FACULTY OF ENGINEERING

1970 HANDBOOK

THE UNIVERSITY OF NEW SOUTH WALES

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FACULTY OF ENGINEERING

1970 HANDBOOK

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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 School about this: where they cannot be available, they have nominated colleagues to deal with enquiries.

P. T. FINK,

Dean,

Faculty of Engineering

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CALENDAR DATES FOR 1970

Term 1: March 2 to May 16
Term 2: June 1 to August 8
Term 3: August 31 to October 31

JANUARY—	
Monday, 19	Last day for acceptance of applications to enrol by new students and students repeating First Year
Tuesday, 27	Deferred examinations begin
FEBRUARY—	
Saturday, 7	Deferred examinations end
Monday, 16	Enrolment Week begins for new students and students repeating First Year
Monday, 23	Enrolment Week begins for students re-enrolling (second and later years)
MARCH—	
Monday, 2	First term lectures begin
Friday, 13	Last day for acceptance of enrolments of new students (late fee payable)
Friday, 27 to Monday, 30	Easter
Tuesday, 31	Last day for acceptance of enrolments of students re-enrolling (late fee payable)
APRIL—	
Saturday, 25	Anzac Day—Public Holiday
Wednesday, 29	Captain Cook Bi-Centenary Day—Public Holiday
MAY—	
Saturday, 16	First term ends
JUNE—	
Monday, 1	Second term begins
Monday, 15	Queen's Birthday—Public Holiday
Friday, 26	Last day for acceptance of applications for re-admission after exclusion under rules governing re-enrolment
JULY—	
Tuesday, 7	Foundation Day
Friday, 17	Last day for acceptance of corrected enrolment details forms

AUGUST—

Saturday, 8	Second term ends
Monday, 31	Third term begins

SEPTEMBER—

Saturday, 19	Annual Examinations begin—21- and 24-week courses

OCTOBER—

Monday, 5	Eight Hour Day—Public Holiday
Saturday, 3	Annual Examinations end—21- and 24-week courses
Saturday, 31	Third term ends

NOVEMBER—

Saturday, 7	Annual Examinations begin—30-week courses
Saturday, 28	Annual Examinations end—30-week courses

1971

Term 1: March 1 to May 15
Term 2: May 31 to August 7
Term 3: August 30 to October 30

JANUARY—

Tuesday, 26 to Saturday, Feb. 6	Deferred examinations

FEBRUARY—

Monday, 15	Enrolment Week begins for new students and students repeating First Year
Monday, 22	Enrolment Week begins for students re-enrolling (second and later years)

MARCH—

Monday, 1	First term lectures begin

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THE FACULTY

SCHOOL OF CIVIL ENGINEERING

The School of Civil Engineering consists of four departments, the Department of Water Engineering, the Department of Structural Engineering, the Department of Structural Mechanics and the Department of Surveying. The School conducts undergraduate courses in Civil Engineering and in Surveying, both part time and full time. In addition, the Departments conduct graduate courses in Structural Engineering, Water Engineering, Public Health Engineering and Engineering Construction. A vigorous graduate research programme is pursued in many fields.

The Department of Water Engineering encompasses the fields of Hydraulics, Hydrology, Public Health Engineering, Soil Mechanics and Engineering Construction. Public Health Engineering and Soil Mechanics Laboratories are 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 at Manly Vale is the centre for hydraulics laboratory instruction and investigations.

The Department of Structural Engineering covers the fields of Structural Engineering, Civil Engineering Materials, and Concrete Technology. The Materials and Concrete Technology laboratories, the Model Structures Laboratory, the Experimental Stress Analysis Laboratory and the Solid Mechanics Laboratory are at Kensington. The Structures Laboratory, which was formerly at Ultimo, is being re-established at King Street, Randwick in the vicinity of the Schools of Highway and Traffic Engineering.

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 of Surveying has facilities for precise astronomical observation and for surveying computation, also a well-equipped Photogrammetrical Laboratory, all at Kensington. As well as the usual surveying equipment, it possesses modern electronic distance measuring equipment.

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 I.B.M. 360/50 computer is installed in the School.

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 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 (Technology) 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 second year for full-time and fourth stage 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 Condi-

tioning, 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 NUCLEAR ENGINEERING

The School of Nuclear Engineering offers a formal graduate course (MEngSc) and accepts candidates for the ME and PhD degrees. Nuclear Engineering covers neutron and gamma transport theory, the analysis of the nuclear aspects of reactor performance, heat and fluid flow, heat removal processes, thermal stress, steady state thermal performance and design, neutron kinetics, reactor and nuclear power system dynamics, and nuclear power system economics, selection and optimization. Digital computation is fundamental to the study of nuclear reactors, and particular attention is given to the efficiency of numerical techniques and the basic mathematical theory.

Research activities in the School include aspects of neutron transport theory, problems of heat flow and thermal stress associated with variable surface heat transfer, ball flow in a pebble bed reactor, reactor noise analysis and studies of nuclear and thermal random processes in nuclear power reactors.

SCHOOL OF TRAFFIC ENGINEERING

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

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.

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.

It should be noted that compliance with these conditions does not in itself entitle a candidate to enter upon a course. While it is the policy of the University to endeavour to admit all properly qualified applicants who have lodged applications by the appropriate closing date, it may be necessary at times to restrict the entry to one or more faculties because of lack of facilities. Information concerning any such restrictions will be publicized as soon as practicable.

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

(for entry to the University in 1969 and until further notice)

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

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

(a) his qualification includes a pass at the level indicated in the subject or subjects specified in Schedule A as Faculty, Course or Subject Pre-Requisites; or

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

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

NOTE

1. For the purposes of clause 2(a), Mathematics and Science BOTH PASSED at First Level or Second Level Full Course shall together count as three subjects.

2. For the purposes of clause 2(b), Mathematics and Science, TAKEN either singly or together at First Level or Second Level Full Course shall each count as one and one half subjects.

Schedule A

FACULTY OR COURSE	FACULTY OR COURSE PRE-REQUISITES
Applied Science (excl. Wool Technology course) 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 Wool Technology course (Faculty of Applied Science) Sheep and Wool Technology (Education option) course	(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.
Military Studies (Arts course)	English at Level 2 or higher OR English at Level 3, provided that the candidate's performance in this subject and his general level of attainment are at standards acceptable to the Professorial Board, and provided that a candidate so qualified shall not enrol in a course of English Literature.

SUBJECT	SUBJECT PRE-REQUISITES
1.011—Higher Physics I 1.001—Physics I 1.041—Physics IC	As for Faculty of Science
2.011—Higher Chemistry I 2.001—Chemistry I 17.001—General and Human Biology 25.001—Geology I	Science at Level 2S or higher
10.011—Higher Mathematics I	Mathematics at Level 2F or higher
10.001—Mathematics I	Either Mathematics at Level 2F or higher OR Mathematics at Level 2S, provided that the candidate's performance in the subject and his general level of attainment are at standards acceptable to the Professorial Board.
10.021—Mathematics IT	Mathematics at Level 2S or higher
15.102—Economics II	As for Faculty of Commerce
50.111—English I 51.111—History I	English at Level 2 or higher
56.111—French I	French at Level 2 or higher
59.111—Russian I	Russian at Level 2 or higher
64.111—German I	German at Level 2 or higher
65.111—Spanish I	Spanish at Level 2 or higher
59.001—Russian IZ 64.001—German IZ 65.001—Spanish IZ	A foreign language, other than that in which enrolment is sought, at Level 2 or higher

Section B

SUPPLEMENTARY PROVISIONS FOR MATRICULATION

1. Notwithstanding the provisions of Section A above, candidates may be accepted as "matriculated students" of the University under the following conditions subject to the approval of the Professorial Board:—

   (a) Any person who holds a diploma from the New South Wales Department of Technical Education, or any other Technical College which may from time to time be recognised by the University, may be admitted to the University as a "matriculated student" with such status as the Board may determine, provided that, in the opinion of the Board, the applicant's qualifications are sufficient for matriculation to the Faculty nominated.

   (b) The Board may admit as a "matriculated student" in any Faculty with such status as the Board may determine in the circumstances;

      (i) A graduate of any approved University.

      (ii) An applicant who presents a certificate from a University showing that he has a satisfactory record and is qualified for entrance to that University, provided that in the opinion of the Board there is an acceptable correspondence between the qualifying conditions relied upon by the applicant and conditions laid down for matriculation to the nominated Faculty of the University of New South Wales.

   (c) (i) Any person who has completed the first year of the course at the Royal Military College of Australia and submits a certificate from the Commandant to that effect may be admitted as a "matriculated student" of the University.

      (ii) Any person who has completed a full course of at least three years' prescribed study at the Royal Military College of Australia and produces a certificate from the Commandant to that effect may be admitted as a "matriculated student" of the University with such status as the Board may determine.

   (d) Any person who had completed satisfactorily the passing out examination of the Royal Australian Naval College and submits a certificate from the Commanding Officer may be admitted as a "matriculated student" of the University.

