiley.

Smith, S. O. & Sidebottom, O. M. *Inelastic Behaviour of Load Carrying Members.* Wiley.

Timoshenko, S. *Theory of Elasticity.* McGraw-Hill.

5.611 Fluid Mechanics/Thermodynamics I

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.

5.612 Fluid Mechanics/Thermodynamics II

Dimensional analysis similitude and modelling. Fields. Mass and momentum equations. Voroity, deformation, dilation. Existence conditions for stream and potential functions. One-dimensional gas dynamics. Nozzle flows, normal shock wave, constant area flow with friction and heat addition. Isothermal flow. Non-reactive mixtures. Refrigeration and air conditioning processes, Design considerations. Steady and unsteady state conduction heat transfer. Convective heat transfer. Radiant heat transfer. Combined modes of heat transfer.

TEXTBOOKS

Holman, J. P. *Heat Transfer.* 2nd ed. McGraw-Hill.

John, J. E. A. *Gas Dynamics.* Allyn & Bacon, 1969.

Streeter, V. L. *Fluid Mechanics.* 4th ed. McGraw-Hill.

5.613 Fluid Mechanics/Thermodynamics III

Cartesian tensors. Compressible flows. Navier-Stokes and energy equations. Turbulent motion. Reynolds stresses. Boundary layer theory. Forced convection in laminar and turbulent flows. Free convection. Diffusion. Mass transfer. Radial flow and axial flow turbomachinery. Design considerations. Cavitation. Matching of component characteristics. General thermodynamics relations. Statistical mechanics. Quantum mechanics. Monatomic gases and solids. Diatomic and polyatomic gases. Chemical equilibrium. Statistical mechanics of dependent particles. Real gases and solids. Irreversible processes.

REFERENCE BOOKS

Kays, W. M. *Convection Heat and Mass Transfer.* McGraw-Hill, 1966.

Longwell, P. A. *Mechanics of Fluid Flow.* McGraw-Hill, 1966.

Shepherd, D. G. *Principles of Turbomachinery.* Macmillan, 1957.

Van Wylen, G. J. & Sonntag, R. E. *Fundamentals of Classical Thermodynamics.* Wiley, 1965.

Van Wylen, G. J. & Sonntag, R. E. *Fundamentals of Statistical Thermodynamics.* Wiley, 1966.

Whitaker, S. *Introduction to Fluid Mechanics.* Prentice-Hall, 1968.

5.661 Mechanical Engineering III

Fluids and fluid properties. The differential equations of fluid flow. Flow of nonviscous fluids. Flow of viscous fluids. Turbulence. Dimensional analysis and its applications. Turbulent flow in pipes; pipe flow problems. Boundary layers. Convection heat transfer. Laminar and turbulent flow. Heat transfer in closed conduits. Conduction and radiation. Engineering units, tables and charts. Analysis of some heat-power cycles (I.C., steam, refrigeration). Steam turbines. Elementary theory of pumps and turbines. Specific speed. Design parameters. Cavitation. Scale up laws.

TEXTBOOKS

Knudsen, J. G. & Katz, D. L. *Fluid Dynamics & Heat Transfer.* McGraw-Hill.

Rogers, G. F. C. & Mayhew, Y. R. *Engineering Thermodynamics Work & Heat Transfer.* Longmans.

5.711 Thermodynamics

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.

5.800 Aircraft Design

Aircraft types and development, overall design process, wing load, shear force, bending moment and torque distributions. Detailed stressing of lugs, sockets, pins, bearings, fittings, hinges, gears, rivetted, welded and bonded joints. Design and drawing of small fittings such as hinge assembly, spar for tailplane, control stick or landing gear component.

5.801 Aircraft Design

(*a*) *Aerodynamic Design* — Design authorities, criteria, flight envelope, design cases. Airloads. Weight and Balance. Performance and stability estimation. Aerodynamic design of an aircraft.

(*b*) *Design of Aircraft Structures* — Significance of design requirements: proof and ultimate load, load and safety factors, interpretation of V-g diagram, Stressing cases. Detailed structural and mechanical design of airframe, controls, joints; choice of materials; use of structures data sheets. Practical design of a simple aircraft structural component.

TEXTBOOKS

Bruhn, E. F. *Analysis and Design of Flight Vehicle Structures.* Tri-State Offset Co., 1965.

Maccabee, F. ed. *Light Aircraft Design Handbook.* Loughborough Univ. of Technology, 1969.

Royal Aeronautical Society. *Handbook of Aeronautics No. 1, Structural Principles and Data.* Pitman.

REFERENCE BOOKS

Ashkouti, J. A. *Aircraft Mechanics Pocket Manual.* Pitman, 1957.

Australian Department of Civil Aviation. *Air Navigation Orders, Section 101.* D.C.A.

Bruhn, E. F. *Analysis and Design of Flight Vehicle Structures.* Tri-State Offset Co., 1965.

Pazmany, L. *Light Aircraft Design.* Author, San Diego, Calif., 1963.

Royal Aeronautical Society. *Data Sheets.* R.Ae.S.

Shanley, F. R. *Weight-Strength Analysis of Aircraft Structures.* 2nd ed. Dover, 1965.

U.K. Air Registration Board. *British Civil Airworthiness Requirements. Section D.* A.R.B.

U.S. Federal Aviation Agency. *Federal Aviation Regulations Part 23: Airworthiness Standards.*

Wood, K. D. *Aerospace Vehicle Design.* Vol. 1. *Aircraft Design.* Univ. of Colorado, 1963 or later.

5.811 Aerodynamics I

Navier-Stokes equations; elementary boundary layer theory; turbulence, convection, friction and form drag; airfoil characteristics. Vorticity and circulation; Prandtl wing theory, induced drag, spanwise lift distribution, wing characteristics. Static longitudinal stability and control. Manoeuvrability. Standard atmosphere, performance calculations. One-dimensional gas dynamics, isentropic, adiabatic and nozzle flow; rocket equation.

TEXTBOOK

Kuethe, A. M. & Schetzer, J. D. *Foundations of Aerodynamics.* 2nd ed. Wiley, 1959.

REFERENCE BOOKS

Abbott, I. H. & Van Doenhoff, A. E. *Theory of Wing Sections.* Dover.
Glauert, H. *The Elements of Aerofoil & Airscrew Theory.* C.U.P.
Houghton, E. L. & Brock, A. E. *Aerodynamics for Engineering Students.* Arnold, London.
Perkins, C. D. & Hage, R. E. *Airplane Performance Stability and Control.* Wiley.
Martinov, A. K. *Practical Aerodynamics.* Pergamon, 1965.
Royal Aeronautical Society Data Sheets. *Aerodynamics and Performance.*
Streeter, V. L. *Fluid Dynamics.* McGraw-Hill.
Von Karman, T. *Aerodynamics.* Cornell U.P., 1954.

5.812 Aerodynamics II

Potential theory of an ideal fluid, conformal Kutta-Joukowski transformation. Vortex streets. Aircraft dynamic stability. Advanced performance calculations. Normal oblique and conical shock and expansion waves. High speed wing theory.

TEXTBOOKS

Kuethe, A. M. & Schetzer, J. D. *Foundations of Aerodynamics.* 2nd ed. Wiley, 1959.
Perkins, C. D. & Hage, R. E. *Airplane Performance Stability and Control.* Wiley.

REFERENCE BOOKS

Royal Aeronautical Society. *Aerodynamics and Performance Data Sheets.* R.Ae.S.
Seckel, E. *Stability and Control of Aeroplanes and Helicopters.* A.P., 1964.

5.822 Analysis of Aerospace Structures I

Equilibrium of forces, plane frames, space frames; inertia forces, load factors; beams: two-moment equation, shear and bending-stress distribution in various thin-webbed beams, tapered beams, beams with variable flange areas. Semi-monocoque structures. Deflection of structures: Maxwell's and Castigliano's theorems, Williot diagram. Statically indeterminate structures: beams, trusses, stiff-jointed frames; methods of superposition, energy, moment distribution, elastic centre; shear distribution in two-cell beam. Aircraft materials, physical properties and their measurement. Dimensionless stress-strain data.

TEXTBOOK

Peery, D. J. *Aircraft Structures.* McGraw-Hill.

REFERENCE BOOK

Timoshenko, S. *Strength of Materials.* Part I. Van Nostrand.

5.823 Analysis of Aerospace Structures II

Warping: open and closed sections. Shear lag: simple cases, torsion of tube with root restraint, cut-outs in monocoque structures. Beam columns: analytical and graphical methods. Buckling: columns with various end conditions, initial eccentricity; energy solution for columns, solution of non-uniform columns. Thin plates: buckling in compression, shear, bending. Stringers: various forms of instability. Tension-field beams: complete and incomplete. Plasticity effects in compression, bending and torsion. Strain gauges: theory, use of rosettes. Mechanical testing of aircraft structures. Fatigue. Creep. Aero-elasticity.

TEXTBOOK

Rivello, R. M. *Theory and Analysis of Flight Structures.* McGraw-Hill, 1969.

REFERENCE BOOKS

Bruhn, E. F. *Analysis and Design of Flight Vehicle Structures.* Tri-State Offset Co.

Hendry, A. W. *Elements of Experimental Stress Analysis.* Pergamon.

Timoshenko, S. & Gere, J. M. *Theory of Elastic Stability.* McGraw-Hill, 1961.

Timoshenko, S. & Goodier, J. M. *Theory of Elasticity.* McGraw-Hill.

Williams, D. *Theory of Aircraft Structures.* Arnold.

5.831 Aircraft Propulsion

Aircraft power plant and propulsion systems. Basic thrust equations; propulsive efficiency. Propeller theory, characteristics and performance. Power plant thermodynamics. Fuels and combustion. Internal aero-dynamics. Compressors and turbines, subsonic and supersonic intake diffusers, nozzles. Design and performance of aircraft reciprocating internal combustion engine and gas turbine systems. Ramjets, Rockets.

TEXTBOOK

Hesse, W. J. & Mumford, N. V. *Jet Propulsion.* Pitman.

REFERENCE BOOKS

Hill, P. G. & Peterson, C. R. *Mechanics and Thermodynamics of Propulsion.* Addison-Wesley.

Morley, A. W. *Aircraft Propulsion.* Longmans, 1953.

Schmidt, F. *The Internal Combustion Engine.* Chapman & Hall.

Shapiro, A. H. *Dynamics and Thermodynamics of Compressible Fluid Flow.* Vol. I. Ronald, 1953.

Shepherd, D. G. *Introduction to the Gas Turbine.* Constable, London.

Sutton, G. P. *Rocket Propulsion Elements.* 3rd ed. Wiley.

Zucrow, M. J. *Principles of Jet Propulsion and Gas Turbines.* Wiley, N.Y.

5.911 Naval Architecture

Hydrostatic calculations. Stability at small angles. Free-surface effects. Inclining experiment. Trim due to weights and flooding. Grounding. Effects of permeability. Stability at large angles. Stability after flooding. Dynamic stability. Floodable length. Requirements of damaged-stability. Trochoidal wave theory. Wave patterns. Rolling, heaving and pitching. Launching.

TEXTBOOK

Comstock, J. P. *Principles of Naval Architecture.* Soc. of Naval Architects & Marine Engineers, 1967.

REFERENCE BOOK

Robb, A. M. *Theory of Naval Architecture.* Griffin & Co.

5.921 Ship Structures

Longitudinal strength of ship's structure: load diagram, bending moment, section modulus. Framing systems. Stress distribution. Superstructure. Transverse strength: structural analysis of bulkheads and side shell. Design of laterally loaded panels. Stiffened plating.

Connections, Derricks. Consideration of fatigue and brittle failure.

TEXTBOOK

Comstock, J. P. *Principles of Naval Architecture.* Soc. of Naval Architects & Marine Engineers, 1967.

REFERENCE BOOKS

Clarkson, J. *The Elastic Analysis of Flat Grillages.* C.U.P., 1965.

D'Arcangelo, A. M. *A Guide to Sound Ship Construction.* Cornell Maritime Press, 1964.

D'Arcangelo, A. M. *Ship Design and Construction.* Soc. of Naval Architects & Marine Engineers, 1969.

Lloyd's Register of Shipping. *Rules and Regulations for the Construction and Classification of Steel Ships.* Published Annually.

Muckle, W. *The Design of Aluminium Alloy Ships Structures.* Hutchinson.

5.922 Ship Structures

Frame analysis. Brackets. Buckling of stiffened panels: edge loading; combined loading. Midship section design synthesis.

Text and reference books as for 5.921.

5.931 Principles of Ship Design IA

Modern ship types and developments. The overall design process. Ship structural arrangements.

5.932 Principles of Ship Design IB

Lines plan. Freeboard, tonnage, capacity. Rules of Classification Societies. Preliminary estimate of ship dimensions.

5.933 Principles of Ship Design II

Theory and technique of ship design. Development of ship's lines. Design criteria and data. Criteria of statutory bodies relating to design. Details of ship's structure. Rudders and steering arrangements. Structural design requirements of classification societies. Ship types, arrangements and equipment. Specifications. Modern shipbuilding methods and prefabrication.

TEXTBOOK

D'Arcangelo, A. M. *Ship Design and Construction.* Soc. of Naval Architects & Marine Engineers, 1969.

REFERENCE BOOKS

Arnott, D. *Design and Construction of Steel Merchant Ships.* Soc. of Naval Architects & Marine Engineers.
Board of Trade. *Instructions as to the Survey of Passenger Steamships.* Vols. I & II. H.M.S.O.
Board of Trade. *Instructions as to the Tonnage Measurement of Ships.* H.M.S.O.
Board of Trade. *Measurements of Vessels for the Panama Canal.* H.M.S.O.
The Commonwealth of Australia. *Statutory Rules, No. 25, Navigation (Construction) Regulations, 1968.*
The Commonwealth of Australia. *Statutory Rules, No. 126, Navigation (Load Lines) Regulations, 1968.*
Manning, G. C. *The Theory and Technique of Ship Design.* Wiley.
Munro-Smith, R. *Merchant Ship Design.* Hutchinson.
Schokker, J. C., Neuerburg, E. M. & Vossnack, E. J. *The Design of Merchant Ships.* Arkenbout-Schokker.
Todd, F. H. *Ship Hull Vibration.* Arnold.