(e) (i) Any person who has completed the first year of the course at the Royal Australian Air Force College and submits a certificate from the Commandant to that effect, may be admitted as a "matriculated student" of the University.

(ii) Any person who has completed two years of the course at the Royal Australian Air Force College and submits a certificate from the Commandant to that effect, may be admitted as a "matriculated student" of the University with such status as the Board may determine.

(f) An applicant who presents a certificate from another University showing that he is qualified for entrance to that University and setting out the grounds of such qualification, provided that in the opinion of the Professorial Board, there is an acceptable correspondence between the qualifying conditions relied upon by the applicant and the conditions laid down for matriculation to the nominated Faculty of the University of New South Wales.

2. (a) The Professorial Board may in special cases, including cases concerning persons of other than Australian education, declare any person qualified to enter a Faculty as a "provisionally matriculated student" although he has not complied with the requirements set out above, and in so doing may prescribe the completion of certain requirements before confirming the person's standing as a "matriculated student". Students who satisfactorily complete these requirements will be permitted to count the courses so passed as qualifying for degree purposes.*

(b) Persons over the age of twenty-five years may be admitted to provisional matriculation status provided that:—

(i) they have satisfactorily completed an approved course of systematic study extending over at least three years after passing the School Certificate Examination or

(ii) they satisfy the Professorial Board that they have reached a standard of education sufficient to enable them profitably to pursue the first year of the proposed course.

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* The Professorial Board has determined that normally confirmation of standing as a "matriculated student" will require the successful completion of not less than half the normal programme in the first year of enrolment.

(c) Any applicant for provisional status may be required to take such examination as the Professorial Board may prescribe before such status is granted.

3. The Professorial Board may at its discretion permit a person, who does not satisfy the requirements for admission, to attend lectures in a subject or subjects at the University, on payment of the prescribed fees provided that such person shall not necessarily have the privileges of "matriculated students" and shall not be eligible to proceed to a degree.

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 4.30 p.m. (closed 1.00 p.m. to 2.00 p.m) from 5th to 19th January, 1970. 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 require-

ments, 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

It is the policy of the University to endeavour to admit all properly qualified applicants who have lodged applications by the appropriate closing date. In 1970, however, facilities available to the University will make it necessary to impose quotas in the faculties of Architecture, Arts, Commerce and Medicine, and in the School of Social Work.

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

First Enrolments

Students with Overseas Entry Qualifications

Overseas students and Australian Residents relying for admission on overseas qualifications must lodge an application for enrolment prior to 31st October of the year preceding that in which admission is sought.

Local and Interstate Residents

(a) Australian Residents including students transferring from one course to another or from another University who have undertaken qualifying examinations in 1969 must lodge an application for enrolment by 19th January, 1970.

(b) Australian Residents already qualified for admission and students wishing to resume University studies must apply for enrolment by 31st October, 1969.

First Year Repeat Students

First year students who fail all subjects at the annual examinations and who are not granted any deferred examinations must apply for re-enrolment to the Admissions Office by 19th January, 1970.

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

Students in the above categories whose applications for enrolment are accepted will be required to complete their enrolment at a specified appointment time before the start of first term. 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.

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 First Term in accordance with the special arrangements made by the individual Schools.

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

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 term (13th March, 1970) 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 in the space at the top right-hand corner 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 by mail to their term address as soon as possible after fee payment. In the meantime, the fees receipt form should be carried during attendance at the University and shown on request. If the Union card is not received within three weeks of fee payment, the University Union should be notified.

FEES *

COURSE FEES

Where course fees are assessed on the basis of term 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 term basis. A full-time course fee will be charged for any term where more than 15 hours' per week instruction, etc., is involved.

(i) Full-time Course Fee (more than 15 hours' attendance per week)—$132 per term.
In courses in which the Third Term is limited to five weeks of formal studies the fee for this term is $66.

(ii) Part-time Course Fee—over 6 hours and up to 15 hours' attendance per week—$66 per term.

(iii) Part-time Course Fee—6 hours' or less attendance per week—$33 per term.

(iv) Course Continuation Fee—A fee of $28 per annum (no term 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 — $8 — payable at the beginning of first year.

Library Fee — annual fee — $14.

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*	— $20	— annual subscription.
Sports Association*	— $2	— annual subscription.
Students' Union*	— $5	— annual subscription.
Miscellaneous	— $10	— annual fee.

Graduation or Diploma Fee — $8 — 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 (botany, zoology, entomology).†

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 — $6 for each subject.

Examinations conducted under special circumstances — $8 for each subject.

Review of examination result — $8 for each subject.

LATE FEES

First Enrolments

Fees paid at the late enrolment session and before the commencement of term	$7
Fees paid during the 1st and 2nd weeks of term	$14
Fees paid after the commencement of the 3rd week of term with the express approval of the Registrar and Head of the School concerned	$28

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

† Students in the original Applied Biology degree course pay an excursion fee of $1 per subject for Botany, Zoology and Entomology.

Re-Enrolments

First Term

Failure to attend enrolment centre during enrolment week	$7
Fees paid after the commencement of the 3rd week of term to 31st March	$14
Fees paid after 31st March where accepted with the express approval of the Registrar	$28

Second and Third Terms

Fees paid in 3rd and 4th weeks of term	$14
Fees paid thereafter	$28
Late lodgement of corrected enrolment details forms (late applications will be accepted for three weeks only after the prescribed dates)	$6

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 First Term 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 term has elapsed, one half of the term's fee may be refunded. Where a student terminates a course of study after half a term has elapsed, no refund may be made in respect of that term's fees.

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

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 first term 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 — $3.33 in respect of each half term.

University of New South Wales Students' Union — where notice is given prior to the end of the fifth week of first term $2, 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 $5, 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 $7.

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 First Term. (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 term (i.e., 13th March, 1970) 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 Term

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

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 First Term and for one month from the date on which a late fee becomes payable in Second and Third Terms.

Where an extension of time is granted to a first year student in First Term, 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 term, 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 Third Term (25th September, 1970).

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

Cashier's Hours

The cashier's office is open for the payment of fees from 9.30 a.m. to 1.00 p.m., and from 2.00 p.m. to 4.30 p.m. Monday to Friday. It is open for additional periods during the first three weeks of each term.

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.

COURSE TRANSFERS

Students wishing to transfer from one course to another (including transfer from full-time to part-time study or vice versa) must make application to the Admissions Office. Applications to transfer to courses where quotas apply will not be accepted after 19th January. The Admissions Office will give each applicant an acknowledgement of his application to transfer.

Having made application to the Admissions Office students

transferring are required to attend the School Enrolment Centre at the time set down for the year/stage of the new course in which they expect to enrol. They must present the letter granting approval of the transfer to the enrolling officer.

Students who have not received a letter granting approval to the transfer before the date on which they are required to enrol must present their acknowledgement to the enrolling officer who will decide whether to permit them to attend classes provisionally in the new course. Students who are permitted to attend classes provisionally should not pay fees until they have received their letter granting formal approval to transfer.

CHANGES IN COURSE PROGRAMMES AND WITHDRAWAL FROM SUBJECTS

Students seeking approval to substitute one subject for another or add one or more subjects to their programme must make application to the Head of the School responsible for the course on a form available from School offices. In the case of students wishing to withdraw from subjects or 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 emphasised that withdrawal from subjects after Term I or failure to sit for the examinations in any subjects for which the student has enrolled is regarded as failure to pass the subjects unless written approval to withdraw 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 19th January, 1970. 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

The annual examinations take place in November-December for students in thirty-week courses, and in September for students in twenty-one and twenty-four week courses. Timetables show-

ing 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 June. 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 17th July. 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 $6 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 $6 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 14th 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 will be applied retrospectively from January, 1971.

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

   Notwithstanding the provisions of Clause 1(i)

   (ii) A student enrolled in the first year or first stage of any course, other than the medical course, who has failed in more than half the programme in which he is enrolled for that year or stage shall be required to show cause why he should be allowed to continue in the course.

(iii) A student enrolled in the first year of the Medical course who has failed in more than one subject of that year shall be required to show cause why he should be allowed to continue in the Medical course.

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 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 per-

mitted 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 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 Professorial Board 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 Board 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 Professorial Board 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. A student may appeal to an Appeals Committee, constituted by Council for this purpose, against his exclusion by the Professorial Board from any subject or course.

RE-ADMISSION AFTER EXCLUSION

Applications for re-admission must be made on the standard form and lodged with the Regestrar not later than 30th June of the year prior to that for which re-admission is sought. An application should include evidence of appropriate study in the subjects (or equivalents) on account of which the applicant was excluded. In addition, evidence that the circumstances which were deemed

to operate against satisfactory performance at the time of exclusion are no longer operative or are reduced in intensity should be furnished. An applicant may be required to take the annual examinations in the relevant subjects as qualifying examinations in which case re-admission does not imply exemption from the subject.

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

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

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 Chief Steward 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 postgraduate and senior undergraduate students (the latter who have completed three years of a full-time course or four years of a part-time course and up to 400 of those who have completed three years of a part-time course) and higher degree students may apply for parking permits. Applications should be made to the Property Section (Bursar's Division). 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 term. 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.

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 new Union Building, which is adjacent to the circular building near Anzac Parade.

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, an affiliated Roman Catholic residential college, is at present under construction. It is planned to open the eight-storey building, which will accommodate 200 students, in 1970. Enquiries should be addressed to the Master, Warrane College, Box 123, Kensington, N.S.W., 2033.

Fees are $20 per week for The Kensington Colleges, New College and Warrane, and $21 for International House.

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 re-

cognized 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.

Omnibus: *Concessions are available to*:

(a) students under 18 years of age irrespective of whether they are employed or receive income or remuneration,

(b) students between 18 and 30 years of age who are not in employment or in receipt of any income or remuneration.

NOTE: Income or remuneration includes allowances paid to Colombo Plan students, Public Service trainees, etc., but does not include allowances paid to holders of Commonwealth Scholarships, Teachers' College Scholarships or Scholarships granted by the State Bursary Endowment Board.

Train:

(a) Periodical tickets are available during term time to full-time students not in employment or in receipt of any remuneration.

(b) Vacation travel concessions are available to students qualifying under (a) above.

(c) As an alternative, a $6.00 concession certificate—unrestricted hours—may be purchased by eligible students under the same terms and conditions as above. This certificate will allow a student to travel at any time between home and university, Monday to Friday inclusive, and on Saturdays up to 6 p.m. It is available through the academic year until the end of third term, including the May and August vacations. Student concession rate of fare must be paid on each journey travelled, on production of the $6.00 certificate.

Ferry: Concession fares are available for travel on ferries controlled by the Port Jackson & Manly Steamship Co. Ltd. and Sydney Harbour Ferries Pty. Ltd. All applicants must be registered full-time students under the age of 21 years.

Aircraft: Concession fares for travel overseas, interstate and intrastate are available under the conditions ruling for the various operating companies.

(i) Airlines of N.S.W. T.A.A. Ansett A.N.A.	Full-time students not in receipt of remuneration, under twenty-six years of age, are eligible for three quarters of the adult fare. An identification card is required before the student can travel and this is obtainable at the Students' Union Office, for 10c.
(ii) East West Airlines	Full-time students not in receipt of remuneration, irrespective of age, can travel for two-thirds of the normal adult fare. No identification card is required.

Location

The Student Amenities Unit at Kensington is located opposite the Basser College end of the new Electrical Engineering building ('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.*

A student health and first aid centre is situated within the University, staffed by a qualified medical practitioner and a nursing sister.

The centre is located in hut "E" on the northern side of the campus, adjacent to Basser College. The service is available to enrolled students, free of charge, between 9 a.m. and 5 p.m. Monday to Friday, and during term from 6 p.m. to 8 p.m. Tuesday and Thursday.

The medical service is in most instances therapeutic, but it is not intended to replace private or community health services. Thus, where chronic or continuing conditions are revealed or suspected, the student will be advised and may be referred to his own doctor or to an appropriate hospital for specialist opinion and treatment. The health service is not responsible for fees incurred in these instances.

The service is confidential and students are encouraged to attend the centre for advice on all matters pertaining to health.

Appointments may be arranged by calling at the centre or by telephoning 663-0351, extension 2679.

STUDENT COUNSELLING AND RESEARCH UNIT

Prospective students seeking advice or guidance regarding the selection and planning of courses (particularly in relation to a career), or advice regarding their suitability for a particular course, are invited to consult the University Student Counselling and Research Unit. Appointments may be made by telephone (663-0351, extensions 2600 to 2605).

In addition to its counselling service, the Unit provides a variety of study skills programmes throughout the year, on a group or individual basis. Programmes offered in the past have included Reading Improvement, Study Methods, Written Expression, Note Taking, Studying Mathematics, Improving Listening, Preparing for Statistics.

STUDENT LOAN FUND

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 $200 from the Student Loan Fund established from contributions made by the Students' Union and the University. Thirdly, a Students' Union donation of $1,000 has made possible urgent cash loans not exceeding $50 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 results of the Higher School Certificate Examination. 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 are offered by the Commonwealth Service, the New South Wales Public Service Board, the Department of Railways and a number of private industrial organizations. Cadets generally have their University fees paid by the employer, and are employed at cadet rates of pay during their course.

Commonwealth University Scholarships

There are three types, and all may be applied to full-time, part-time and external courses, and for pass and honours courses:—

Open Entrance Scholarships, which are granted on the results of the Higher School Certificate examination to students who are under thirty years of age on 1st January of the year in which they are first awarded the scholarship, 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 at least one year of a full-time or two years of a part-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 $620 per annum or $1,000 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).

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. Applications must be lodged with the Registrar within seven days of the publication of Higher School Certificate Examination results.

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, C/- Department of Education, Bridge Street, Sydney.

The Fell Scholarship (University Residential Colleges)

The Fell Scholarship is available to any undergraduate who is or will be in residence at one of the Colleges under the administration of Kensington College Ltd. during 1970. The annual value of the Scholarship is $100. It may be held concurrently with Commonwealth and other scholarships.

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

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

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 notification of Higher School Certificate results.

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 two 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.

Mining and Metallurgical Bursaries Fund

Mining and Metallurgical Bursaries at the University of New South Wales, valued at $100 per annum, will be awarded by the Trustees of the Mining and Metallurgical Bursaries Fund, Melbourne. Candidates must be British subjects and have completed

the first year of the following courses at the University of New South Wales, or who have been awarded equivalent status in consideration of work done elsewhere: Degree of Bachelor of Engineering in Mining Engineering, Bachelor of Metallurgical Engineering, Bachelor of Engineering in Applied Geology, Bachelor of Mineral Engineering, Bachelor of Science in Metallurgy, Geology or Applied Geology, or Bachelor of Applied Science in Metallurgy or Geology.

UNDERGRADUATE COURSES

The Faculty of Engineering consists of the Schools of Civil Engineering, including the Department of Surveying, of Electrical Engineering, and Mechanical and Industrial Engineering, and the Schools of Highway Engineering, Nuclear Engineering, and Traffic Engineering, the three last named Schools offering graduate courses only. The Schools of Civil, Electrical, and Mechanical and Industrial Engineering offer full-time courses leading to the degrees of Bachelor of Engineering or Bachelor of Surveying, and part-time courses leading to the degrees of Bachelor of Science (Technology) or Bachelor of Surveying.

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.

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 pre-requisite 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 Civil Engineering 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 Associate 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 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). Courses for this 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 B.Sc. (Tech.) is recognized by the Institution of Engineers, Australia, as giving complete exemption from the examinations required for admission to the grade of Associate 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 B.Sc. (Tech.) degree course and wishing to qualify for the corresponding B.E. degree may, on the recommendation of the Head of the School, transfer to the corresponding full-time B.E. course provided he does not take out the B.Sc. (Tech.) 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 B.Sc. (Tech.) degree course.

Holders of the B.Sc (Tech.) 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 B.Sc. (Tech.) 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 B.Sc. (Tech.).

The programme towards the B.Sc (Tech.) 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 Civil Engineering offers a part-time course in Surveying 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	B.E.	B.Sc. (Tech.)
Ceramic Engineering	B.Sc.	,,
Fuel Engineering	B.E.	,,
Metallurgy*	B.Sc.	,,
Mining Engineering†	B.E.	,,
Textile Engineering	B.Sc.	—

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 Engineer-

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

† Part-time courses leading to the award of the B.Sc.(Tech.) degree are available only at Wollongong and Broken Hill.

ing students may enter the Mining Engineering course after the 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 B.Sc. (Tech.) demand three years approved concurrent industrial training.

Holders of the degrees of B.E. (pass or honours) and B.Sc. (Tech.) in Chemical Engineering, Fuel Engineering, Fuel 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.

Fuel Engineering

The Department of Fuel Technology, the first of its kind in Australia, was established to meet the growing need of industrial and research establishments for personnel with specialized training in the science and technology of fuels and their utilization.

A degree in Fuel Engineering qualifies for exemption from the examinations for admission to corporate membership of the Institute of Fuel.

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 a part-time course in Mining Engineering at both Wollongong and Broken Hill and a part-time course in Mineral Processing at Broken Hill, both courses 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 and lucrative positions for textile engineers in industry and research.

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 Department of Surveying in the School of Civil Engineering offers courses leading to the degree of Master of Surveying Science.

Courses for Graduate Diplomas

Highway Engineering, 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 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 (Technology) (B.Sc. (Tech.)). In the full-time B.E. course, a period of one hundred working days of industrial training must be completed between Years III and IV and it is strongly recommended that further industrial experience be gained in the long vacations between Years I and II and Years II and III. Part-time students in the B.Sc. (Tech.) course are required to gain a minimum of three years of suitable engineering experience concurrently with the University course. Students enrolled in the fourth year of the full-time B.E. course may be required to present a seminar and attend a prescribed number of seminar sessions as part of their final year programme.