5.934 Ship Design Project

Design of a vessel to provide characteristics of hull form, preliminary general arrangement, lines plan, hydrostatic curves, investigation of stability and trim, structural profile and midship section, capacity, freeboard, tonnage, floodable length (if applicable), power requirements, propeller design and final general arrangement.

Text and reference books as for 5.933.

5.941 Ship Propulsion and Systems

Hydrodynamics. Model testing. Determination of resistance and power requirements of hull form from statistical data. Optimum form characteristics. Propulsion systems. Propeller theory and design. Trials and analysis of data. Steering. Design of rudders. Prime movers and auxiliaries. Ship systems: ventilation, air-conditioning, refrigeration, pumping, flooding and draining.

TEXTBOOK

Comstock, J. P. *Principles of Naval Architecture.* Soc. of Naval Architects & Marine Engineers.

REFERENCE BOOKS

Barnaby, K. C. *Basic Naval Architecture.* 5th ed. Hutchinson.
Bullen, F. L. *Ventilation and Heating of Ships.* 3rd ed. Birchall, Liverpool, 1950.
O'Brien, T. P. *The Design of Marine Screw Propellors.* Hutchinson.
Robb, A. M. *Theory of Naval Architecture.* Griffin & Co.
Van Lammeren, W. P. A. *Resistance, Propulsion and Steering of Ships.* Technical Publishing Co., Holland.

5.951 Hydrodynamics

Kinematics of fluids: stream function, velocity potential and application. Elementary treatment of equations of motion and examples in hydronamics.

REFERENCE BOOKS

Glauert, H. *Aerofoil and Airscrew Theory.* C.U.P.
Milne-Thomson, L. M. *Theoretical Hydrodynamics.* Macmillan.

SCHOOL OF ELECTRICAL ENGINEERING

6.021 Electrical Engineering II

Fundamental laws and units. Circuit theory: circuit parameters, networks. Transient and complete responses, poles and zercs. Phasors, balanced phase circuits. Fourier series. Equivalent circuits. Dynamics of physical systems. Electron-control devices: cathode ray tubes, semi-conductor diodes, transistors, thyristors. Electronic circuits: rectifiers, transistor amplifiers, simple logic circuits. Magnetic theory and circuits: transformers, equivalent circuits, phasor diagrams. Electro-mechanical energy conversion. Torque, induced voltage, rotating field. Three phase induction motors, synchronous machines, d.c. machines, single phase induction motors.

TEXTBOOK

Smith, R. J. *Circuits, Devices and Systems.* Wiley International.

REFERENCE BOOKS

Fitzgerald, A. E., Grabel, A. & Higgenbotham, D. E. *Basic Electrical Engineering.* 3rd ed. McGraw-Hill.

Fink, D. G. ed. *Standard Handbook for Electrical Engineers.* (Knowlton.) 10th ed. McGraw-Hill.

6.031 Electrical Engineering III

A. Systems and Circuit Theory: Steady state, transient and three phase circuits. Network topology and matrix methods, state equations. Analysis of feedback systems. Distributed parameter systems.

TEXTBOOKS

Desoer, C. A., & Kuh, E. S. *Basic Circuit Theory.* McGraw-Hill, 1969.

Elgerd, O. I. *Control Systems Theory.* McGraw-Hill, 1967.

REFERENCE BOOKS

Close, C. M. *The Analysis of Linear Circuits.* Harcourt, Brace & Javanovich.

Kuo, T. I. *Automatic Control Systems.* 2nd ed. Prentice-Hall, 1967.

Kuo, F. F. *Network Analysis and Synthesis.* 2nd ed. Wiley, 1966.

Ley, B. J., Lutz, S. G. & Reyberg, C. S. *Linear Circuit Analysis.* McGraw-Hill, 1959.

Moore, R. K. *Traveling-wave Engineering.* McGraw-Hill, 1960.

Newcomb, R. W. *Concepts of Linear Systems and Controls.* Brooks-Cole, 1968.

Schwarz, R. J., & Friedland, B. *Linear Systems.* McGraw-Hill, 1967.

B. Machines and Transformers: The principles of steady state operation and an introduction to the transient operation of transformers and rotating machines used for the conversion of energy. Single and three phase transformers, synchronous and asynchronous machines, direct current machines and metadynes.

TEXTBOOK

Harrison, H. *The Principles of DC and AC Machines.* Univ. of N.S.W.

REFERENCE BOOKS

Clayton, A. E. *Design & Performance of D.C. Machines.* Pitman.

Fitzgerald, A. E. & Kingsley, C. *Electric Machinery.* McGraw-Hill.

M.I.T. *Magnetic Circuits and Transformers.* Wiley.

Say, M. G. *Design and Performance of A.C. Machines.* Pitman.

C. Electronic Circuits and Signal Processing: Characterization of transistors and other active devices. Small signal amplifiers, wide band, direct-coupled, tuned. Regulated power supplies. Wave shaping circuits, typical logic circuits, gates. Power amplifiers Classes A, B and C. Oscillators sinewave and limit cycle. Demodulation. Introduction to aerials and propagation. Modulation, need and types. Simple radio transmitter and receiver. Rectifiers and inverters: single and polyphase.

TEXTBOOK

Millman, J. & Halkias, C. *Electronic Devices and Circuits.* McGraw-Hill, 1967.

REFERENCE BOOKS

Abrahams, J. & Pridham, G. *Semiconductor Circuits: Worked Examples.* Pergamon.

Gibbons, J. *Semiconductor Electronics.* McGraw-Hill.

Phillips, A. *Transistor Engineering.* McGraw-Hill.

D. Computing: Switching algebra, combinational analysis and synthesis of switching circuits, simplification of switching functions. Level sequential and pulse sequential analysis. Flow tables, cycles, races, hazards. Number systems, codes, error detection.

Numerical analysis, errors, interpolation, quadrature linear and non-linear equation, differential equations. Logical organization of computers in functional units.

TEXTBOOKS

Blatt, J. M. *Introduction to Fortran IV Programming.* Goodyear Publishing Co.

Booth, T. L. *Digital Networks and Computer Systems.* Wiley.

REFERENCE BOOKS

Gear, C. W. *Computer Organization and Programming.* McGraw-Hill.

Heath, F. G. *Digital Computer Design.* Oliver & Boyd.

Hill, F. J., & Peterson, G. R. *Introduction to Switching Theory and Logical Design.* Wiley.

Lewin, C. G. *Logical Design of Switching Circuits.* Nelson.

Marcus, M. P. *Switching Circuits for Engineers.* Prentice-Hall.

McCluskey, E. J. *Introduction to the Theory of Switching Circuits.* McGraw-Hill.

E. Electron Physics and Devices: Classification of solids. Bond model of semiconductors, electron and hole conduction; donors and acceptors, equilibrium carrier densities. Band theory of solids; wave mechanics of electrons, density of states. Statistics, Boltzmann and Fermi-Dirac distributions. Electrons in steady state electric and magnetic fields; effective mass; hole conduction. Electron lattice interactions. Generation and recombination of carriers, diffusion, drift. P-N junctions, surfaces and metal-semiconductor contacts. Junction transistor, power transistors and thyristors, field effect transistors, tunnel diodes. Valves and gas discharge tubes. Luminescent materials and lasers. Ferromagnetism, dielectrics, superconductivity.

TEXTBOOK

Solymar, L., & Walsh, D. *Lectures on the Electrical Properties of Materials.* O.U.P., 1970.

REFERENCE BOOKS

Beeforth, T. H., & Goldsmid, H. J. *Physics of Solid State Devices.* SEEC Vol. 4. Wiley, 1964.

Thornton, R. D., & De Witt, D. *Characteristics and Limitations of Transistors.* SEEC Vol. 4. Wiley, 1964.

Van der Ziel, A. *Solid State Physical Electronics.* 2nd ed. Prentice-Hall, 1968.

6.041 Fields and Measurements

Fields: Applications of field theory not elsewhere treated in the course, selected from: elements of incompressible fluid magnetohydrodynamics; some engineering applications of magnetostatics; analogies between the telegraphist's equations and a variety of potential theory problems, particularly non-electrical.

TEXTBOOK

Shercliff, J. A. *A Textbook of Magnetohydrodynamics.* Pergamon, 1965.
or,
To be advised.

REFERENCE BOOKS

Moore, R. K. *Wave and Diffusion Analogies.* McGraw-Hill, 1964.

Reitz, J. R. & Milford, F. J. *Foundations of Electromagnetic Theory.* Addison-Wesley, 1960.

Measurements: Principles of electrical measurements of moderate precision using direct currents and alternating currents of frequency such that lumped circuit techniques are satisfactory.

TEXTBOOK

Stout, M. B. *Basic Electrical Measurements.* Prentice-Hall.

REFERENCE BOOKS

Harris, F. K. *Electrical Measurements.* Wiley.

Terman, F. M. & Pettit, J. M. *Electronic Measurements.* McGraw-Hill.

6.042 Circuits, Signals and Infomation Theory

Circuit theory and network synthesis. *Signal Analysis* and transmission through networks, including theory of noise and stochastic signals. Includes time frequency and mixed domain presentation; transients and other signals; correlation, convolution, etc.; statistical properties of signals; applications. *Information Theory* of discrete systems including coding and encoding of patterns. Information theory of continuous systems. Mathematical theory of signal detection, including an introduction to decision theory. Signal and system analysis in the light of information theory.

TEXTBOOK

Karbowiak, A. E. *Theory of Communication.* Oliver & Boyd, 1969.

REFERENCE BOOKS

Beckmann, P. *Probability in Communication Engineering.* Harcourt, Brace & World, 1967.

Bendat, J. S. *Principles and Applications of Random Noise Theory.* Wiley, 1958.

Goldman, S. *Frequency Analysis Modulation and Noise.* McGraw-Hill, 1948.

Karbowiak, A. E. *Trunk Waveguide Communication.* Chapman & Hall, 1965.

Schwartz, L. S. *Principles of Coding, Filtering and Information Theory.* Cleaver-Hume, 1963.

Schwartz, M. *Information Transmission, Modulation and Noise.* McGraw-Hill, 1959.

6.043 Electrical Measurements

Measurements section of 6.041 Fields and Measurements.

TEXTBOOK

Stout, M. B. *Basic Electrical Measurements.* Prentice-Hall.

REFERENCE BOOKS

Harris, F. K. *Electrical Measurements.* Wiley.
Terman, F. M. & Pettit, J. M. *Electrical Measurements.* McGraw-Hill.

6.202 Power Systems

Transmission line parameters, symmetrical components, transformers, steady state system calculations for balanced and fault conductions. Lightning and switching voltage transients, circuit interruption. Load and frequency control of a single machine, steady state and transient stability. Load and frequency control of a system, economic transmission line loading, introduction to digital computer system calculations. Protection.

TEXTBOOK

Stevenson, W. D. *Elements of Power System Analysis.* 2nd ed. McGraw-Hill, 1962.

REFERENCE BOOKS

Kimbark, E. W. *Power System Stability.* Vols. I, II & III. Wiley.
M.I.T. *Magnetic Circuits and Transformers.* Wiley.
Weedy, B. M. *Electric Power Systems.* Wiley, 1967.
Westinghouse Electric Corp. *Electrical Transmission and Distribution Reference Book.* Westinghouse.

6.212 Machines

General: revision of three phase circuit theory, power measurement; machine inductances. *D.C. Machines:* cross field machines — thyristors and thyristor speed control; accelerating and braking. *Parallel Wound Machines:* motors and generator, motor speed control using thyristors. *Induction Machines:* polyphase and single phase; speed control via rotor injection and stator frequency control; accelerating and braking. *Synchronous Machines:* generators and motors, cylindrical and salient poles; locus diagrams; transients, faults, motor pull-in, hunting. *Machine Design:* to include windings. Generalised machine theory.

TEXTBOOK

Brosan, G. S. & Hayden, J. T. *Advanced Electrical Power and Machines.* Pitman.

REFERENCE BOOKS

Adkins, B. *The General Theory of Electrical Machines.* Chapman & Hall.
Clayton, A. E. *Performance and Design of D.C. Machines.* Pitman.
Draper, A. *Electrical Machines.* Longmans.
Gibbs, W. J. *Electric Machine Analysis using Matrices.* Pitman.
Kimbark, E. W. *Power System Stability.* Vol. III. Wiley.
Kron, G. *Tensors for Circuits.* Dover.
Say, M. G. *Design and Performance of A.C. Machines.* Pitman.
Taylor, E. O. *Performance and Design of A.C. Commutator Motors.* Pitman.
Tustin, A. *Direct Current Machines for Control Systems.* Sporn.
Veinott, C. J. *Theory and Design of Small Induction Motors.* McGraw-Hill.
White, D. C. & Woodson, H. H. *Electromechanical Energy Conversion.* Wiley.
Wood, W. S. *Theory of Electrical Machines.* Butterworth.

6.303 Communication Electronics

Signal Processing and Techniques: Modulation principles and techniques, DSB, SSB, FM, PM, pulse modulation circuits. Demodulation. Bandwidth, signal to noise ratio, noise factor. Tuned power amplifiers, lumped tuned circuits, distributed tuned circuits. *Devices:* Properties and circuits of small-signal amplifiers. Noise and high-frequency performance of passive and active devices and circuits. Parametric amplifiers. Quantum electronic devices, e.g., masers and lasers. Semiconductor bulk-effect devices. Microwave high-power vacuum-tube amplifiers.

TEXTBOOK

Betts, J. A. *Signal Processing, Modulation and Noise.* English U.P., 1970.

REFERENCE BOOKS

Bennett, W. R. *Introduction to Signal Transmission.* McGraw-Hill, 1970.
Blackwell, L. A. & Kotzebue, K. L. *Semiconductor Diode Parametric Amplifiers.* Prentice-Hall, 1961.
Bloom, A. L. *Gas Lasers.* Wiley, 1968.
Carlson, A. B. *Communication Systems.* McGraw-Hill.
Carroll, J. E. *Hot Electron Microwave Generators.* Arnold, 1970.
Dix, C. H. & Aldous, W. H. *Microwave Valves.* Iliffe, 1966.
Goldman, S. *Frequency Analysis Modulation and Noise.* McGraw-Hill.
Hancock, J. C. *An Introduction to the Principles of Communication Theory.* McGraw-Hill.
Haykin, S. S. *Active Network Theory.* Addison-Wesley, 1970.
Jolly, W. P. *Low Noise Electronics.* English Universities Press, 1967.
S.E.E.C. *Semi-Conductor Electronics Education Committee Series.* Vols. III, IV, V. Wiley, 1966.
Lathi, B. *Communication Systems.* Wiley.
Sakrison D. *Communication Theory.* Wiley, 1968.
Stein, S. & Jones, J. *Modern Communication Principles.* McGraw-Hill.
Thorp, J. S. *Masers and Layer.* Macmillan, 1967.
Watson, H. A. ed. *Microwave Semi-Conductor Devices and Their Circuit Applications.* McGraw-Hill, 1969.