The School of Civil Engineering through its Department of Surveying also offers a full-time and a part-time course each leading to the degree of Bachelor of Surveying at Pass or Honours level. Details of these courses are set out in the following pages under the heading "Department of Surveying".

The courses in Civil Engineering are set out below. However, as a result of revisions in recent years, some students in Year IV of the B.E. course in 1970 may take a modified General Studies programme. Also, students entering Stage 6 of the B.Sc.(Tech.) course will normally undertake the programme shown in the 1968 Calendar and not that shown below. Such students, who are governed by the old course regulations, must complete the prescribed requirements by the end of the 1971 academic year. Because of these transitional arrangements these students should first consult the School before completing their formal enrolment.

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 (Technology) may be awarded with Merit in recognition of superior performance throughout the course.

CIVIL ENGINEERING—FULL-TIME COURSE

Bachelor of Engineering

FIRST YEAR

(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
1.051	Physics IE	3 — 3
2.021	Chemistry IE*	3 — 3
5.011	Engineering IA	4½ — 3½
10.001	Mathematics I *or*	4 — 2
10.011	Higher Mathematics I	
		14½ — 11½

* 15 weeks only.

SECOND YEAR

(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
6.801	Electrical Engineering	1 — 2
8.151	Mechanics of Solids	2 — 1
8.251	Properties of Materials	1½ — 1½
8.261	Geotechnics†	2 — 1
8.441	Engineering Surveying*	1½ — 1½
8.511	Hydraulics	1½ — 1½
8.621	Engineering Construction	1½ — ½
10.022	Mathematics	2 — 2
		13 —11

*A one-week Survey Camp 29.491 must be attended in Third Term.

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

THIRD YEAR

(21 weeks day course)

		Hours per week for 2 terms lec. lab./tut.
8.152S	Structures	4½ — 1½
8.161S	Engineering Mathematics	2 — 2
8.252S	Civil Engineering Materials	2 — ½
8.301S	Systems Engineering	1½ — 1½
8.531S	Water Engineering	4 — 2
	General Studies Electives*	2½ — 1½
		16½ — 9

*Students in Third Year will study two ordinary electives.

FOURTH YEAR

(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
8.153	Structures	3 — 2
8.253	Civil Engineering Materials	3 — 2
8.532	Water Engineering	1½ — 1½
8.631	Civil Engineering	3 — ½
8.012	Engineering Electives	2 — 2
	General Studies Electives*	2 — 1
		14½ — 9

*Students in Fourth Year will study two electives, one of which must be advanced.

CIVIL ENGINEERING—PART-TIME COURSE

Bachelor of Science (Technology)

FIRST STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
1.051	Physics IE	3 — 3
10.001	Mathematics I *or*	4 — 2
10.011	Higher Mathematics I	
		7 — 5

SECOND STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
2.021	Chemistry IE*	3 — 3
5.011	Engineering IA	4½ — 3½
	General Studies Elective	1 — ½
		8½ — 7

THIRD STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
8.151	Mechanics of Solids	2 — 1
8.251	Properties of Materials	1½ — 1½
8.441	Engineering Surveying*	1½ — 0
10.022	Mathematics	2 — 2
		7 — 4½

*Plus an additional 45 hours of Saturday field work and attendance at a Survey Camp 29.491 in Third Term.

FOURTH STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
6.801	Electrical Engineering	1 — 2
8.261	Geotechnics*	2 — 1
8.511	Hydraulics	1½ — 1½
8.621	Engineering Construction	1½ — ½
	General Studies Elective	1 — ½
		7 — 5½

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

FIFTH STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
8.152	Structures	3 — 1
8.161	Engineering Mathematics	1½ — 1½
8.301	Systems Engineering	1 — 1
8.531	Water Engineering	2½ — 1½
		7½ — 4½

SIXTH STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
8.154	Structures	2 — 2
8.252	Civil Engineering Materials	1½ — ½
8.254	Civil Engineering Materials	1 — 2
8.632	Civil Engineering	1½ — 0
	General Studies Elective	1 — ½
		7 — 5

DEPARTMENT OF SURVEYING

The Department of Surveying offers a four-year full-time course and a seven-year part-time course, both 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 II and III 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 industrial training for a period of not less than forty days after the completion of year II and for a further period of not less than eighty days after the completion of year III. 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. The award and grade of Honours depend upon the degree 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

FIRST YEAR

(30 weeks day course)

		Hours per week for 3 terms lec. tut. etc.
1.041	Physics IC	3 — 3
5.001	Engineering I	3 — 3
10.001	Mathematics I *or*	4 — 2
10.011	Higher Mathematics I	
29.801	Surveying I	2 — 4
		12 —12

SECOND YEAR

(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
2.212	Physics IIT	1½— 1½
8.711	Engineering for Surveyors	2½— ½
10.022	Mathematics	2 — 2
10.341	Statistics‡...	2 — 0

‡First and Second Terms only.

25.101	Geology for Engineers†	1 — 1½
29.802	Surveying II	2 — 2½
29.841	Surveying Computations	1 — ½
29.892	Survey Camp* ...	- — -
	General Studies Elective	1 — ½
		13 — 9

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

THIRD YEAR
(21 weeks day course)

		Hours per week for 2 terms lec. tut., etc.
8.712S	Engineering for Surveyors	2 — 0
29.803S	Surveying III	2 — 1½
29.821S	Geodesy I	2½ — 2
29.831S	Astronomy I	2 — 1
29.842S	Surveying Computations	1½ — 1
29.851S	Photogrammetry I	2 — 1½
29.881S	Land Law, Utilization and Valuation†	3½ — 0
29.893	Survey Camp*	- — -
	Two General Studies Electives	2½ — 1½
		18 — 8½

*Lectures cease at end of Second Term. Students must attend a two-week survey camp in the two weeks following completion of the examinations.
†Two one day excursions are an essential part of the course.

FOURTH YEAR
(30 weeks day course)

		Hours per week for 3 terms lec. tut., etc.
6.811	Electronic Instrumentation for Surveyors	1 — 0
11.411	Town Planning*	1 — 1
25.303	Geophysics for Surveyors†	2 — 0
29.081	Thesis	3 — 0
29.822	Geodesy II	2 — 1½
29.832	Astronomy II	1½ — 1
29.852	Photogrammetry II	1 — 3½
29.882	Cadastral Surveying	1½ — ½
	General Studies Elective	1 — ½
		14 — 8

*Lectures cease at end of Second Term.
†During Third Term there will be only one hour of lectures per week. A one-day Geophysical excursion is an essential part of the subject.

SURVEYING—PART-TIME COURSE

Bachelor of Surveying

FIRST STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
1.041	Physics IC	3 — 3
10.001 10.011	Mathematics I *or* Higher Mathematics I }	4 — 2
		7 — 5

SECOND STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.001	Engineering I	3 — 3
29.80	Surveying I	2 — 4
		5 — 7

THIRD STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
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	1 — ½
	General Studies Elective	1 — ½
		7 — 4

*Students who have not taken Optics should consult the Head of School.

FOURTH STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
10.022/2	Mathematics II, Part II	1 — 1
10.341	Statistics**	1½ — 0
25.101	Geology for Engineers†	1 — 1½
29.802	Surveying II§*	2 — 2½
29.892	Survey Camp*	- — -
	General Studies Elective	1 — ½
		6½ — 5½

**First and Second Terms only.

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

§Students who have not taken Optics should consult the Head of School.

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

FIFTH STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
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.

SIXTH STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
6.811	Electronic Instrumentation for Surveyors	1 — 0
25.303	Geophysics for Surveyors†	2 — 0
29.821	Geodesy I	1½ — 1½
29.851	Photogrammetry I	1½ — 1
29.882	Cedastral Surveying	1½ — ½
29.893	Survey Camp*	- — -
	General Studies Advanced Elective	2 — 0
		9½ — 3

†A one-day Geophysical field tutorial is an essential part of this subject.

*Students must attend a one-week survey camp during Third Term.

SEVENTH STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
11.411	Town Planning*	1 — 1
29.822	Geodesy II	2 — 1½
29.832	Astronomy II	1½— 1
29.852	Photogrammetry II	1 — 3½
		5½— 7

*21 weeks only. Lectures cease at end of Second Term.

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 thus well-suited to offer undergraduate and postgraduate training in all branches of the profession of electrical engineering. The School's building and facilities are being expanded and its 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 (Technology). 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 (Technology) 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 the problems in electrical engineering.

In the early years of the electrical engineering courses, students concentrate on acquiring knowledge of the basic sciences, i.e., mathematics, physics, and chemistry, but with some introduction to engineering.

In the final year students will elect, with the approval of the Head of the School, to study in the specialized fields of electrical engineer-

ing. At the same time they will 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 will be 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 identical formal programme will be 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 (Technology) 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 thirty weeks. All students are strongly recommended to complete two periods of industrial training, one of forty-five working days between Years II and III, and the other of forty-five working days between Years III and IV. They are also advised to obtain practical experience during the long vacation between Years I and II.

FIRST YEAR
(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
1.001 / 1.011	Physics I *or* Higher Physics I	3 — 3
2.001 / 2.011	Chemistry I *or* Higher Chemistry I	3 — 3
5.001	Engineering I	4 — 2
10.001 / 10.011	Mathematics I *or* Higher Mathematics I	4 — 2
		14 —10

SECOND YEAR*
(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
1.112	Physics II	4 — 4
6.021	Electrical Engineering II	3 — 3
8.111	Civil Engineering	2 — 1½
10.911	Mathematics II	4 — 2
	One General Studies subject	1 — ½
		14 —11

* This year also meets the requirements of the Second Year of the Science course for the degree of Bachelor of Science.

THIRD YEAR
(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
5.661	Mechanical Engineering III	2 — 1
6.031	Electrical Engineering III	9 — 7
10.033	Mathematics	2 — 0
10.361	Statistics	1 — ½
	Two General Studies subjects	2 — 1
		16 —9½

FOURTH YEAR
(30 weeks day course)

		Hours per week for 2 terms lec. lab./tut.
	Electrical Engineering IV*	12 —10
6.911	Thesis† *or*	0 — 2
6.931	Group Thesis	
	One General Studies Subject	3 — 0

† Full-time in Third Term.

* Each student selects 12 lecture hours of courses from a list of electives: each programme must be approved by the Head of School and it is intended that approximately half of each programme will be common to all.

The electives will usually be each of two lecture hours per week for two terms; shorter subjects will be grouped for election purposes. A number of general topics will be offered and each Department will offer some specialized electives. It is not planned that all electives will be available every year nor will the compulsory subjects always remain the same. Students will be advised each year which electives are available and which subjects are compulsory.

For continuation, see footnote on next page.

Third Term of Fourth Year

In the fourth year the formal lecture work extends over twenty-one weeks (the first two terms). This is followed by a study vacation of three weeks and examinations are held during the first three weeks of the third term. The balance of this term is mainly devoted to directed laboratory and research work on an approved subject, with special reading and study associated with the preparation of a thesis; seminar work is also carried out. The thesis must be submitted by the first Monday in December.

General Studies

The General Studies requirement in this course is four 45-hour subjects of which at least one must be an advanced elective.

Substitution of Subjects

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

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 B.E. in Electrical Engineering.

The list of subjects offered is:

		lec. lab./tut.
6.041S	Fields and Measurements	2 — 2
6.042S	Circuits, Signals and Information Theory	2 — 2
6.202S	Power Systems	2 — 2
6.212S	Machines	2 — 2
6.222S	Computer Applications and Software	2 — 2
6.303S	Communication Electronics	2 — 2
6.313S	Antennas Propagation and Guided Waves ...	2 — 2
6.322S	Electronics	2 — 2
6.333S	Communication Systems	2 — 2
6.383S	Bioengineering	2 — 2
6.412S	Automatic Control	2 — 2
6.422S	Computer Control	2 — 2
6.512S	Advanced Semi-conductor Device Theory ...	2 — 2
6.522S	Transistor and Integrated Circuit Design ...	2 — 2
6.612S	Computer Systems Engineering	2 — 2

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

(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 programme includes 12 lecture hours in Electrical Engineering IV much of which will be provided in two-hour strands. It is proposed that students may substitute for ONE of these strands, 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 approvals of the Deans of the Faculties of Engineering and Science) and do two Group III Science subjects (see the Science course and regulations) and two General Studies Electives. 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 pro-

gramme 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.

ELECTRICAL ENGINEERING—PART-TIME COURSE

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

FIRST STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
2.001	Chemistry I *or*	3 — 3
2.011	Higher Chemistry I	
10.001	Mathematics I *or*	4 — 2
10.011	Higher Mathematics I	
		7 — 5

SECOND STAGE

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
1.001	Physics I *or*	3 — 3
1.011	Higher Physics I	
5.001	Engineering I	4 — 2
		7 — 5

THIRD STAGE

(30 weeks part-time course)

		Hours per year lec. lab./tut.
1.112	Physics II (Unit B: Atomic Physics)	40 — 40
6.021	Electrical Engineering II	90 — 90
10.911	Mathematics II (Unit B of 10.111 and Unit A of 10.211)	80 — 40
		220 —160

FOURTH STAGE
(30 weeks part-time course)

		Hours per year lec. lab./tut.
1.112	Physics II (Unit A: Electromagnetism, and Unit C: Mechanics, Thermodynamics, Kinetic Theory of Gases)	80 — 80
6.031	Electrical Engineering III (Unit A: Systems and Circuit Theory)	60 — 60
10.911	Mathematics II (Unit A of 10.111)	45 — 15
	One General Studies subject	30 — 15
		215 —170

FIFTH STAGE*†
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
Communications Option		
6.031	Electrical Engineering III	
	Unit C: Electronic Circuits and Signal Processing ...	2 — 2
	Unit E: Electron Physics and Devices	2 — 0
8.111	Civil Engineering	2 — 1½
	Two General Studies subjects	2 — 1
		8 — 4½
Power and Control Option		
6.031	Electrical Engineering III	
	Unit B: Machines and Transformers	2 — 2
	Unit D: Computing	1 — 1
8.111	Civil Engineering	2 — 1½
	Two General Studies subjects	2 — 1
		7 — 5½

* Revised course. Will be offered in 1971.
† In Fifth Stage students must take either the Communications *or* the Power and Control Option. Whichever option is chosen must be continued in Sixth Stage.

SIXTH STAGE*
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
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

* Revised course. Will be offered in 1972.

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

† Power and Control students will substitute 5.661 Mechanical Engineering for 6.031 Electrical Engineering III (Unit E: Electron Physics and Devices).

The present Fifth and Sixth Stages will be discontinued progressively.

FIFTH STAGE*

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.301	Engineering Mechanics	1½ — ½
6.251	Electric Power Engineering	1½ — 2
6.357	Electronics	1½ — 2
8.112	Materials and Structures	1 — 2
	General Studies Elective	1 — ½
		6½ — 7½

*Will be offered only in 1970.

SIXTH STAGE*

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.701	Thermodynamics	1 — 1
6.052	Electrical Engineering	1 — 0
	General Studies Elective	1 — ½
Plus one of the following options :—		
Option I—		
	Power and Control—	
6.262	Electrical Machines	2 — 2
6.454	Power Systems and Control	2 — 2
Option II—		
	Communications—	
6.352	Communications	1½ — 2½
6.362	Communications	1½ — 2½
		7/6 — 5½/6½

* Will be offered only in 1970 and 1971.

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

The subjects of the revised B.Sc. (Tech.) course will each be 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.

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 of study. 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. General studies form a regular part of all courses.

Industrial experience is an integral part of the full-time courses. Industrial Engineering students must complete forty working days of approved industrial training between Years 2 and 3 and one-hundred working days between Years 3 and 4. Mechanical and Aeronautical Engineering and Naval Architecture students must complete one-hundred working days of approved industrial training between Years 3 and 4. All students irrespective of their

specialization are strongly recommended to gain as much industrial training as possible between Years 1 and 2 and between Years 2 and 3. Full-time students in Naval Architecture and Aeronautical Engineering are required to attend certain part-time classes during the third term of the 3rd Year and will therefore be required to obtain their industrial experience within the metropolitan area at least during third term.

Each student is required to prepare a short paper and deliver it in the Technical Communications period and each full-time student is also required to present a thesis at the end of his final year.

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 (Technology) 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 (Technology) courses mentioned above may transfer to the second year of any of the full-time B.E. courses offered by the School. The Bachelor of Science (Technology) courses have been revised and it is highly probable that a part-time student will be able to transfer at the end of stage 4 of the revised course to the third year of the corresponding B.E. course. The B.Sc.(Tech.) degree may be awarded 'With Merit' to students whose performance in the course is superior.

The award of the degree B.E. or B.Sc. (Tech.) in Mechanical Engineering is recognized by the Institution of Mechanical Engineers, London, as giving exemption from Parts I and II of the examinations required for admission to the grade of Member.

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.(Tech.) in any of the undergraduate courses offered by the School.

MECHANICAL ENGINEERING—FULL-TIME COURSE

Bachelor of Engineering

FIRST YEAR
(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
1.051	Physics IE	3 — 3
2.021	Chemistry IE*	3 — 3
5.011	Engineering IA	4½— 3½
10.001 10.011	Mathematics I *or* Higher Mathematics I }	4 — 2
		14½—11½

* 15 weeks only.