6.313 Wave Radiation and Guidance

A selection from the following topics:

Maxwell's equations. Poynting's theorem. Plane waves and spherical waves. Conductors and dielectrics. Propagation in free space. Reflection and refraction at the interface of two media. Propagation in anisotropic media. Ionspheric and tropospheric propagation. Guided waves. Types of transmission lines including coaxial and strip lines, surface-wave lines. Waveguides and cavities. Microwave components and signal sources.

Radiator characteristics and concept of spatial filters. Wave-forms and spectra versus aperture distribution and radiation pattern. Noise characteristics in the microwave spectrum. Gain, efficiency and signal-to-noise ratio. Elementary radiators first-principle approach. Phased arrays. Travelling wave and frequency independent radiators. Illustration of applications of antenna theory including radio interferometers, large radio telescopes and satellite communication.

TEXTBOOK

No set text.

REFERENCE BOOKS

Glazier, E. V. D. & Lamont, H. R. L. *Transmission and Propagation.* H.M.S.O., 1958.

Hallen, E. G. *Electromagnetic Theory.* Chapman & Hall, 1962.

Huxley, L. G. H. *The Principles and Practice of Waveguides.* Cambridge, 1947.

Jasik, H. *Antenna Engineering Handbook.* McGraw-Hill.

Jordan, E. C. *Electromagnetic Waves and Radiating Systems.* Constable.

Karbowiak, A. E. *Trunk Waveguide Communication.* Chapman & Hall, 1965.

Marcuvitz, N. *Waveguide Handbook.* M.I.T. Vol. 7. McGraw-Hill, 1950.

Montgomery, C. G. et al. *Principles of Microwave Circuits.* M.I.T. Vol. 8. McGraw-Hill.

Ramo, S., Whinnery, J. R., & Van Duzer, T. *Fields and Waves in Communication Electronics.* Wiley, 1965.

Reitz, J. R. & Milford, E. J. *Foundations of Electromagnetic Theory.* Addison-Wesley, 1960.

6.322 Electronics

Topics in this course include: An introduction to *modern filter theory;* pulse spectra. *Amplifiers:* wide band, compensation; direct coupled, operational amplifiers, regulators. *Pulse and Digital circuits:* semiconductor switches; emitter coupled multivibrators; blocking oscillators. *Integrated Circuits:* non-linear and linear; use in systems. *Power Converters:* polyphase rectifiers, controlled rectifiers; high voltage converters, inverters. *Semiconductor controls:* motor controls, firing circuits, etc. *Reliability Engineering:* calculation of MTBF; statistical and worst case design; environmental and operating stresses.

TEXTBOOK

No set text.

REFERENCE BOOKS

G.E. *Silicon Controlled Rectifier Manual.* General Electric.

Hemingway, T. K. *Electronic Designers Handbook.* Business Publications.

Kuh, E. S. & Pederson, D. O. *Principles of Circuit Synthesis.* McGraw-Hill.

Millman, J. & Taub, H. *Pulse, Digital & Switching Waveforms.* McGraw-Hill.

Motorola. *Power Transistor Handbook.* Motorola.

Motorola. *Silicon Zener Diode and Rectifier Handbook.* Motorola.

Motorola. *Switching Transistor Handbook.* Motorola.

Myers, R., Wong, K. & Gordy, H. *Reliability Engineering for Electronics Systems.* Wiley.

Schaefer, J. *Rectifier Circuits.* Wiley.

Storer, J. E. *Passive Network Synthesis.* McGraw-Hill.

Texas Instruments. *Transistor Circuit Design.* McGraw-Hill.

6.333 Communication Systems

Sound Systems: Psychoacoustics, loudness, pitch, masking, binaural effects, characteristics of speech, bandwidth and intelligibility. Sound sources, piston radiator, exponential horn. Acoustic and mechanical equivalent circuits, transducers. Introduction to room acoustics. *Telephone, Telegraph and Data Systems:* General principles, multiplexing, carrier systems, code, speech and data transmission, telemetry, facsimile. *Television Systems:* Physiological aspects of television, television standards, colour systems, transmitters, receivers. *Radar:* Principles of pulse and C.W. radar, distance and direction measuring equipment for navigation and surveying.

TEXTBOOK

Showalter, L. C. *Closed Circuit T.V. for Engineers and Technicians.* Howard W. Sams & Co., 1969.

REFERENCE BOOKS

Beranek, L. L. *Acoustics.* McGraw-Hill.
Brown, J. & Glazier, E. *Telecommunications.* Chapman & Hall, 1966.
Filipowsky, R. & Muehldorf, E. I. *Space Communications Systems.* Prentice-Hall, 1965.
Fraser, W. *Telecommunications.* Macdonald, 1957.
Hamsher, D. H. ed. *Communications System Engineering Handbook.* McGraw-Hill, 1967.
Millman, J. & Taub, H. *Pulse Digital and Switching Waveforms.* McGraw-Hill, 1965.
Olson, H. F. *Elements of Acoustical Engineering.* Van Nostrand.
Skolnik, M. I. *Introduction to Radar Systems.* McGraw-Hill, 1962.
Terman, F. E. *Electronic and Radio Engineering.* 4th ed. McGraw-Hill, 1955.
Townsend, B. *Pal Colour Television.* C.U.P., 1970.
Zworykin, V. K. & Morton, G. A. *Television.* Wiley.

6.383 Biomedical Engineering

A course designed to introduce electrical engineering students to the practice of engineering techniques applied to the biological and medical fields. The lectures are supplemented by demonstrations and experimental work, and deal with the basic physiology of cells, tissues, organs and organisms, instrumentation and measurement techniques and modelling of various types of biological systems.

TEXTBOOK

No set text.

REFERENCE BOOKS

To be advised in class.

6.412 Automatic Control

Principles and techniques applicable to the analysis and design of feedback control systems encountered in industrial processes. Frequency transform and state space methods for compensation and stability analysis of single-input single-output linear systems. Extension to include some common nonlinearities. Optimum design including identification of process parameters by both on- and off-line methods.

TEXTBOOK

Class notes will be issued.

REFERENCE BOOKS

Elgerd, O. I. *Control Systems Theory.* McGraw-Hill.

Gilbert, C. P. *The Design and Use of Electronic Analogue Computers.* Chapman & Hall.

Gille, J. C. et al. *Feedback Control Systems.* McGraw-Hill.

Graham, D. & McRuer, D. *Analysis of Nonlinear Control Systems.* Wiley.

6.422 Computer Control

The principles of plant modelling, parameter estimation and optimal control in the computer control of complex processes. The mathematical representation of physical processes. Analogue, digital and hybrid simulation of physical processes. Concepts basic to optimization. Parameter and state estimation in linear systems by regression methods. Parameter and state estimation in linear and nonlinear systems using parameter influence coefficients. Optimal control theory. Adjoint variable techniques applied to parameter and state estimation. The implementation of optimal control.

TEXTBOOK

Speedy, C. B., Brown, R. F. & Goodwin, G. C. *Control Theory.* Oliver & Boyd.

REFERENCE BOOKS

Merriam, C. W. *Optimization Theory and the Design of Feedback Control Systems.* McGraw-Hill, 1964.

Pontryagin, L. S. et al. *The Mathematical Theory of Optimal Processes.* Interscience Publishers Inc., 1962.

Sage, A. P. *Optimum Systems Control.* Prentice-Hall, 1968.

6.512 Advanced Semiconductor Device Theory

Characteristics and limitations of semiconductor devices as functions of operating point and environment. Devices include high-frequency and power transistors, FETs, thyristors and negative resistance devices.

TEXTBOOK

Lindmayer, J. & Wrigley, C. *Fundamentals of Semiconductor Devices.* Van Nostrand, 1965.

REFERENCE BOOKS

Crawford, R. H. *Mosfet in Circuit Design.* McGraw-Hill.

General Electric. *Tunnel Diode Manual.* General Electric.

Gentry, F. et al. *Semiconductor Controlled Rectifiers.* Prentice-Hall.

Sevin, L. J. *Field Effect Transistors.* McGraw-Hill.

Van der Ziel, A. *Solid State Physical Elecronics.* 2nd ed. Prentice-Hall, 1968.

6.522 Transistor and Integrated Circuit Design

Development of theory of transistor operation including high injection level effects and three dimensional geometry effects. Kinetics of epigrowth, diffusion and oxide growth as far as these are required to permit the student to specify process cycles. Design of transistor in terms of desired diffusion profiles, oxide growth thicknesses, and the specification of process cycles. Extension of the above to passive components as used in integrated circuits. Design aspects of integrated circuits, covering aspects peculiar to integrated circuits such as distributed parameters, parasitic couplings, correlated component tolerances and variations, special D.C. biasing methods.

TEXTBOOKS

Lynn, D. K., Meyer, C. S. & Hamilton, P. J. *Integrated Circuits.* Vol. II. Motorola Series in Solid-State Electronics. McGraw-Hill, 1967.

Warner, R. W. & Fordemwalt, J. N. *Integrated Circuits.* Vol. I. Motorola Series in Solid-State Electronics. McGraw-Hill.

REFERENCE BOOKS

To be advised in class.

6.612 Computer Systems Engineering

Switching circuits, memory systems, control and sequencing methods, digital to analogue and analogue to digital converters, input output and display devices. Data representation in machines, system architecture, multiprocessor systems. Fundamentals of software systems and languages.

Analogue and hybrid computing; *or* advanced machine organization and construction.

TEXTBOOK

Hill, F. J. & Peterson, G. R. *Introduction to Switching Theory and Logical Design.* Wiley.

REFERENCE BOOKS

Bartee, T., Lebow, I. L. & Reed, I. S. *Theory and Design of Digital Machines.* McGraw-Hill.

Chu, Y. *Digital Computer Design Techniques.* Wiley.

Givone, D. D. *Introduction to Switching Circuit Theory.* McGraw-Hill.

Lewin, C. G. *Logical Design of Switching Circuits.* Nelson.

McCluskey, E. J. *Introduction to the Theory of Switching Circuits.* McGraw-Hill, 1965.

Marcus, M. P. *Switching Circuits for Engineers.* 2nd ed. Prentice-Hall, 1967.

Phister, M. *Logical Design of Digital Computers.* Wiley.

6.622 Computer Application and Software

Simulation, heuristics, numerical analysis, mathematical optimization, languages, compilers and operating systems.

TEXTBOOK

IBM System/360 Principles of Operation IBM Form A22-6821.

REFERENCE BOOKS

Gear, C. W. *Computer Organisation and Programming.* Book 10. McGraw-Hill.

Flores, I. *Computer Software.* Prentice-Hall.

6.801 Electrical Engineering

A special course for metallurgists and engineers not intending to follow electrical engineering as a profession. Presentation of the fundamental principles of electric and magnetic circuits and vacuum tubes and the application of these principles to the theory, performance and control of electrical equipment.

A. Circuit Theory. B. Machines and Rectifiers. C. Electronics. D. Supplementary Circuit Theory and Machines.

TEXTBOOK

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

REFERENCE BOOKS

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.

6.802 Electrical Engineering

More advanced work on circuits, electrical and electronic equipment following on 6.801 and applications. Electrical and electronic measurement techniques, with emphasis on the instrumentation required for the electrical measurement of non-electrical quantities.

TEXT AND REFERENCE BOOKS

To be advised in class.

6.811 Electronic Instrumentation for Surveyors

Measurement of time, frequency and distance, Propagation of electromagnetic waves affecting the accuracy of tellurometry, time measurement, position finding and navigational aids.

TEXTBOOK

No set text.

REFERENCE BOOKS

Bartholomew, D. *Electrical Measurements and Instrumentation.* Allyn & Bacon.

Del Toro, V. *Principles of Electrical Engineering.* Prentice-Hall.

Smith, R. J. *Circuits, Devices and Systems.* Wiley.

Soisson, H. E. *Electronic Measuring Instruments.* McGraw-Hill.

Terman, F. E. & Pettit, J. M. *Electronic Measurements.* 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. Up to four weeks of field instruction will be included in the course.

TEXT AND REFERENCE BOOKS
To be advised in class.

6.901 Seminar

6.911 Thesis

For students in the fourth year of the B.E. course.

6.931 Group Thesis

For students in the fourth year of the B.E. course.

SCHOOL OF CIVIL ENGINEERING

8.010 Project

Assignments in civil engineering topics.

Co-requisites: 8.152 Structures and 8.531 Water Engineering.
Hydraulic Engineering

8.012 Engineering Electives

The following electives are offered from which the student must choose and complete two. A supervised project or thesis may be substituted for an elective with the permission of the Head of Department.

8.012A Architecture

8.012B Bridge Engineering

TEXTBOOKS

Anon. *Continuous Concrete Bridges.* P.C.A.

Morice, P. B., & Little, G. *The Analysis of Right Bridge Decks Subjected to Abnormal Loading.* C. & C.A.

N.A.A.S.R.A. *Highway Bridge Design Specification.* 1970.

Somerville, G., & Tiller, R. M. *Standard Bridge Beams from 7m to 36m.* C. & C.A.

REFERENCE BOOKS

A.A.S.H.O. *Specification for Highway Bridges.* 1969.

Abbett, R. W. ed. *American Civil Engineering Practice.* Vol. III. Wiley, 1957.

A.R.E.A. *Manual for Railway Engineering.* 1970.

A.W.S. *Specifications for Welded Highway and Railway Bridges.* A.W.S. D2-O, 1969.

Blodgett, O. *Design of Welded Structures.* Lincoln, 1968.

Koziol, M. A. ed. *Manual of Bridge Design Practice.* 2nd ed. State of California, Highway Transportation Agency, 1963.

O'Connor, C. *Design of Bridge Superstructures.* Wiley, 1971.

Rowe, R. E. *Concrete Bridge Design.* C. R. Books, 1963.

Viest, I. M., Fountain, R. S., & Singleton, R. C. *Composite Construction in Steel and Concrete for Bridges and Buildings.* McGraw-Hill, 1958.

8.012C Computers

8.012D Construction and Administration

8.012E Road Engineering

8.012F Railway Engineering

TEXTBOOKS

N.A.A.S.R.A. *Highway Bridge Design Specification.* 1970.

Somerville, G., & Tiller, R. M. *Standard Bridge Beams from 7m to 36m.* C. & C.A.

REFERENCE BOOKS

As for 8.012B.

8.012H Hydraulic Engineering

TEXTBOOK

Henderson, F. M. *Open Channel Flow.* Macmillan, N.Y., 1966.

REFERENCE BOOKS

Charts for the Design of Channels. Hydraulics Research Paper No. 2. H.M.S.O.

Chow, V. T. *Open Channel Hydraulics.* Butterworth.

Resistance of Fluids Flowing in Channel Pipes. Hydraulics Research Paper No. 1. H.M.S.O.

Rouse, H. *Engineering Hydraulics.* Wiley.

Streeter, V. L. *Fluid Mechanics.* 4th ed. McGraw-Hill.

Vallentine, H. R. *Applied Hydrodynamics.* Butterworth.

8.012P Project

8.111 Civil Engineering

Theory of Structures — Stress; strain; elastic and inelastic deformation. Principal stresses and strains. Compound bars and temperature stresses. Direct stresses and shear stresses in beams. Deflection of beams. Torsion of circular and thin-walled sections. Combined bending, twisting and axial force. Instability of bars in compression.

Properties of Materials — Characteristic modes of deformation and fracture of materials under load. Response to steadily applied tension, compression and shear. Response to oscillatory stress, rapidly applied stress and long-term stress. Effect of shape and environmental factors. Critical stress conditions for deformation and fracture. Standard tests of mechanical properties.

Metallurgy — Structure of solids. The crystalline nature of metals and ceramics. Defects in crystals and their influence on the behaviour of metals. Solidification of metals. Phase equilibria in metallic alloys. Zone refining and zone levelling. Strengthening mechanisms in solids. Magnetic materials. Corrosion of metals. Ceramics and polymers. Application of the above to electrical and magnetic materials.

TEXTBOOK

Hall, A. S. *Mechanics of Solids.* Wiley, 1968.

REFERENCE BOOKS

Davis, H. E., Troxell, G. E. & Wiskocil, G. T. *Testing and Inspection of Engineering Materials.* McGraw-Hill.

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

8.112 Materials and Structures

Theory of Structures — Moduli of elasticity, simple stress and strain. Compound bars, temperature stresses. Thin shells. Stress at a point. Strain at a point. Principal stresses and strain. Relationship between load, shear force and bending moment. Moments of inertia, principal moments of inertia. Stresses due to axial force, bending moment shear force, and torsion. Differential equations of simple beam theory. Deflection of beams. Statically indeterminate beams. Strain energy. Deflections at a single load. Shock loads. Theory of centrally loaded column and eccentrically loaded columns.

Properties of Materials — Mechanical behaviour of materials; response to static and dynamic loads. Laboratory techniques. Analysis and presentation of experimental results. Use of material properties in analysis and design.

REFERENCE BOOKS

Davis, H. E., Troxell, G. E. & Wiskocil, G. T. *Testing and Inspection of Engineering Materials.* McGraw-Hill.

Hall, A. S. *Mechanics of Solids.* Wiley, 1968.

Lancaster, P. R. & Mitchell, D. *The Mechanics of Materials.* McGraw-Hill.

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

Shanley, F. R. *Strength of Materials.* McGraw-Hill.

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 the Mechanics of Solids.* Wiley, 1968.

REFERENCE BOOKS

Popov, E. P. *Introduction to Mechanics of Solids.* Prentice-Hall.

Shanley, F. R. *Strength of Materials.* McGraw-Hill.

Smith, J. O. & Sidebottom, O. M. *Elementary Mechanics of Deformable Bodies.* Macmillan.

8.152 Structures

Introduction to structural design; design loads, safety factors and load factors; Codes of Practice. Design of metal structures; members in tension, compression and bending, connections; framed structures. Reinforced concrete design; beams and short columns; simple slabs. Structural analysis; principle of virtual work; force and displacement methods; deflections in structures; solution of statically indeterminate structures; introduction to moment distribution; influence lines; introduction to structural dynamics.

TEXTBOOKS

A.S. Code A1 — 1965.
A.S. Code CA1 — 1968.
A.S. Code CA2 — 1963 (incl. 1968 amendments).
A.S. Code CA8. Part 1 — 1965.
A.S. Code CA34. Part 1 — 1969.
A.S. Code CA45 — 1971.
C. & C.A. *Australian Reinforced Concrete Design Handbook*. 1st ed. Tradition House, 1968.
S.A.A. Interim Code No. 350.

REFERENCE BOOKS

Bresler, B. & Lin, T. Y. *Design of Steel Structures*. Wiley.
Cowan, H. J. & Smith, P. R. *Design of Reinforced Concrete*. A. & R.
Crawley, S. W., & Dillon, R. M. *Steel Buildings: Analysis and Design*. Wiley, 1970.
Ferguson, P. M. *Reinforced Concrete Fundamentals*. Wiley.
Gorenc, B. E. *Steel Designer's Handbook*. N.S.W. Univ. Press.
Gray, C. S. et al. *Steel Designer's Manual*. Lockwood.
McGuire, W. *Steel Structures*. Prentice-Hall.
Salvadori, M. G. & Heller, R. *Structure in Architecture*. Prentice-Hall.
Tall, L. et al. *Structural Steel Design*. Ronald Press.
Timoshenko, S. & Young, D. H. *Theory of Structures*. 2nd ed. McGraw-Hill.
Wang, C. K. *Matrix Methods of Structural Analysis*. International Textbook Company.
Winter, G., Urquhart, L. C., O'Rourke, C. E. & Nilson, A. H. *Design of Concrete Structures*. 7th ed. McGraw-Hill, 1964.

8.153 Structures

Analysis. Introduction to three-dimensional theory of elasticity. Stress, strain, Hooke's Law, strain compatibility. Three-dimensional principle of virtual displacements. Forces and displacements in statically determinate and indeterminate pinjointed structures; matrix formulation. Forces and displacements in rigid jointed structures; matrix formulation. Introduction to elastic stability dynamic behaviour of structures.

Design of Structures. Design of continuous structures in reinforced concrete. Introduction to ultimate strength design in reinforced concrete. Elements of prestressed concrete. Pre-tensioning and post-tensioning. Design by permissible stress. Checking ultimate-strength of members. Applications limited to statically determinate structures.

Extension of earlier work on steel design to include continuous structures; design of a single storey continuous gable-framed structure using permissible stress method, with emphasis on design of welded joints for continuity. Introduction to plastic method of design of steel structures. Load factor. Principle of redistribution of moments. Simple application such as design of continuous beams.

Timber design. Emphasis on special properties of timber affecting design of timber structures.

Earth retaining structures.

REFERENCE BOOKS

Analysis

Hoff, N. J. *The Analysis of Structures.* Wiley, 1956.
Livesley, R. K. *Matrix Methods of Structural Analysis.* Pergamon, 1964.
Shaw, F. S. *Virtual Displacements and the Analysis of Structures.* Prentice-Hall.
Sokolnikoff, I. S. *Mathematical Theory of Elasticity.* McGraw-Hill.
Southwell, R. V. *An Introduction to the Theory of Elasticity.* Dover.

Design

Beedle, L. S. *Plastic Design of Steel Frames.* Wiley.
Bresler, B., Lin, T. Y., & Scalzi, J. B. *Design of Steel Structures.* Wiley, 1968.
Ferguson, P. M. *Reinforced Concrete Fundamentals.* Wiley.
Gerstle, K. H. *Basic Structural Design.* McGraw-Hill.
Lin, T. Y. *Design of Prestressed Concrete Structures.* Wiley.
Pearson, R. G. et al. *Timber Engineering Design Handbook.* M.U.P.
Winter, G., Urquhart, L. C., O'Rourke, C. E. & Nilson, A. H. *Design of Concrete Structures.* 7th ed. McGraw-Hill, 1964.

8.154 Structures

Analysis. Revision of force method of solving statically indeterminate pinjointed structures, and rigid framed structures. Further examples of the use of force method including rigid frames in which axial and shear deformations as well as flexural deformations are significant. Treatment of members of variable cross-section. Extension of earlier work on moment distribution method to include the problem of sidesway. Derivation of the slope-deflection equations — their use in solving simple frame problems. The matrix formulation of the stiffness method of analysis. Introduction to elastic stability of structures.

Design of Structures. Syllabus as for 8.153.

REFERENCE BOOKS

Hall, A. S., & Woodhead, R. W. *Frame Analysis.* 2nd ed. Wiley.
Przemieniecki, J. S. *Theory of Matrix Structural Analysis.* McGraw-Hill.
Timoshenko, S., & Young, D. H. *Theory of Structures.* Student ed. McGraw-Hill.

8.161 Engineering Mathematics

Probability and Statistics — Introduction to probability. Random variables and standard elementary distributions. Sampling distributions. Statistical inference, hypotheses testing. Engineering applications.

Engineering Computations — Flow charts and computer programming. Error propagation. Interpolation, finite differences and regression analysis. Solution of simultaneous equations, matrix operations and eigenvalue problems. Numerical integration and solution of ordinary and partial differential equations.

REFERENCE BOOKS

Freund, J. E. *Mathematical Statistics.* Prentice-Hall, 1962.
McCracken, D. D. & Dorn, W. S. *Numerical Methods and Fortran Programming.* Wiley, 1964.
Salvadori, M. G. & Baron, M. L. *Numerical Methods in Engineering.* 2nd ed. Prentice-Hall, 1962.
Shaw, F. S. *Relaxation Methods.* Dover.

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.

REFERENCE BOOKS

Grim, R. *Applied Clay Mineralogy.* McGraw-Hill, 1962.
Jaeger, J. C. *Elasticity, Fracture and Flow.* 3rd ed. Methuen, 1969.
Soil Mechanics for Road Engineers. H.M.S.O., 1959.

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, 1967.

8.250 Properties of Materials

Mechanical behaviour of materials. Response to static loading in tension, compression, shear and bending. Use of static test data in analysis and and design; variability of material properties; factors of safety. Hardness tests. Creep in solid materials. Response to dynamic loading; fatigue; impact. Detioration of engineering materials. Rheological classification of materials.

TEXTBOOK

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

REFERENCE BOOKS

Davis, H. E., Troxell, G. E., & Wiskocil, G. T. *Testing and Inspection of Engineering Materials.* McGraw-Hill.
Mann, J. Y. *Fatigue of Materials.* M.U.P.
Marin, J. *Mechanical Behaviour of Engineering Materials.* Prentice-Hall, 1962.
Polakowski, N. H., & Ripling, E. J. *Strength and Structure of Engineering Materials.* Prentice-Hall, 1966.

8.252 Civil Engineering Materials

Concrete Technology — Properties of concrete and its applications: structure and composition. Rheological properties of fresh concrete. Mechanical properties of hardened concrete. Mix design. Methods of testing constituent materials.

Soil Mechanics — Pressure and movement of soil moisture, effective stress. Consolidation and settlement. Shear strength and testing of soils. Elastic theory of soil stress. Stability of slopes. Lateral earth pressure, retaining walls.

TEXTBOOKS

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

Troxell, G. E., Davis, H. E., & Kelly, J. W. *Composition and Properties of Concrete,* 2nd ed. McGraw-Hill, 1968.

REFERENCE BOOKS

Ackroyd, T. N. W. *Concrete Properties and Manufacture.*

A.S.T.M. Standards, Part 10. Concrete and Mineral Aggregates. Amer. Soc. for Testing Materials (revised annually in Oct.) Philadelphia.

Bishop, A. W. & Henkel, D. J. *The Measurement of Soil Properties in the Triaxial Test.* Arnold.

BSI Specification (current editions) *B.S12 Portland Cement (Ordinary and Rapid Hardening); B.S812 Sample and Testing of Mineral Aggregates, Sands and Fillers; B.S882 Concrete Aggregates from Mineral Sources; B.S1881 Methods of Testing Concrete.* Br. Stand. Instit. London.

Concrete Manual. U.S. Bureau of Reclamation.

Design, Control and Characteristics of Concrete. Cement & Concrete Association of Australia.

Fulton, F. S. *Concrete Technology.* Portland Cement Instit. 1964. Johannesburg.

Robson, T. D. *High Alumina Cements and Concretes.* Contractors Record 1962, London.

S.A.A. Code CA2 Concrete in Buildings. Stand. Assoc. of Aust. (incl. 1968 amendments).

S.A.A. Specifications (current editions) *A2 Portland Cement; A64 Ready Mixed Concrete; A167-170 Aggregates for Concrete; A100-A113 Methods of Testing Portland Cement Concrete; A130 Los Angeles Test for Coarse Aggregate.* Stand. Assoc. of Aust.

Soil Mechanics for Road Engineers. H.M.S.O.

Taylor, W. H. *Concrete Technology and Practice.* 3rd ed. A. & R.

Terzaghi, K. *Theoretical Soil Mechanics.* Wiley.

Terzaghi, K. & Peck, R. B. *Soil Mechanics in Engineering Practice.* 2nd ed. Wiley, 1967.

8.253 Civil Engineering Materials

Part I — Materials of Construction. The mechanical behaviour of real materials; elasticity, inelasticity, plasticity, anelasticity and damping. Multiphase theory of elastic behaviour. Theories of failure.

Structural steel. Resumé of metallurgy, manufacture and types of steels. Specifications for and selection of steels; precautions. Corrosion protection. Structural aluminium alloys, properties, selection, applications and limita-

tions. Polymers. Structural applications of plastics, reinforced plastic and plastic laminates. Wood technology. Structural model materials.