SECOND YEAR
(30 weeks day course)

		Hours per week		
		Term I lec. lab./tut.	Term II lec. lab./tut.	Term III lec. lab./tut.
5.061	Technical Orientation ...	1 — 0	1 — 0	1 — 0
5.111	Mechanical Engineering Design	4 — 0	1 — 3	1 — 3
5.311	Mechanics*...	0 — 0	1 — 1	1 — 1
5.611	Fluid Mechanics/ Thermodynamics	2 — 2½	2 — 2½	2 — 2½
6.801	Electrical Engineering ...	1 — 2	1 — 2	1 — 2
8.151	Mechanics of Solids ...	2 — 1	2 — 1	2 — 1
8.259	Properties of Materials ...	2 — 1½	2 — 1½	2 — 1½
10.022	Mathematics	2 — 2	2 — 2	2 — 2
	General Studies Elective ...	1 — ½	1 — ½	1 — ½
		15 —9½	13 —13½	13 —13½

* Students who have completed 5.001 Engineering may substitute 5.301 Engineering Mechanics for this subject.

THIRD YEAR

(21 weeks day course)

		Hours per week for 2 terms lec. lab./tut.
5.071	Engineering Analysis	3 — 1
5.112	Mechanical Engineering Design	2 — 2
5.331	Dynamics of Machines	2 — 1
5.412	Mechanics of Solids	2 — 1
5.612	Fluid Mechanics/Thermodynamics	3 — 1
6.802	Electrical Engineering	1 — 1
18.011 18.021	Industrial Engineering IA or Industrial Engineering IB	2 — 1
	General Studies Elective*	3 — 1
		18 — 9

* Students will study one Elective in Term I and the corresponding Advanced Elective in Term II. They will study a second Elective in 4th Year.

FOURTH YEAR

(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
5.051	Thesis	0 — 6
5.062	Communications	1 — 1
5.324	Automatic Control Engineering	2 — 1
	General Studies Elective	1 — ½
Plus 12 hours from the following Technical Electives:		
4.913	Materials Science	2 — 1
5.113	Mechanical Engineering Design	1½ — 4½
5.332	Dynamics of Machines II	2 — 1
5.413	Mechanics of Solids II	2 — 1
5.613	Fluid Mechanics/Thermodynamics III	4 — 2
18.012	Industrial Engineering IIA	2 — 1
18.022	Industrial Engineering IIB	2 — 1
18.431	Design for Production	2 — 1
18.551	Operations Research	2 — 1

MECHANICAL ENGINEERING—PART-TIME COURSE
Bachelor of Science (Technology)

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

FIRST STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
1.051	Physics IE	3 — 3
10.001	Mathematics I *or*	
10.011	Higher Mathematics I	4 — 2
		7 — 5

SECOND STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
2.021	Chemistry IE*	3 — 3
5.011	Engineering IA	4½ — 3½
		7½ — 6½

* 15 weeks only.

THIRD STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.311	Mechanics	1 — ½
8.151	Mechanics of Solids	2 — 1
8.259	Properties of Materials	2 — 1½
10.022	Mathematics	2 — 2
		7 — 5

FOURTH STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.111	Mechanical Engineering Design	2 — 1
5.611	Fluid Mechanics/Thermodynamics	2 — 2½
6.801	Electrical Engineering	1 — 2
	General Studies Elective	1 — ½
		6 — 6

FIFTH STAGE

(30 weeks part-time course)

		Hours per year lec. lab./tut.
5.071	Engineering Analysis	45 — 30
5.112	Mechanical Engineering Design	45 —30
5.331	Dynamics of Machines	37½—22½
5.412	Mechanics of Solids	37½—22½
5.612	Fluid Mechanics/Thermodynamics	45 —30
	General Studies Elective	30 —15
		240 —150

SIXTH STAGE*

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.324	Automatic Control Engineering	2 — 1
	General Studies Elective	1 — ½

Plus 9 hours from Mechanical Engineering Electives:

4.913	Materials Science	2 — 1
5.113	Mechanical Engineering Design	1½— 4½
5.332	Dynamics of Machines	2 — 1
5.413	Mechanics of Solids	2 — 1
5.613	Fluid Mechanics/Thermodynamics	4 — 2

* Revised course. Will be offered in 1971.

The present Sixth Stage will continue to operate in 1970, and will then be discontinued.

SIXTH STAGE*

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.102	Mechanical Engineering Design	1 — 2
5.321	Automatic Control Engineering	1 — 0
5.502	Fluid Mechanics	1 — 1½
5.702	Thermodynamics	1 — 1½
6.802	Electrical Engineering	1 — 1
		5 — 6

* Will be offered only in 1970.

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.

THIRD YEAR
(21 weeks day course)

		Hours per week for 2 terms lec. lab./tut.
5.071	Engineering Analysis...	3 — 1
5.331	Dynamics of Machines	2 — 1
5.412	Mechanics of Solids	2 — 1
5.811	Aerodynamics I*	2 — 1
5.822	Analysis of Aerospace Structures I*	1½ — ¾
6.802	Electrical Engineering	1 — 1
18.011 / 18.021	Industrial Engineering IA *or* Industrial Engineering IB	2 — 1
	General Studies Elective†	3 — 1
		16½ — 7¾

* 30 week subjects. Students will be required to undertake industrial training locally so that they can attend these subjects for 30 weeks part-time.

† Students will study one elective in Term I and the corresponding advanced elective in TERM II. They will study a second elective in 4th Year.

FOURTH YEAR
(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
5.051	Thesis	0 — 6
5.062	Communications	1 — 1
5.801	Aircraft Design	2 — 2
5.812	Aerodynamics II	2 — 1
5.823	Analysis of Aerospace Structures II	1 — 1
5.831	Aircraft Propulsion	1½ — ½
	General Studies Elective	1 — ½
	Plus one technical elective from :—	
5.324 / 18.012 / 18.022 / 18.431 / 18.551	Automatic Control Engineering / Industrial Engineering IIA / Industrial Engineering IIB / Design for Production / Operations Research	2 — 1
		10½ — 13

AERONAUTICAL ENGINEERING—PART-TIME COURSE
Bachelor of Science (Technology)

This course is of six years' duration and leads to the degree of Bachelor of Science (Technology). For outlines of the first four stages of the revised course, see the Mechanical Engineering part-time course.

FIFTH STAGE
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.071	Engineering Analysis	1½ — 1
5.331	Dynamics of Machines	1¼ — ¾
5.412	Mechanics of Solids	1¼ — ¾
5.811	Aerodynamics I	2 — 1
5.822	Analysis of Aerospace Structures I	1¼ — ¾
	General Studies Elective	1 — ½
		8¼ — 4¾

SIXTH STAGE*
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.801	Aircraft Design	2 — 2
5.812	Aerodynamics II	2 — 1
5.823	Analysis of Aerospace Structures II	1 — 1
5.831	Aircraft Propulsion	1½ — ½
	General Studies Elective	1 — ½
		7½ — 5

* Revised course. Will be offered in 1971.

The present Sixth Stage will continue to operate in 1970, and will then be discontinued.

SIXTH STAGE*
(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.801	Aircraft Design	2 — 1
5.812	Aerodynamics II	2 — 1
5.823	Analysis of Aerospace Structures II	1½ — ½
5.831	Aircraft Propulsion	2 — 0
	General Studies Elective	1 — ½
		8½ — 3

* Will be offered only in 1970.

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.

THIRD YEAR
(21 weeks day course)

		Hours per week for 2 terms lec. lab./tut.
5.071	Engineering Analysis	3 — 1
5.331	Dynamics of Machines (*Mechanical Vibrations* only)	1 — 0
5.412	Mechanics of Solids	2 — 1
5.911	Naval Architecture*	2½ — 2½
5.921	Ship Structures*	1½ — ½
6.802	Electrical Engineering	1 — 1
18.021	Industrial Engineering IB	2 — 1
	General Studies Elective†	3 — 1
		16 — 8

* 30 week subjects. Students will be required to undertake industrial training locally so that they can attend these subjects for 30 weeks part-time.

† Students will study one Elective in Term I and the corresponding Advanced Elective in Term II. They will study a second elective in 4th Year.

FOURTH YEAR
(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
5.051	Thesis	0 — 6
5.062	Communications	1 — 1
5.922	Ship Structures	1 — 0
5.931	Principles of Ship Design	2 — 1
5.932	Ship Design Project	0 — 3
5.941	Ship Propulsion and Systems...	3 — 2
	General Studies Elective	1 — ½
	Plus one elective from:—	
4.913	Materials Science	
18.022	Industrial Engineering IIB	2 — 1
18.551	Operations Research	
		10— 14½

NAVAL ARCHITECTURE—PART-TIME COURSE

Bachelor of Science (Technology)

This course is of six years' duration and leads to the degree of Bachelor of Science (Technology). For outlines of the first four stages of the revised course, see the Mechanical Engineering part-time course.

The Royal Institution of Naval Architects grants exemption from all examinations for associate membership to holders of the B.Sc. (Tech.) degree in Naval Architecture.

FIFTH STAGE

(30 weeks part-time course)

		Hours per year lec.	lab./tut.
5.071	Engineering Analysis	45	—30
5.331	Dynamics of Machines (*Mechanical Vibrations* only)	20	— 0
5.412	Mechanics of Solids	37½	—22½
5.911	Naval Architecture	75	—75
5.921	Ship Structures	45	—15
	General Studies Elective	30	—15
		252½	—157½

SIXTH STAGE*

(30 weeks part-time course)

		Hours per week for 3 terms lec.	lab./tut.
5.922	Ship Structures	1	— 0
5.931	Principles of Ship Design	2	— 1
5.932	Ship Design Project	0	— 3
5.941	Ship Propulsion and Systems	3	— 2
	General Studies Elective	1	— ½
		7	— 6½

* Revised course. Will be offered in 1971.

The present Sixth Stage will continue to operate in 1970, and will then be discontinued.

SIXTH STAGE*

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
5.922	Ship Structures	1 — 0
5.931	Principles of Ship Design	2 — 1
5.932	Ship Design Project	0 — 3
6.801	Electrical Engineering	1 — 2
	General Studies Elective	1 — ½
		5 — 6½

* Will be offered only in 1970.

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 (Technology) respectively. These courses are designed for students with engineering ability whose interests lie in the planning, developing and control of manufacturing operations. Completion of either of these courses gives full exemption from membership examinations of the Institution of Engineers, Australia, and the Institution of Production Engineers. Completion of the full-time B.E. course is accepted by the Institution of Mechanical Engineers, London, as giving exemption from all examinations required for membership; completion of the part-time B.Sc. (Tech.) course is recognized as giving exemption from Parts I and II of the examinations required for membership.

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 oper-

ations; 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, one of forty working days between Years II and III and the other of one hundred working days between Years III and IV. They are also strongly advised to obtain further experience during the long vacation between Years I and II.

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 co-ordination 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.

THIRD YEAR

(21 weeks day course)

		Hours per week for 2 terms lec. lab./tut.
5.071	Engineering Analysis	3 — 1
5.112	Mechanical Engineering Design	2 — 2
5.331	Dynamics of Machines	2 — 1
5.412	Mechanics of Solids	2 — 1
6.802	Electrical Engineering	1 — 1
14.061	Accounting	1 — 0
18.011	Industrial Engineering IA	2 — 1
18.021	Industrial Engineering IB	2 — 1
	General Studies Elective*	3 — 1
		18 — 9

* Students will study one Elective in Term I and the corresponding Advanced Elective in Term II. They will study a second elective in 4th Year.

FOURTH YEAR

(30 weeks day course)

		Hours per week for 3 terms lec. lab./tut.
5.062	Communications	1 — 1
5.324	Automatic Control Engineering	2 — 1
18.012	Industrial Engineering IIA	2 — 1
18.022	Industrial Engineering IIB	2 — 1
18.041	Thesis	0 — 6
18.551	Operations Research	2 — 1
	General Studies Elective	1 — ½
Plus one elective from:		
4.913	Materials Science	
5.332	Dynamics of Machines II	
5.413	Mechanics of Solids II	2 — 1
18.431	Design for Production	
		12 —12½

INDUSTRIAL ENGINEERING—PART-TIME COURSE

Bachelor of Science (Technology)

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

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

FIFTH STAGE

(30 weeks part-time course)

		Hours per year lec. lab./tut.
5.071	Engineering Analysis	45 — 30
5.112	Mechanical Engineering Design	45 — 30
5.331	Dynamics of Machines	37½—22½
14.061	Accounting	20 — 0
18.011	Industrial Engineering IA	40 —20
18.021	Industrial Engineering IB	40 —20
	General Studies Elective	30 —15
		257½—137½

SIXTH STAGE*

(30 weeks part-time course)

		Hours per week for 3 terms lec. lab./tut.
18.012	Industrial Engineering IIA	2 — 1
18.022	Industrial Engineering IIB	2 — 1
18.431	Design for Production	2 — 1
18.551	Operations Research	2 — 1
	General Studies Elective	1 — ½
		9 — 4½

* Revised course. Will be offered in 1971.

The present Sixth Stage will continue to operate in 1970, and will then be discontinued.

SIXTH STAGE*

(30 weeks part-time course)

		Hours per week for— Term I lec. lab./tut.	Terms II & III lec. lab./tut.
5.321	Automatic Control Engineering	1 — 0	1 — 0
6.802	Electrical Engineering	1 — 1	1 — 1
18.321	Methods Engineering	1 — 1	1 — 1
18.422	Design for Production II	1 — 1	2 — 1
18.521	Industrial Marketing	1 — 0	1 — 0
18.621	Engineering Economics	2 — 1	1 — 1
	General Studies Elective	1 — ½	1 — ½
		8 — 4½	8 — 4½

* Will be offered only in 1970.

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. *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.

TEXTBOOK

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

REFERENCE BOOKS

Aitchison, L. *A History of Metals.* Vols. I and II. McDonald & Evans.
Dennis, W. H. *Extractive Metallurgy.* Pitman, *or,*
Gilchrist, J. D. *Extractive Metallurgy.* Pergamon, *or,*
Newton, J. *Extractive Metallurgy.* Wiley.
Guy, A. G. *Physical Metallurgy for Engineers.* Addison-Wesley.
Street, A. *Metals in the Service of Man.* Penguin.
Timoshenko, S. *History of the Strength of Materials.* Van Nostrand.

(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.

(iii) *Introduction to Engineering Design*: Engineering method, problem identification, creative thinking, mathematical modelling, materials and processes, communication of ideas, the place of engineering in society, *or*
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.

TEXTBOOK

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

REFERENCE BOOKS

Beakley, G. C. & Leach, H. W. *Engineering: An Introduction to a Creative Profession.* Collier-Macmillan.
Dixon, J. R. *Design Engineering.* McGraw-Hill.
Edel, D. H. *Introduction to Creative Design.* Prentice-Hall.
Krick, E. V. *Introduction to Engineering and Engineering Design.* Wiley.
McCormick, E. J. *Human Engineering.* McGraw-Hill.
Miles, L. D. *Technique of Value Analysis.* McGraw-Hill.
Ryder, F. L. *Creative Engineering Analysis.* Prentice-Hall.

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.* McGraw-Hill.
Higdon, A. & Stiles, W. B. *Engineering Mechanics.* Vector ed. Prentice-Hall.

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

Australian Standard Engineering Drawing Practice. I.E. Aust., 1966.
Robertson, R. G. *Descriptive Geometry.* Pitman.
Thomson, R. *Reading Exercises in Engineering Drawing.* Nelson.

REFERENCE BOOK

Abbott, W. *Practical Geometry and Engineering Graphics.* Blackie.

5.001/1 Engineering I, Part I

For students in Year 2 of the Applied Geology course. It consists of Section B. I (Engineering Mechanics) and Section C (Engineering Drawing) of 5.001 Engineering I.

5.011 Engineering IA

A. *Introduction to Engineering*

As for 5.001 Engineering I.

B. 2 *Engineering Mechanics*: Two and three dimensional force systems, composition and resolution of forces, laws of equilibrium. Statics of rigid bars, pin-jointed frames. Virtual work. Cables and cartenaries. Shear force, axial force, bending moment. Simple states of stress, geometric properties of plane figures. Kinematics of the plane motion of a particle. Kinetics of the plane motion of a particle and of systems of particles; equations of motion, dynamic equilibrium, work and energy, impulse and momentum. Rotation of a rigid body about a fixed axis. Construction of graphs, line charts, linearization, logarithmic graphs. Graphical differentiation and integration.

TEXTBOOKS

Hall, A. S. *Construction of Graphs and Charts.* Pitman.
Meriam, J. L. *Dynamics.* Wiley.
Meriam, J. L. *Statics.* Wiley.

C. *Engineering Drawing*
As for 5.001 Engineering I.

5.023 Seminar

For students in the B.Sc (Tech.) course in Mechanical Engineering.

5.051 Thesis

For students in the full-time course in Mechanical 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.

5.102 Mechanical Engineering Design

Lectures — Advanced application of strength of materials with respect to the design of reciprocating machinery. Balancing of rotating and reciprocating masses. Flywheel determination. Governors.

Drawing Office — Design of elements encountered in reciprocating machinery. Crankshafts, connecting rods, pistons, cams, governors, etc.

Text and Reference Books as for 5.112, together with:

TEXTBOOKS

Howarth, M. M. *Design of High Speed Diesel Engines.* Constable.
Purday, H. F. P. *Diesel Engine Designing.* Constable, 1963.

REFERENCE BOOKS

A.S. B215. Rating and Testing Internal Combustion Engines. S.A.A., 1966.
Hirschhorn, J. *Dynamics of Machinery.* Nelson.
Molian, S. *Design of Cam Mechanisms & Linkages.* Constable.

5.111 Mechanical Engineering Design

Introductory lectures illustrating the interdependence of design and technology. Mechanical technology. Introduction to workshop metrology. Philosophy and technique of design. Simple creative design assignments. Basic engineering elements.