Concrete: mechanical properties. Multi-phase theory of elastic behaviour, effect on deflection of structural members. Bond with reinforcement. Volume change. Influence on stress distribution of reinforced and prestressed concrete members and mass concrete. Special requirements in design and construction methods. Durability. Permeability, extensibility and crack resistance. Thermal effects, residual stresses. Physical and chemical deterioration. Concrete manufacture, field control and acceptance. Special non-destructive tests. Special applications. Non-destructive testing and methods of measurement.

Laboratory. Examination of concrete properties and concrete-making materials; proportioning methods; analysis, manufacture and testing of reinforced concrete members.

REFERENCE BOOKS

A.C.I. *Manual of Concrete Practice*. 3 vols. 1968.

A.S.T.M. Standards, Part 10. *Concrete and Mineral Aggregates*. Amer. Soc. for Testing Materials (revised annually in Oct.), Philadelphia.

Beuche, F. *Physical Properties of Polymers*. Wiley.

Concrete Manual. U.S. Bureau of Reclamation.

Desch, H. E. *Timber, Its Structure and Uses*. 3rd ed. Macmillan.

Fulton, F. S. *Concrete Technology*. Portland Cement Inst., Johannesburg, 1964.

Hayden, H. W., Moffatt, W. G. & Wulff, J. *The Structure and Properties of Materials*. Vol. III: *Mech. Behaviour*. Wiley, 1967.

Murdock, L. J., & Blackledge, G. F. *Concrete Materials and Practice*. 4th ed. Arnold.

Neville, A. M. *Properties of Concrete*. Pitman, 1963.

S.A.A. Specifications (current editions) *A64 Ready Mixed Concrete; A77 Aggregates for Concrete; A100-A111 Methods of Testing Portland Cement Concrete*. Stand. Assoc. of Aust.

S.A.A. Code CA2 Concrete in Buildings. Stand. Assoc. of Aust.

Short, A. & Kinniborgh, K. *Lightweight Concrete*. Contractors Record. London, 1963.

Taylor, W. H. *Concrete Technology and Practice*. A. & R., 1965.

Wangarrd, F. F. *The Mechanical Properties of Wood*. Wiley.

Part II — Soil Engineering

Foundation engineering; bearing capacity theory; allowable settlement, shallow and deep foundations; rafts; pile groups; site investigation as applicable to foundation design. Earth and rockfill dams, types, materials, stability analysis and design, construction problems. True shear strength of saturated soils, modern failure theories, yield criteria and yield surface theories applied to soil behaviour. Non-saturation; mechanics of unsaturated flow, soil suction, shear strength of unsaturated soils, drainage process.

Laboratory. Consolidation and shear strength testing of cohesive and granular soils. Evaluation of simple earth pressure, foundation engineering and earth dam theory.

TEXTBOOKS

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

Terzaghi, K., & Peck, R. B. *Soil Mechanics in Engineering Practice*. 2nd ed. Wiley, 1967.

REFERENCE BOOKS

Bishop, A. W., & Henkel, D. J. *The Measurement of Soil Properties in the Triaxial Test,* Arnold.
Lee, I. K. ed. *Soil Mechanics—Selected Topics.* Butterworth, 1968.
Terzaghi, K. *Theoretical Soil Mechanics.* Wiley.
Troxell, G. E., & Davis, H. E. *Composition and Properties of Concrete.* 2nd ed. McGraw-Hill, 1968.

8.254 Civil Engineering Materials

Part I — Concrete: mechanical properties. Multi-phase theory of elastic behaviour, effect on deflection of structural members. Bond with reinforcement. Volume change. Special requirements in design and construction methods. Durability. Permeability, extensibility and crack resistance. Thermal effects, residual stresses. Physical and chemical deterioration. Concrete manufacture, field control and acceptance.

Laboratory. Examination of concrete and concrete materials; aggregate testing, mix design, mechanical properties of concrete.

Part II — Soil Engineering

Foundation engineering; bearing capacity theory; allowable settlement, shallow and deep foundations; rafts; pile groups; site investigation as applicable to foundation design. Earth and rockfill dams, types, materials, stability analysis and design, construction problems.

Laboratory. Consolidation and shear strength testing of cohesive and granular soils. Evaluation of simple earth pressure, foundation engineering and earth dam theory.

Text and Reference Books as for 8.253.

8.259 Properties of Materials

8.250—Properties of Materials, plus the structure and properties of binary alloys; control of structure and properties, commercial alloys, materials selection.

8.260 Soil Mechanics

Historical background to soil mechanics, classification of soils, determination of soil properties, sampling and field assessment.

TEXTBOOK

Terzaghi, K. & Peck, R. B. *Soil Mechanics in Engineering Practice.* 2nd ed. Wiley, 1967.

REFERENCE BOOK

Soil Mechanics for Road Engineers. H.M.S.O.

8.261 Geotechnics

Introduction to aspects of engineering geology and rock and soil characteristics to provide a basis of subsequent work in Soil Mechanics, Concrete Technology and Road Materials. Main topics covered are structural geology; groundwater; petrology; clay mineralogy; soil properties; testing of coarse aggregates. Some previous study of geology is assumed.

TEXTBOOK

Terzaghi, K. & Peck, R. B. *Soil Mechanics in Engineering Practice.* 2nd ed. Wiley, 1967.

REFERENCE BOOK

Soil Mechanics for Road Engineers. H.M.S.O.

8.301 Systems Engineering

Covers the following topics: Systems approach. Basic systems concepts including networks. Optimization techniques. Linear systems. Complex systems. Applications.

TEXTBOOK

de Neufville, R., & Stafford, J. *Systems Analysis for Engineers and Managers.* McGraw-Hill, 1971.

REFERENCE BOOKS

Benjamin, J. R., & Cornell, C. A. *Probability, Statistics and Decision for Civil Engineers.* McGraw-Hill, 1970.

Stark, R. M. *Mathematical Foundations for Design: Civil Engineering Systems.* McGraw-Hill, 1971.

Wagner, H. M. *Principles of Operations Research.* Prentice-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. Schaum, N.Y.

Vennard, J. K. *Elementary Fluid Mechanics.* 4th ed. Wiley, 1961.

REFERENCE BOOK

Vallentine, H. R. *Water in the Service of Man.* Penguin, 1967.

8.531 Water Engineering

Hydrology — The hydrologic cycle, the runoff cycle, water balance, energy balance, circulation of atmosphere, dynamic cooling, condensation and precipitation, probability analysis of precipitation and floods, infiltration, soil water and groundwater hydrology, streamgauging, hydrograph analysis, flood estimation, yield and storage determination, evaporation, evapotranspiration.

Hydraulics — Dimensional analysis, hydraulic model theory, scale effect. Fluid turbulence, velocity distribution, surface resistance in flow past plane boundaries and in pipes and channels. Pipe flow, pipe networks, water-hammer. Channel flow, steady non-uniform flow, backwater curves, hydraulic jump, unsteady flow, waves, flood routing. Flow measurement. Hydraulic machinery, radial and axial flow, characteristic curves, cavitation.

Public Health Engineering — Elements of organic chemistry, elements of biology, process of decomposition and decay, colloids and colloidal solutions, adsorption, ionic theory and dissociation, chemical and biochemical measurement of degree of pollution, rate of biochemical oxidation, principles of water treatment, principles of sewage treatment.

TEXTBOOKS

Clark, J. W. & Viessman, W. *Water Supply and Pollution Control.* Int. Textbook Co., 1966.

Giles, R. V. *Fluid Mechanics and Hydraulics.* Schaum's Outline Series. Schaum, N.Y.

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

Vennard, J. K. *Elementary Fluid Mechanics.* 4th ed. Wiley, 1961.

REFERENCE BOOKS

Behr, L. C., Fuson, R. C. & Snyder, H. A. *Brief Course in Organic Chemistry.* Wiley, 1959.

Bruce, J. P. & Clark, R. H. *Introduction to Hydrometeorology.* Pergamon, 1966.

Chow, V. T. ed. *Handbook of Applied Hydrology.* McGraw-Hill, 1964.

Hardenbergh, W. A. & Rodie, E. R. *Water Supply and Waste Disposal.* Internat. Textbook Co., Pa., 1961.

Henderson, F. M. *Open Channel Flow.* Macmillan.

Johnstone, D. & Cross, W. P. *Elements of Applied Hydrology.* Ronald, 1949.

Murray, P. D. F. *Biology.* Macmillan, 1954.

Stepanoff, A. J. *Axial and Centrifugal Pumps.* Wiley.

Vallentine, H. R. *Applied Hydrodynamics.* Butterworth, 1967.

Wisler, C. O. & Brater, E. F. *Hydrology.* 2nd ed. Wiley, 1959.

8.532 Water Engineering

Part I — Hydraulics: Unsteady Flow: pendulation and surge tanks, water hammer in branching lines, waves in frictionless channels, solitary, periodic and shallow water waves, surges and flood waves, flood routing. *Sediment Theory:* introduction to critical tractive stress and regime theories, design of stable channels in alluvium. *Hydrodynamics:* equations of continuity, motion and vorticity, ϕ and ψ functions, Laplace equation, standard flow patterns, introduction to method of solution of Laplace equation. Applications to groundwater hydraulics. *Advanced Hydraulics Computations:* solution to selected hydraulic problems including backwater calculations, unsteady flow with friction, pipe networks, surge tanks, water hammer, two-dimensional networks.

Part II — Applied Water Engineering: water resources problems and solutions, the systems approach. General principles of regulation and utilisation of water; reservoirs and storage, distribution and transmission, treatment, collection and disposal. Examples of applied water engineering selected from the following fields: water supply, sewerage, irrigation, land drainage, urban drainage, flood control, hydro-electric generation, multi-purpose projects, river channel control, coastal engineering.

TEXTBOOK

Vennard, J. K. *Elementary Fluid Mechanics.* 4th ed. Wiley, 1961.

REFERENCE BOOKS

Charts for the Design of Channels. Hydraulics Research Paper No. 2. H.M.S.O.

Chow, V. T. ed. *Handbook of Applied Hydrology.* McGraw-Hill.

Chow, V. T. *Open Channel Hydraulics.* McGraw-Hill.

Henderson, F. M. *Open Channel Flow.* Macmillan.

Linsley, R. K. & Franzini, J. B. *Water Resources Engineering.* McGraw-Hill, 1964.

Raudkivi, A. J. *Loose Boundary Hydraulics.* Pergamon.

Resistance of Fluids in Channel Pipes. Hydraulics Research Paper No. 1. H.M.S.O.

Robertson, J. M. *Hydrodynamics.* Prentice-Hall.

Rouse, H. ed. *Engineering Hydraulics.* Wiley.

Streeter, V. L. & Wylie, E. B. *Hydraulic Transients.* McGraw-Hill.

Vallentine, H. R. *Applied Hydrodynamics.* Butterworth, 1967.

8.621 Engineering Construction

Construction plant and equipment; compressed air services, drilling, earth-moving, tunnelling and blasting, hoisting and conveying, pile-driving, etc.; aggregate and concrete plant. Principles of construction administration; evolution of management; objectives of management; principles of organisation; motivation and communication; project management. The role of government and local government authorities. An introduction to construction planning and scheduling; cost control and cost accounting; tenders and the preparation of estimates; scheduling of operations; linear programming, critical path and PERT techniques; contracts and specifications.

TEXTBOOKS

Antill, J. M. & Ryan, P. W. S. *Civil Engineering Construction.* 3rd ed. A. & R.

Peurifoy, R. L. *Construction, Planning, Equipment and Methods.* 2nd ed. McGraw-Hill.

REFERENCE BOOKS

Allen, L. *Management and Organisation.* McGraw-Hill, 1958.

Antill, J. M. *Civil Engineering Management.* A. & R.

Antill, J. M. & Woodhead, R. *Critical Path Methods in Construction Practice.* McGraw-Hill.

Linsley, R. K. & Franzini, J. B. *Water Resources Engineering.* McGraw-Hill.

O'Neill, L. V. *Fundamentals of Estimating and Construction Cost Control.* Tait.

8.631 Civil Engineering

Part I: Regional and Urban Planning. The planning process with particular regard for the improvement of urban environment. The unified approach and the role of the civil engineer. Socio-economic and physical elements. Historical background to the urbanisation process. Regional planning: principles of

regionalism, regional survey techniques, case studies. Urban planning: urban form and growth patterns, communication networks. Principles of site planning and civic design. Outline of town planning law and administration in New South Wales.

Part II: Transport Planning and Operations. Definition of a land use/transport system — land use potential, traffic generation, intensity of traffic generation, transport system capacity. Stability and steady state performance — output, specific output. Land use, generation, desire line and assignment models. The transport planning process — systems versus programming approach. Evaluation of operational performance of transport systems — travel time and flow relationships (the queueing model), level of service, network characteristics, transfer terminals. Economic evaluation of transport schemes and plans — criteria, benefits, costs, time streams, discounting, present worth, rates of return, benefit/cost and cost/effectiveness ratios.

Part III: Road Engineering. Route analysis and road location in the rural and urban environment including the location of bridges. Road geometrics and design, its influence on the behaviour of drivers. Landscape aspects of road design. Some examples of road design policies and their application. Types of roads and expressways and their applications, advantages and disadvantages. Types of intersections and interchanges, and some problems in their design. Pavement requirements, thickness design, pavement materials, gravels, stabilisation, cement and bituminous concrete. Function of wearing courses. Road drainage requirements and examples of design, road construction methods and plant. Uses of electronic computation in Highway Engineering.

Part IV: Project Planning and Evaluation. Management principles: historical development; scientific management; the managerial process, communication and control. Management practice: the role of design, research and development; management functions. Organisation: span control, divisionalisation, responsibility, authority and accountability. Engineering economics: interest, rates of return, minimum attractive rate of return, comparison, benefit-cost ratio. Project planning: organisational pattern, cost control, procurement, personnel management, resources scheduling and planning, critical path, project evaluation and review. Project evaluation: cost estimation, benefit estimation, economic comparison.

8.632 Civil Engineering

Comprises Parts I and III, being respectively Regional and Urban Planning and Road Engineering of 8.631 Civil Engineering.

8.711 Engineering for Surveyors

Engineering materials and structures. Design of instruments. Aspects of hydraulics, hydrology and soil mechanics.

REFERENCE BOOKS

Linsley, R. K., & Franzini, J. B. *Water Resources Engineering.* McGraw-Hill.
Whitehead, T. N. *Instruments and Accurate Mechanisms.* Dover, N.Y.

8.712 Engineering for Surveyors

Highways: location and design. Railways: design and construction. Aerodrome design. Harbours: seabed exploration, natural and artifical harbours. Municipal engineering: water and sewage reticulation, drainage, reservoirs, dam sites, irrigation, tunnel construction.

TEXTBOOKS

Antill, J. M. & Ryan, P. W. S. *Civil Engineering Construction.* 3rd ed. A. & R.

or

Peurifoy, R. L. *Construction, Planning, Equipment and Methods.* 2nd ed. McGraw-Hill.

Hennes, R. G. & Ekse, M. I. *Fundamentals of Transportation Engineering.* McGraw-Hill.

Policy for Geometric Design of Two Lane Rural Highways. Nat. Assoc. of Aust. State Road Authorities (avail. from D.M.R.).

REFERENCE BOOKS

Antill, J. W. & Ryan, P. W. S. *Civil Engineering Construction.* 3rd ed. A. & R., 1967.

A Policy on Geometric Design of Rural Highways. American Assoc. of State Highway Officials. Washington, 1965.

Bituminous Materials in Road Construction. H.M.S.O. London, 1962.

Design of Foulwater Sewers. M.W.S. & D.B., Sydney, 1963.

Hardenbergh, W. A. & Rodie, E. R. *Water Supply and Waste Disposal.* Int. Textbook Co., 1961.

Linsley, R. K. & Franzini, J. B. *Water Resources Engineering.* McGraw-Hill.

Oglesby, C. H. & Hewes, J. L. *Highway Engineering.* 2nd ed. Wiley, 1963.

Tunnard, C. & Pushkarev, B. *Man-made America—Chaos or Control.* Yale U.P., 1963.

Yoder, E. J. *Principles of Pavement Design.* Wiley, N.Y., 1960, *and* Chapman & Hall, London, 1960.

DEPARTMENT OF INDUSTRIAL ENGINEERING

18.011 Industrial Engineering IA

Manufacturing Properties of Materials: Stress-strain curves to high strains, effects of strain-rate and temperature. Combined stresses, yield criteria, introduction to plasticity theory. *Metal Cutting Theory:* Mechanics of the process, effect of work-hardening, prediction of shear angle and cutting force. *Metal Cutting Tools:* Tool materials: plain carbon, alloy steel and sintered materials, hardening and heat treatment, T.T.T. curves. Tool wear, life and failure, tool performance. Surface finish. Machinability. Economics of machining. *Other Metal Removal Processes:* Electric-discharge machining, electrochemical machining. *Aspects of Machine Tool Design and Utilization:* Structural stiffness, drive-trains, slideways. Causes of chatter. Factors affecting the selection and use of machine tools.

TEXTBOOK

Alexander, J. M. & Brewer, R. C. *Manufacturing Properties of Materials.* Van Nostrand, 1963.

REFERENCE BOOKS

Armarego, E. J. A., & Brown, R. H. *The Machining of Metals.* Prentice-Hall, 1969.

Boothroyd, G. *Fundamentals of Metal Machining.* Arnold, 1965.

Cook, N. H. *Manufacturing Analysis.* Addison-Wesley, 1966.

Dieter, G. D. *Mechanical Metallurgy.* Int. ed. McGraw-Hill, 1961.

18.012 Industrial Engineering IIA

Technology of Manufacturing: Basic plasticity theory. Theories of deformation processes, extrusion, tube making, forming and deep drawing. *Design for Production:* Interchangeable manufacture; standardisation; design communication; pre-production planning; introduction to design analysis. *Metrology:* Principles of measurement and measuring systems; basic design concepts of mechanical, optical, pneumatic and electrical systems, linear and angular measurements; straightness and flatness; screw thread measurements; machine tool testing.

TEXTBOOKS

A.S. CZ-1. 1966. *Engineering Drawing Practice.*

B.S. 1916, 1953. *Limits and Fits.* Parts I and II.

Gladman, C. A. *Manual for Geometric Analysis of Engineering Designs.* Aust. Trade Pub., 1966.

Johnson, W. & Mellor, P. B. *Plasticity for Mechanical Engineers.* Van Nostrand, 1966.

Scarr, A. J. T. *Metrology and Precision Engineering.* McGraw-Hill, 1967.

REFERENCE BOOKS

Alexander, J. M. & Brewer, R. C. *Manufacturing Properties of Materials.* Van Nostrand, 1963.
Hoffman, O. & Sachs, G. *Introduction to the Theory of Plasticity for Engineers.* McGraw-Hill, 1953.
Hume, K. J. *Engineering Metrology.* 2nd ed. Macdonald.
Rowe, G. W. *An Introduction to the Principles of Metalworking.* Arnold, 1968.

18.021 Industrial Engineering IB

Engineering Economics — The structure of the Australian economy. The theory of the firm. The selection and replacement of processes and equipment. Construction and optimisation of particular economic models e.g. inventory. *Industrial Applications of Probability* — Tutorial problems from the fields of sampling inspection, quality control, control charts — simple economic models, e.g. newsboy problem, length of steel bars.

TEXTBOOKS

Burr, I. W. *Engineering Statistics and Quality Control.* McGraw-Hill, 1953.
Smith, G. W. *Engineering Economy.* Iowa State U.P., 1968.

REFERENCE BOOKS

Duncan, A. J. *Quality Control and Industrial Statistics.* Irwin, 1959.
Grant, E. L. *Statistical Quality Control.* Int. ed. McGraw-Hill, 1964.
Moroney, M. J. *Facts from Figures.* Penguin, 1965.
Samuelson, P. A., Hancock & Wallace. *Economics.* Aust. ed. McGraw-Hill, 1970.

18.022 Industrial Engineering IIB

Design of manufacturing facilities — Product and objectives, equipment selection, plant location, factory layout.

The use of human and physical resources — Motion and time study, financial incentives, applications to machine controlled processes, work sampling and data collection.

Production Control — The detailed mechanics of control of jobbing production, and its extension to batch and continuous production. Manufacturing organisations, functions, inter-relationships and information flow. Application of data processing and control systems.

TEXTBOOKS

Buffa, E. S. *Modern Production Management.* 3rd ed. Wiley, 1969.
Niebel, B. W. *Motion and Time Study.* 4th ed. Irwin, 1967.

REFERENCE BOOKS

Carson, G. B. ed. *Production Handbook.* 2nd ed. Ronald, 1958.
Greene, J. H. *Production Control Systems and Decisions.* Irwin, 1965.
Maynard, H. B. ed. *Industrial Engineering Handbook.* 2nd ed. McGraw-Hill, 1963.
Moore, F. G. *Production Control.* Int. ed. McGraw-Hill, 1959.
Moore, J. M. *Plant Layout and Design.* Macmillan, 1962.
Murrell, K. F. H. *Ergonomics.* Chapman and Hall, 1965.

18.121 Production Management

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 Operations 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.* Whitcomb & 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, 1965.

Hillier, F. S., & Lieberman, G. J. *Introduction to Operations Research.* Holden-Day, 1968.

Smith, G. W. *Engineering Economy.* Iowa State U.P., 1968.

18.431 Design for Production

Interchangeable manufacture; standardisation; unit and selective assembly; preferred sizes. Presentation and interpretation of geometric tolerances; grouping: analysis of non-linear loop equations, economic allocation of tolerances; application of probability theory to tolerance allocation. Gauge design: effect of gauge tolerances on interchangeability.

TEXTBOOKS

A.S. CZ-1. 1966. *Engineering Drawing Practice.*

B.S. 4500: 1969. *Limits and Fits.*

Gladman, C. A. *Manual for Geometric Analysis of Engineering Designs.* Aust. Trade Pub., 1966.

REFERENCE BOOK

Parker, S. *Drawings and Dimensions.* Pitman, 1956.

18.551 Operations Research

The formulating and optimisation of mathematical models. The development of decision rules. Some techniques of operations research such as mathematical programming, queueing theory, inventory models, replacement and reliability models, and simulation will be introduced. These techniques will be applied to situations drawn from industrial fields, e.g. production planning and inventory control. Practical problems of data collection, problem formulation and analysis will be included.

TEXTBOOK

Hillier, F. S. & Lieberman, G. J. *Introduction to Operations Research.* Holden-Day, 1967.

REFERENCE BOOKS

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

Haussmann, F. *Operations Research in Production and Inventory Control.* Wiley, 1962.

Houlden, B. T. ed. *Some Techniques of Operational Research.* E.U.P., 1962.

SCHOOL OF SURVEYING

29.081 Thesis

29.411 Surveying for Architects

Introduction. Chaining, methods of measurement, corrections, chain surveys. Level, differential levelling, booking. Contours, volumes of earthworks. Theodolite, methods of reading angles, applications in building. Traversing, setting out.

REFERENCE BOOKS

Foxall, H. G. *Handbook for Practising Land and Engineering Surveyors.* 2nd ed. Institution of Surveyors, N.S.W. Division, Sydney.

Whyte, W. S. *Basic Metric Surveying.* Butterworth, 1969.

Wright Perrott, S. *Surveying for Young Engineers.* A. L. Allan. rev. 3rd ed. Chapman & Hall, 1970.

29.431 Surveying and Cartography

History of surveying and its relationship with town planning. Types of survey, methods of measurement, corrections, chain surveys. Level, differential levelling. Contours, volumes of earthworks. Theodolite, applications in building. Traversing, setting out. Basic concepts of land tenure, land registration and cadastral surveying. Outline of photogrammetry. Plotting. Preparation of plans, methods of enlargement and reduction, plan registration. Measurement of areas by planimeter.

29.441 Engineering Surveying

Part A. Ordinary levelling. Angle measurement. Linear measurement (tapes). 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, 1967. Paperback.

Seven Figure Mathematical Tables. Chambers, 1958.

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. International 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.

29.491 Survey Camp

A one-week field camp for students studying 29.441 Engineering Surveying.

29.801 Surveying I

Historical development of surveying methods and instruments, geodesy, cartography and astronomy. Introduction to modern aspects. Cartographic drawing and equipment. Surveying methods and instruments. Computations.

TEXTBOOKS

Clark, D. *Plane and Geodetic Surveying.* Vol. I. 5th ed. Constable, 1965.
Greenhood, D. *Mapping.* Phoenix Science Series. Univ. of Chicago. PSS 521, 1965.
Seven Figure Mathematical Tables. Full ed. Chambers, 1958.

REFERENCE BOOKS

Mitchell, H. C. *Definition of Terms used in Geodetic and other Surveys.* U.S. Coast and Geodetic Survey Sp. Pub. 242, 1948.
Whyte, W. S. *Basic Metric Surveying.* Butterworth, 1969.

29.802 Surveying II

Part A: Introduction to errors of observation. Engineering surveys; investigation and setting out surveys, e.g. plane triangulation, traversing, contours, areas, volumes, horizontal and vertical curves, height determination by barometric, differential and trigonometric levelling. Hydrographic surveying.

Part B: Cartography, atlas map projections, map reproduction.

TEXTBOOKS

Bannister, A. & Raymond, S. *Surveying.* Pitman, 1959.
Clark, D. *Plane and Geodetic Surveying.* Vol. I. 6th ed. Constable, 1969.
Clark, D. *Plane and Geodetic Surveying.* Vol. II. 5th ed. Constable, 1963.
Clendinning, J. & Olliver, J. G. *Principle and Use of Surveying Instruments.* 3rd ed. Blackie, 1969.
Seven Figure Mathematical Tables. Chambers, 1958.

REFERENCE BOOKS

Admiralty Manual of Hydrographic Surveying. Vol. I. *Surveying on Shore.* Hydrographic Department of the Navy, London, 1965.
Mitchell, H. C. *Definitions of Terms used in Geodetic and other Surveys.* U.S. Coast and Geodetic Survey Sp. Pub. 242, 1948.
Sandover, J. A. *Plane Surveying.* Arnold, 1961.

29.803 Surveying III

Graduation errors, linear and angular. Optical and electronic distance measurement. Mining and tunnel surveys. Survey methods for engineering projects.

TEXTBOOKS

Burnside, C. D. *Electromagnetic Distance Measurement.* Crosby Lockwood, London, 1971.

Clark, D. *Plane and Geodetic Surveying.* Vol. I. 6th ed. Constable, 1969.

Cooper, M. A. R. *Modern Theodolites and Levels.* Crosby Lockwood, London, 1971.

Smith, J. R. *Optical Distance Measurement.* Crosby Lockwood, London, 1971.

REFERENCE BOOKS

Clendinning, J., & Olliver, J. G. *Principle and Use of Surveying Instruments.* 3rd ed. Blackie, 1969.

Hardy, A. C. & Perrin, F. H. *The Principles of Optics.* McGraw-Hill, 1956.

International Association for Geodesy. *Symposium on Electromagnetic Distance Measurement.* Hilgar & Watts, Oxford, 1965.

Laurila, S. H. *Electronic Surveying and Mapping.* 2nd ed. Farrar, 1967.

Mitchell, H. C. *Definitions of Terms used in Geodetic and other Surveys.* U.S. Coast and Geodetic Survey Sp. Pub. 242, 1948.

Richardus, P. *Project Surveying.* North Holland, 1966.

Saastamoinen, J. J. ed. *Surveyors Guide to Electromagnetic Distance Measurement.* Univ. of Toronto, 1967.

29.821 Geodesy I

Figure of the earth, geoid, ellipsoid. Differential geometry: Euler's Theorem, Clairaut's Theorem, properties of geodesics, curvatures on the spheroid. Legendre's Theorem, calculations for short and medium lines on the spheroid. Outline of surveyor's projections. Technique of observation, estimates and tests of internal precision of angle, direction and distance measurements. Adjustment of control surveys, precision of adjusted values, testing of results. Approximate adjustments, braced quadrilateral.

TEXTBOOK

Clark, D. *Plane and Geodetic Surveying.* Vol. II. 5th ed. Constable, 1963.

REFERENCE BOOKS

Bomford, G. *Geodesy.* O.U.P., 1962.

Eisenhart, L. P. *A Treatise on the Differential Geometry of Curves and Surfaces.* Dover, 1960.

Mitchell, H. C. *Definition of Terms Used in Geodetic and other Surveys* U.S. Coast and Geodetic Survey Sp. Pub. 242, 1948.

Jordan, W. & Eggert, O. *Handbook of Geodesy.* Carta, M. W. trans. Vols. I and III. U.S. Army Map Service, 1962.

Peters, J. *Eight Place Table of Trigonometric Functions.* Edward Bros., 1943.

Reynolds, W. F. *Manual of Triangulation Computation and Adjustment.* U.S. Coast and Geodetic Survey Sp. Pub. 138, 1955.

Richardus, P. *Project Surveying.* North Holland, 1966.

Seven Figure Mathematical Tables. Chambers, 1958.

Shortrede, R. *Logarithms of Sines and Tangents for Every Second.* Layton.

The Australian Map Grid. Technical Manual. 2nd ed. National Mapping Council, Canberra, 1971.

Vega, G. *Seven Figure Logarithmic Tables.* Hafner Pub. Co., N.Y.

29.822 Geodesy II

Calculations on the ellipsoid; longitude, latitude and reverse azimuth. Major horizontal control surveys, plumb line deviations and Laplace stations. Base lines, precise traversing, trilateration, high precision levelling. Geophysical applications in geodesy.

REFERENCE BOOKS

Bomford, G. *Geodesy.* O.U.P., 1962.

Jordan, W. & Eggert, O. *Handbook of Geodesy.* Carta, M. W. trans. Vols. I and III. U.S. Army Map Service, 1962.

Mather, R. S. *The Theory and Geodetic Use of some Common Projections.* School of Surveying, U.N.S.W.

Mueller, I. & Rockie, J. D. *Gravimetric and Celestial Geodesy—A Glossary of Terms.* Ungar, N.Y., 1966.

Reynolds, W. F. *Manual of Triangulation Computation and Adjustment.* U.S. Coast and Geodetic Survey Sp. Pub. 138, 1955.

Richardus, P. *Project Surveying.* North Holland, 1966.

Thomas, P. D. *Conformal Projections in Geodesy and Cartography.* U.S. Coast and Geodetic Survey Sp. Pub. 251, 1952.

29.831 Astronomy I

The celestial sphere and the astronomical triangle. Time. Latitude, longitude and azimuth determinations; best position, balancing, circum- and ex-meridian methods. Sun observations.

TEXTBOOKS

Mackie, J. B. *The Elements of Astronomy for Surveyors.* 6th ed. Griffin, London, 1964.

or,

Textbook of Field Astronomy. H.M.S.O., 1960.

Star Almanac for Land Surveyors for Current Year. H.M.S.O.

29.832 Astronomy II

Precise time of observation. Geodetic methods for determination of precise latitude, longitude and azimuth. Position lines. Astrolabes. Reduction of star-co-ordinates from Mean to Apparent Place.

TEXTBOOK

Star Almanac for Land Surveyors for Current Year. H.M.S.O.

REFERENCE BOOKS

Hoskinson, A. J. & Duerksen, J. A. *Manual of Geodetic Astronomy.* U.S. Coast and Geodetic Survey Sp. Pub. 237, 1952.

Roelofs, R. *Astronomy Applied to Land Surveying.* Ahrend, 1950..

29.841 Surveying Computations I

Use of tables. Plane and spherical trigonometrical formulae. Calculation of triangles, areas, roadways, subdivisions, curves. Traverse computations and areas from co-ordinates. Resections and intersections. Transformations. Electronic computation.

TEXTBOOKS

Seven Figure Mathematical Tables. Chambers, 1958.

Tables of Natural Sines, Tangents, etc. to every Ten Seconds. D.M.R., 1949, *or,*

Natural Trigonometrical Tables. Six Figures. Govt. Printer, Pretoria.

REFERENCE BOOKS

Allan, A. L., Hollwey, J. R., & Maynes, J. H. B. *Practical Field Surveying and Computations.* Heinemann, 1968.

Richardus, P. *Project Surveying.* North Holland, 1966.

29.842 Surveying Computations II

Transformations. Resection, intersection. Error theory. Adjustment by least squares, variance-covariance matrix.

TEXTBOOKS

Seven Figure Mathematical Tables. Chambers, 1958.

Tables of Natural Sines, Tangents, etc. to every Ten Seconds. D.M.R., 1949, *or,*

Natural Trigonometrical Tables. Six Figures. Govt. Printer, Pretoria.

REFERENCE BOOKS

Richardus P. *Project Surveying.* North Holland, 1966.

Shortrede, R. *Logarithms of Sines and Tangents for Every Second.* Layton.

Vega, G. *Seven Figure Logarithmic Tables.* Hafner Pub. Co., N.Y.

29.851 Photogrammetry I

Photogrammetric optics, stereoscopic vision. Geometry of air photo, central perspective projection. Survey cameras, photographic materials. Radial triangulation. Restitution of stereoscopic instruments.

TEXTBOOK

Moffit, F. H. *Photogrammetry*. 2nd ed. International Textbook Co., 1968.

REFERENCE BOOKS

Crone, D. R. *Elementary Photogrammetry*. Arnold, 1963.
Hallert, B. *Photogrammetry*. McGraw-Hill, 1960.
Manual of Photogrammetry. 3rd ed. Am. Soc. Photogram., 1966.
Zeller, M. *Textbook of Photogrammetry*. Lewis, 1952.

29.852 Photogrammetry II

Photogrammetric orientation; photo-interpretation. Camera calibration, focal length, principal point. Stereoscopic instruments, restitution and approximate instruments. Aerial triangulation, propagation of errors, strip and block adjustment. Rectification, mosaics. Flight planning, auxiliary instruments. Aerial mapping.

TEXTBOOK

Moffit, F. H. *Photogrammetry*. 2nd ed. International Textbook Co., 1968.

REFERENCE BOOKS

Hallert, B. *Photogrammetry*. McGraw-Hill, 1960.
Manual of Photogrammetry. 3rd ed. Am. Soc. Photogram., 1966.
Zeller, M. *Textbook of Photogrammetry*. Lewis, 1952.

29.881 Land Law, Utilization and Valuation

Survey Law — General outline, history. Land tenure, boundaries, easements. Common law, statute law. Equity and case law. Relevant acts and regulations.

Land Valuation — General principles, unimproved and improved capital value, valuation of freehold and leasehold, depreciation. Relevant acts, regulations and court procedures. Urban and rural valuations.

Land Utilization — Climate, vegetation, soils, Erosion and conservation. Land types; classification and use. Tree identification.

TEXTBOOKS

Collins, H. G. *Rural Land Utilization*. Commonwealth Institute of Valuers, 1968.
Costin, A. B., & Frith, H. J. *Conservation*. Penguin, 1971.
Murray, J. F. N. *Principles and Practice of Valuation*. C'wealth Inst. of Valuers, 1966.

or

Rost, R. O., & Collins, H. G. *Land Valuation and Compensation in Australia*. C'wealth Inst. of Valuers, 1971.

29.882 Cadastral Surveying

Land tenure, registration and cadastral surveys in selected countries. Survey practice law, professional ethics, surveyors' rights, powers and duties. Cadastral surveys in New South Wales; searches, Torrens and Old System title surveys, identification surveys, field records and plans.

TEXTBOOK

Willis, R. W. *Survey Investigation.* Registrar-General's Dept.

REFERENCE BOOK

Dowson, E. M. & Sheppard, V. L. O. *Land Registration.* H.M.S.O., 1956.

29.892 Survey Camp

A two-week Field camp.

29.893 Survey Camp

A two-week Field camp followed by one week on campus for computations.

NON-ENGINEERING SUBJECTS

(For General Studies subjects see the Department of General Studies Handbook.)

1.001 Physics I

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

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

TEXTBOOKS

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., & Mann, K. *Introductory Electronics.* Clarendon.

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

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

REFERENCE BOOKS

Ference, M., Lemon, H., & Stephenson, R. J. *Analytical Experimental Physics.* Chicago U.P.

Halliday, D., & Resnick, R. *Physics for Students of Science and Engineering.* Vols. I & II. Wiley.

Wiedner, R. T. V., & Sells, R. L. *Elementary Classical Physics.* Vols. I and II. Allyn & Bacon.

1.011 Higher Physics I

Subject matter same as 1.001, but in greater depth.

TEXTBOOKS

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

Halliday, D. & Resnick, R. *Physics for Students of Science and Engineering.* Vols. I and II, or combined volume. Wiley, 1960.

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

Spiegel, M. R. *Theory and Problems of Theoretical Mechanics.* Schaum.

REFERENCE BOOKS

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

1.041 Physics IC

For students in the Faculty of Science, School of Surveying, and Industrial Arts course; also available as an elective in the Faculty of Arts. Consists of Units 1-6, 8 and 9.

For Text and Reference Books see list after 1.051 Physics IE.

1.051 Physics IE

For students in the Aeronautical, Civil, Industrial and Mechanical Engineering and Naval Architecture courses. Consists of Units 1, 3-5, 8-10.

UNITS

1. *Mechanics I* Kinematics. Centripetal acceleration. Newton's laws of motion. Momentum. Impulse. Work, energy and power. Friction. Conditions of equilibrium. Simple harmonic motion.
2. *Mechanics II* Collisions. Coefficient of restitution. Moment of Inertia. Rotational dynamics. Conservation of angular momentum. Gravitation. Kepler's laws. Planetary motion.
3. *Wave Motion* Equation of wave motion. Longitudinal and transverse waves. Sound waves. Superposition of waves. Energy current. Stationary waves. Resonance. Beats, Doppler effect.
4. *Optics* Electromagnetic spectrum, Huygens' wave principle. Reflection. Plane and spherical mirrors. Refraction. Lenses. Dispersion. Aberrations. Optical instruments. Interference. Diffraction. Resolution. Grating. Plane polarized light.
5. *Introduction to Modern Physics* Measurement of e and e/m. The neutron. Natural and artificial radioactivity. Quantum properties of radiation. The Bohr atom. Wave properties of matter. The uncertainty principle. Nuclear fission and fusion.
6. *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.
8. *Electrostatics, Electromagnetism and D.C. Circuits.* Coulomb's Law. Electric field. Electric potential. Capacitance. Electrical energy sources. Conductors. Resistivity. Atomic view of conduction. emf. Kirchoff's Laws. Magnetic induction. Torque on a coil in magnetic field. Moving coil meter. Wheatstone's bridge. Potentiometer. Faraday's Law. Transient circuits.
9. *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.
10. *Physical Acoustics* Vibration of strings, bars and plates. Acoustical measurements. Room acoustics. Ultrasonics.

TEXTBOOKS

For 1.041 Physics IC and 1.051 Physics IE (for students taking one year of Physics only):

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

Giutronich, J. E. *Electricity.* Clarendon.

Halliday, D. & Resnick, R. *Physics for Students of Science and Engineering.* Vol. I. Wiley.

Lishmund, R. E. *Introductory Physical and Geometrical Optics.* U.N.S.W.

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

For 1.051 only:

Dunlop, J. I., & Mann, K. *Introductory Electronics.* O.U.P.

Pollard, H. F., & Harris, R. W. *Introductory Physical Acoustics.* N.S.W.U.P.

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

REFERENCE BOOK

For 1.041 Physics IC and 1.051 Physics IE (for students taking one year of Physics only):

Wiedner, R. T. & Sells, R. L. *Elementary Modern Physics.* Vol. III. Allyn & Bacon, 1960.

PHYSICS LEVEL II UNITS (Professional)

The units are at two levels, an ordinary level, prefix 1.112, and a higher level, prefix 1.122:

TEXTBOOK

For all students taking Level II Physics laboratory:

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

1.112A Electromagnetism

Electrostatics in vacuum and in dielectrics. Magnetostatics in vacuum and in dielectrics. Magnetostatics in vacuum and in magnetic materials. Maxwell's equations and simple applications.

TEXTBOOK

Whitmer, R. M. *Electromagnetics.* 2nd ed. Prentice-Hall, 1962.

1.112B Modern Physics

Special theory of relativity, Lorentz transformation, relativistic mass, momentum and energy; quantum theory, photoelectric effect, Compton effect; wave-particle duality, Schrodinger wave equation, infinitely deep square well, H atom; spectra, magnetic moment, exclusion principle; Rutherford scattering, nuclear properties, mass spectrograph, binding energy, radioactivity, alpha, beta and gamma radiation, nuclear reactions.

TEXTBOOK

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

REFERENCE BOOKS

Mermin, N. D. *Space and Time in Special Relativity.* McGraw-Hill, 1968.
Weidner, R. T. V. & Sells, R. L. *Elementary Modern Physics.* Vol. III. Allyn & Bacon.

1.112C Waves in Continuous Media and Thermodynamics

Continuum Mechanics: Free oscillations in simple systems: one degree of freedom, linearity, superposition, two degrees of freedom, beats, modulation. Oscillations with many degrees of freedom: continuous string, non continuous systems, Fourier analysis. Forced oscillations: harmonic oscillator, filters, many degrees of freedom. Travelling waves: refraction, dispersion, impedance, energy flux. Reflections: termination matching, transmission. Modulation, pulses, wave packets.

Thermodynamics: Kinetic theory of gases. Equipartition of energy. Maxwell-Boltzmann distribution law. First and second laws of thermodynamics. Entropy and the entropy principle. Thermodynamic functions. Phase changes. Joule-Kelvin effect.

TEXTBOOKS

Continuum Mechanics

Crawford, P. S. *Waves.* McGraw-Hill, 1968.

Thermodynamics

Sears, F. W. *Thermodynamics, the Kinetic Theory of Gases and Statistical Mechanics.* Addison-Wesley.

1.122A Electromagnetism

Electrostatics, Gauss' theorem. Dipoles. Dielectrics. Electric displacement. Poisson's and Laplace's equations. Electrical images. Classical theory of conduction. Magnetic effects of currents. Magnetic shells. Magnetic scalar potential. Magnetostatics. B and H. Ferromagnetism. Maxwell's equations of e.m. field. Poynting vector. Plane waves in isotropic dielectric and conducting media. Reflection, refraction at the boundary of two dielectrics. Reflection from surface of metal.

TEXTBOOK

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

REFERENCE BOOK

Panofsky, W. K. H. & Phillips, M. *Classical Electricity and Magnetism.* 2nd ed. Addison-Wesley.

1.122B Quantum Physics

Introductory relativity theory, kinematics and mechanics. Electrons and quanta, the photoelectric effect, Compton effect. The nuclear atom. Atomic stability. Atomic spectra. Bohr theory. Particles and waves and Schrodinger's equation. The free particle. Step potentials. The one electron atom. The exclusion principle. X-rays, origin and spectra. Electron energy levels in solids.

TEXTBOOK

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

REFERENCE BOOK

Mermin, N. D. *Space and Time in Special Relativity.* McGraw-Hill, 1968.

1.122C Thermodynamics and Mechanics

First and second laws of thermodynamics. Thermodynamic equilibrium, and reversibility. Kelvin temperature scale. Entropy. Thermodynamic functions and Maxwell's relationships. Application of thermodynamics to different systems. Maxwell-Boltzmann velocity distribution law. Oscillators. Vibrating strings. Motion of system of particles. Lagrange's equations. Variational principles. Hamilton's equations of motion. Transport properties of a gas.

TEXTBOOKS

Symon, K. R. *Mechanics.* 2nd ed. Addison-Wesley, 1965.
Zemansky, M. W. *Heat and Thermodynamics.* 5th ed. McGraw-Hill, 1969.

REFERENCE BOOKS

Goldstein, H. *Classical Mechanics.* Addison-Wesley.
Pippard, A. B. *Classical Thermodynamics.* C.U.P., 1964.
Spiegel, M. R. *Theory and Problems of Theoretical Mechanics.* Schaum Pub.

1.212 Physics IIT

Two sections of this course are offered:

Unit A

Geometrical Optics: The concept of the ray of light and the point image. Reflection. Fresnel's laws. Refraction. The thin lens. The thick lens and lens system. Instruments and their aberrations. Trigonometrical ray tracing. Photometry.

TEXTBOOK

Fincham, W. *Optics.* Hatton Press.

REFERENCE BOOKS

Conrady, A. E. *Applied Optics and Optical Design.* Dover.
Emsley, H. H. *Aberrations of Thin Lenses.* Hatton Press.
Hardy, A. C. and Perrin, P. H. *Principles of Optics.* McGraw-Hill.
Morgan, J. *Introduction of Geometrical and Physical Optics.* McGraw-Hill.

Unit B

Electronics: Conduction in solids; electron emission, vacuum tubes and applications; solid state diodes, transistors, thyristors, unijunction transistors, amplifiers, feed back; block diagrams of complete systems.

TEXTBOOK

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

REFERENCE BOOKS

Azaroff, L. V. *Introduction to Solids*. McGraw-Hill.

Azaroff, L. V., & Brophy. *Electronic Process in Materials*. McGraw-Hill, 1968.

Moffat, W. G., Rose, R. M., Shepard, L. A., & Wulff, J. *Structure and Properties of Materials*. Vol. 4: *(Electronic Properties)*. Wiley, 1966.

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. *SI Chemical Data*. Wiley, Sydney, 1971.

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

Chemistry I—Laboratory Manual. Univ. of N.S.W., 1971.

Hart, H. & Schuetz, R. D. *Organic Chemistry*. Feffer & Simons, 1967.

O'Malley, R. F. *Problems in Chemistry*. McGraw-Hill, 1968.

Schaum Outline Series. *Theory and Problems of College Chemistry*. McGraw-Hill.

Turk, A., Meislich, H., Brescia, F. & Arents, J. *Introduction to Chemistry*. Academic, 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, N.Y., 1964.

Sisler, H. H., Van der Werf, C. A. & Davidson, A. W. *College Chemistry*. 3rd ed. Collier-Macmillan, 1967.

2.021 Chemistry IE

A terminating subject for students in the Aeronautical, Civil, Industrial and Mechanical Engineering, Naval Architecture, and Applied Geography courses.

Classification of matter and theories of the structure of matter. Atomic structure, the periodic table and chemical behaviour. Chemical bonding and the nature and properties of chemical substances. Equilibrium and change in chemical systems.

TEXTBOOKS

Aylward, G. A. & Findlay, T. J. V. *Chemical Data Book.* 2nd ed. Wiley, Sydney, 1966.

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

Chemistry IE. Laboratory Manual. Univ. of N.S.W., 1971.

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

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

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.

TEXTBOOK

Wulff, J. ed. *Structure and Properties of Materials.* Vols. I, II & IV. Wiley.

REFERENCE BOOK

Guy, A. G. *Elements of Physical Metallurgy.* Addison-Wesley.

10.001 Mathematics I

Calculus, analysis, analytic geometry, linear algebra, an introduction to abstract algebra, elementary computing.

TEXTBOOKS

Blatt, J. M. *Introduction to Fortran IV Programming.* Prentice-Hall.
Kelly, G. M. *Introduction to Linear Algebra and Vector Geometry.* Reed Education, Sydney, 1971.
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.
Zelinsky, D. *A First Course in Linear Algebra.* Academic.

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.

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. *Lectures in Algebra.* N.S.W.U.P.
Spivak, M. *Calculus.* Benjamin.

REFERENCE BOOKS

As for 10.001 Mathematics I plus:

Abraham, R. *Linear and Multilinear Algebra.* Benjamin.
Blatt, J. M. *Basic Fortran IV Programming* (IBM/360 Version). Computer Systems (Aust.).
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.

PRELIMINARY READING LIST

As for 10.001 Mathematics I plus:

Arnold, B. H. *Intuitive Concepts in Elementary Topology.* Prentice-Hall.
David, F. N. *Games, Gods and Gambling.* Griffin.
Felix, L. *The Modern Aspect of Mathematics.* Science Editions.
Huff, D. *How to Lie with Statistics.* Gollancz.
Reid, C. *From Zero to Infinity.* Routledge & Kegan Paul.

10.021 Mathematics IT

Calculus, analysis, analytic geometry, algebra, probability theory, elementary computing.

TEXTBOOKS

Blatt, J. M. *Introduction to Fortran IV Programming.* Prentice-Hall.
Calculus—To be advised.
Notes on Sets, Probability, Matrices and Vectors. N.S.W.U.P.

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 Mathematics

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

Ayres, F., Jr. *Theory and Problems of Matrices,* Schaum, N.Y.
Gere, J. M. & Weaver, W. Jr. *Matrix Algebra for Engineers.* Van Nostrand Engineering Paperback.
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.

10.022/1 and 10.022/2 Mathematics, Parts 1 and 2

10.022 for part-time students in Engineering over two years. Text and Reference Books as for 10.022 Mathematics.

10.033 Mathematics

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. & 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.

10.111A Pure Mathematics II—Algebra

Vector Spaces: inner products, linear operators, spectral theory, quadratic forms. Linear Programming: convex sets and polyhedra, feasible solutions, optimality, duality.

TEXTBOOKS

Gass, H. *Linear Programming.* I.S.E. McGraw-Hill.

Tropper, A. M. *Linear Algebra.* Nelson. Paperback.

10.111B Pure Mathematics II—Analysis

Complex variables: analytic functions, elementary functions, Taylor and Laurent series, integrals, Cauchy's theorem, residues, evaluation of certain real integrals, maximum modulus principles. Linear differential equations of the second order: equations with constant coefficients, power series solutions, Laplace transforms, Bessel functions.

TEXTBOOKS

Churchill, R. V. *Complex Variables and Applications.* I.S.E. McGraw-Hill.

Hilton, P. J. *Partial Derivatives.* Routledge.

Purcell, E. J. *Calculus with Analytic Geometry.* Appleton-Century-Crofts.

REFERENCE BOOKS

Crowell, R. H., & Williamson, R. E. *Calculus of Vector Functions.* Prentice-Hall.

Kaplan, W., & Lewis, D. J. *Calculus and Linear Algebra.* Wiley.

Knopp, K. *Theory of Functions,* Part I. Dover.

10.111C Pure Mathematics II—Abstract Algebra

Abstract Algebra: Euclidean algorithm, unique factorization theorem, mathematical systems, groups, determination of small groups, homomorphisms and normal subgroups. Geometry: elementary concepts of Euclidean, projective and affine geometries.

TEXTBOOKS

Dean, R. A. *Elements of Abstract Algebra.* Wiley.
Gans, D. *Transformations and Geometries.* Appleton-Century-Crofts.

REFERENCE BOOKS

Birkhoff, G. & MacLane, S. *A Survey of Modern Algebra.* Macmillan.
Lederman, W. *Introduction to the Theory of Groups.* Oliver & Boyd.

10.341 Statistics

An introduction to probability theory. Random variables and distribution functions; the binomial, Poisson and normal distributions in particular. Standard sampling distributions, including those of χ^2, t and F. Estimation by moments and maximum likelihood; confidence interval estimation. The standard tests of significance based on the above distributions, with a discussion of power where appropriate. An introduction to linear regression. Least squares adjustment of data.

10.351 Statistics

For students in Aeronautical, Industrial and Mechanical Engineering and Naval Architecture as part of 5.071 Engineering Analysis.

An introduction to probability theory, with finite, discrete and continuous sample spaces. Random variables: the standard elementary distributions including the binomial, Poisson and normal distributions. Sampling distributions, with emphasis on those derived from the normal distribution: t, χ^2 and F. Estimation of parameters: the methods of moments and maximum likelihood, and confidence interval estimation. The standard tests of statistical hypotheses, and, where appropriate, the powers of such tests. An introduction to regression and the bivariate normal distribution.

TEXTBOOKS (for 10.341 and 10.351.)

Freund, J. E. *Mathematical Statistics.* 2nd ed. Prentice-Hall.
Statistical Tables.

REFERENCE BOOKS

Derman, C. & Klein, M. *Probability and Statistics Inference for Engineers.* O.U.P.
Freeman, H. *Introduction to Statistical Inference.* Addison-Wesley.
Hald, A. *Statistical Theory with Engineering Applications.* Wiley.

36.411 Town Planning

The study of factors influencing the direction of the development and use of land in the public interest. Objectives of town and regional planning; historical background; contemporary planning techniques; New South Wales planning law and administration; parks and playing fields; housing

and neighbourhood planning; traffic and transport; the central area; elements of civic design; the city of the future. Studio work in the design and layout of residential areas.

TEXTBOOK

Brown, A. J. & Sherrard, H. M. *Town and Country Planning.* 2nd ed. A. & R., 1969.

REFERENCE BOOKS

Abercrombie, P. *Town and Country Planning.* 3rd ed. O.U.P., 1959.
Mumford, L. *The City in History.* Secker & Warburg, 1961.
Ritter, P. *Planning for Man and Motor.* Oxford, Pergamon Press, 1964.

14.001 Introduction to Accounting

An introduction for non-commerce students to the nature, purpose and conceptual foundation of accounting. Information systems including accounting applications. Analysis and use of accounting reports. Relevance of accounting to managerial and technological functions including planning, decision-making and control.

PRELIMINARY READING

Anthony, R. N. *Essentials of Accounting.* Addison-Wesley, 1964.
Salmonson, R. F. *Basic Financial Accounting Theory.* Wadsworth, 1969, Paper Back.
Solomon, I., & Weingart, L. O. *Management Uses of the Computer.* Mentor, 1966.

TEXTBOOK

Fertig, P. E., Istvan, D. F., & Mottice, H. J. *Using Accounting Information.* 2nd ed. Harcourt, Brace, 1971.

25.101 Geology for Engineers

Basic geology and engineering geology for Civil Engineering students.

Geology: the geochemistry and structure of the earth. Rock-forming minerals and the classification of rocks. Clay minerals and their engineering properties. Elementary stratigraphy and structural geology. The mineralogy, lithology, and formation of igneous, sedimentary and metamorphic rocks. The denudation and weathering of rocks with particular reference to the nature of residual and transported soils. The nature of residual and transported soils. The nature and occurrence of groundwater.

Engineering Geology: review of the application of geology in engineering practice. Geophysics methods utilized in sub-surface exploration. The mechanical properties of the main rock types. Chemical instability of rock as affecting foundations and aggregates. Mass movement and the stability of slopes. The structural analysis of discontinuities in rock masses and its application to the study of failure in dams, tunnels, open-cut excavations and other engineering works. Engineering geology report writing as utilized in dam and reservoir investigations, nuclear facilities, hydrogeological investigations. *Laboratory:* the identification of common rock-forming minerals and rock types. The examination of rocks in the hand specimen to establish their relative strength, resistance to abrasion and chemical stability. The preparation and interpretation of geological maps and sections.

TEXTBOOK

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

REFERENCE BOOKS

Application of Geology to Engineering Practice. Geol. Soc. of America. N.Y., 1950.

Dapples, E. C. *Basic Geology*. Wiley, 1959.

Krynine, D. P. & Judd, W. R. *Principles of Engineering Geology and Geotechnics*. McGraw-Hill, 1957.

Paige, S. ed. *Application of Geology to Engineering Practice: Berkey Volume*. Geol. Soc. of America, N.Y., 1950.

Schultz, T. R. & Cleaves, A. B. *Geology in Engineering*. Wiley, 1952.

25.303 Geophysics for Surveyors

Physics, shape, structure and constitution of the earth; geotectonics, seismology, gravity, geodesy, geothermy, geomagnetism, palaeomagnetism, geoelectricity, aeronomy and geochronology. Practical work includes a one day field tutorial.

TEXTBOOKS

Garland, G. D. *The Earth's Shape and Gravity*. Pergamon, 1964.

Stacey, F. D. *Physics of the Earth*. Wiley, 1969.

REFERENCE BOOKS

Bullen, K. E. *Introduction to Theory of Seismology*. C.U.P., 1963.

Chapman, S. *The Earth's Magnetism*. Methuen, 1951.

Gass, I. G., Smith, P. J., & Wilson, R. C. L. *Understanding the Earth*. Artemis Press, 1971.

Gutenberg, B. *Physics of the Earth's Interior*. Academic, 1959.

Heiskanen, W. A. & Meinesz, F. A. V. *The Earth and its Gravity Field*. McGraw-Hill.

Hill, M. N. *The Sea*. Vol. 3. Wiley, 1963.

Irving, E. *Palaeomagnetism*. Wiley, 1964.

Jacobs, J. A. *The Earth's Core and Geomagnetism*. Pergamon, 1963.

Jacobs, J. A., Russell, R. D. & Wilson, J. T. *Physics and Geology*. McGraw-Hill, 1959.