TEXTBOOKS

Australian Standard Engineering Drawing Practice. I.E. Aust., 1966.
B.S. 1916, Parts I and II. Limits and Fits for Engineering. B.S.I. 1953.
Edel, D. H. *Introduction to Creative Design.* Prentice-Hall.
Puttock, M. J. *Introduction to Engineering Metrology.* W. Brook, Sydney.

REFERENCE BOOKS

Beakley, G. C. & Leach, H. W. *Engineering: An Introduction to the Creative Profession.* Collier-Macmillan.
Dixon, J. R. *Design Engineering.* McGraw-Hill.
Faires, V. M. *Design of Machine Elements.* Collier-Macmillan.
Harrisberger, L. *Engineersmanship.* Wadsworth.
Krick, E. V. *Introduction to Engineering & Engineering Design.* Wiley.
Levens, A. S. *Graphics with an Introduction to Conceptual Design.* Wiley.
Matousek, R. *Engineering Design.* Blackie.
Merrett, A. J. & Sykes, A. *Discounted Cash Flow.* Longmans.
Miles, L. D. *Technique of Value Analysis.* McGraw-Hill, 1961.
McCormick, E. J. *Human Engineering.* McGraw-Hill, 1957.
Parker, S. *Drawing and Dimensions.* Pitman.
Rosenstein, A. B., Rathbone, R. R. & Schneerer, W. F. *Engineering Communications.* Prentice-Hall.
Ryder, F. L. *Creative Engineering Analysis.* Prentice-Hall.

5.112 Mechanical Engineering Design

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

Faires, V. M. *Design of Machine Elements.* Collier-Macmillan.
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

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 and rigid bodies. Rectilinear, curvilinear and angular motion; dynamic equilibrium; work and energy; impulse and momentum. Dynamics of mass flow.

TEXTBOOK

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

REFERENCE BOOK

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

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. and Johnston, E. *Mechanics for Engineers: Dynamics.* Vector ed. McGraw-Hill.

5.321 Automatic Control Engineering

Block diagrams and Laplace transform methods for system analysis. Transfer functions. Response functions. The general criterion for stability. Routh's criterion. Types of controller action and their effects on system response. Analysis of some pneumatic control system components including one or two types of pneumatic controller.

TEXTBOOK

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

REFERENCE BOOK

Raven, F. H. *Automatic Control Engineering.* 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

Kinematics and Dynamics of Simple Plane Mechanisms — Velocity and acceleration analysis. Forces in mechanisms. *Toothed Gearing* — Kinematic requirements for gear teeth profiles, motion of meshing teeth. Meshing at non-standard centre distance. Gear trains: simple, compound and epicyclic. *Mechanical Vibrations* — Simple harmonic motion. One degree of freedom systems, free vibrations, forced vibrations, transmissibility and motion isolation. Whirling of shafts.

TEXTBOOK

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

REFERENCE BOOK

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

5.332 Dynamics of Machines II

Advanced Kinematics — Velocity and acceleration analysis of complex mechanisms, inflection circle, Euler-Savary equation. *Dynamic Motion Analysis* — Energy distribution, rate of change of energy methods. ***Disc***

Cams — Analysis. Synthesis. Follower offset. Spring determination. *Mechanical Vibrations* — Two-three-and multi-degree of freedom systems; natural modes, forced vibrations, Whirling of shafts with many degrees of freedom. *Inertia Effects in Machinery* — Balancing of rotating and reciprocating masses Flywheels.

TEXTBOOKS

Church, A. H. *Mechanical Vibrations.* Wiley.
Hirschhorn, J. *Dynamics of Machinery.* Nelson.

REFERENCE BOOKS

Burton, R. *Vibrations and Impact.* Addison-Wesley.
Den Hartog, J. P. *Mechanical Vibrations.* 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

Stress and strain components, principal values, equilibrium and compatibility. Theories of failure. Unsymmetrical bending of beams, composite beams. Analysis of statically indeterminate systems. Energy methods of analysis. Buckling of columns, combined loadings. Torsion of prisms and thin-walled sections. Stress distribution in thick-walled cylinders. Axisymmetric loading of circular plates and shells of revolution. 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.

TEXTBOOKS

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

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.
Smith, S. O. & Sidebottom, O. M. *Inelastic Behaviour of Load Carrying Members.* Wiley.
Timoshenko, S. *Theory of Elasticity.* McGraw-Hill.

5.502 Fluid Mechanics

Dimensional analysis. Theory of models. Boundary layer theory on flat plates. Resistance of bodies. One-dimensional gas dynamics: isentropic, adiabatic flows. Flow of gases and vapours in nozzles. Theory of centrifugal pumps, axial flow pumps and turbines; similitude laws; cavitation.

TEXTBOOKS

Barna, P. S. *Fluid Mechanics for Engineers.* Butterworth, London, *or,*
Shepherd, D. G. *Principles of Turbomachinery.* Macmillan.

REFERENCE BOOKS

Addison, H. *Centrifugal and Other Rotodynamic Pumps.* 3rd ed. Chapman & Hall, London, 1965.
Shapiro, A. H. *Dynamics and Thermodynamics of Compressible Fluid Flow,* Vol. I, Parts 1 & 2. Ronald Press, 1953.
Streeter, V. L. *Fluid Mechanics.* 4th ed. McGraw-Hill.

5.611 Fluid Mechanics/Thermodynamics

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

Steeter, V. L. *Fluid Mechanics.* 4th ed. McGraw-Hill, *or,*
Vennard, J. K. *Elementary Fluid Mechanics.* 4th ed. Wiley.
Wark, K. *Thermodynamics.* McGraw-Hill, 1966, *or,*
Lee, J. F. & Sears, F. W. *Thermodynamics.* 2nd ed. Addison-Wesley.

5.612 Fluid Mechanics/Thermodynamics II

Dimensional analysis similitude and modelling. Fields. Mass and momentom 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

Eckert, F. R. G. & Drake, R. M. *Heat & Mass Transfer.* 2nd ed. McGraw-Hill.
Shapiro, A. H. *Dynamics and Thermodynamics of Compressible Fluid Flow.* Vol. I, Parts 1 & 2. Ronald, 1953.
Streeter, V. L. *Fluid Mechanics.* 4th ed. McGraw-Hill.
Van Wylen, G. J. & Sonntag, R. E. *Fundamentals of Classical Thermodynamics.* Wiley.

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.

TEXTBOOKS

Dixon, S. L. *Fluid Mechanics of Turbomachinery.* Pergamon, 1966.
Kays, W. M. *Convection Heat and Mass Transfer.* McGraw-Hill, 1966.
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.

REFERENCE BOOK

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

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.

5.701 Thermodynamics

Fundamental thermodynamic concepts. First and second laws and corollaries. Reversibility. General thermodynamic relations. Properties of a perfect gas, liquids and vapours. Non-flow and flow processes. Multistream steady flow processes. Carnot cycle. Rankine cycle, reheat and regenerative feed heating. Boilers and boiler auxiliaries. Otto, Diesel and mixed cycles. Cycles having Carnot efficiency.

TEXTBOOK

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

REFERENCE BOOKS

Lee, J. F. & Sears, F. W. *Thermodynamics.* 2nd ed. Addison-Wesley.
Mooney, D. A. *Introduction to Thermodynamics and Heat Transfer.* Prentice-Hall.

5.702 Thermodynamics

Heat pump and refrigeration cycles. Vapour compression, absorption and compressed air systems. Properties of non-reactive mixtures of gases and vapours. Gibbs-Dalton law. Psychrometry. Hygrometric chart. Thermodynamic charts. Reciprocating engines and compressors, criteria of performance. Axial and radial flow, turbines and compressors. Gas turbine cycles with heat exchange, inter-cooling and reheat. Steady heat conduction through composite wall-cylinders. Three-dimensional steady heat conduction in homogeneous materials. Relaxation processes. Unsteady one-dimensional heat conduction. Electrical analogy. Heat transfer by free and forced convection. Similarity parameters. Heat exchangers. Radiation heat exchange between black and non-black surfaces. Radiation geometric factors. Reciprocity theorem. Radiation from gases and flames.

TEXTBOOK

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

REFERENCE BOOKS

Kreith, F. G. *Principles of Heat Transfer.* International Textbook Co.
Soo, S. L. *Thermodynamics of Engineering Science.* Prentice-Hall.

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.

TEXTBOOKS

Lee, J. F. & Sears, F. W. *Thermodynamics.* 2nd ed. Addison-Wesley, *or,*
Van Wylen, G. J. *Thermodynamics.* Wiley.

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.

TEXTBOOK

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.
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.*

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.

REFERENCE BOOKS

Abbott, I. H. & Van Doenhoff, A. E. *Theory of Wing Sections.* Dover.
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.

TEXTBOOK

Perkins, C. D. & Hage, R. E. *Airplane Performance Stability and Control.* Wiley.

REFERENCE BOOKS

Kaufmann, W. *Fluid Mechanics.* McGraw-Hill.
Rauscher, M. *Introduction to Aeronautical Dynamics.* Wiley.

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.

TEXTBOOKS

Peery, D. J. *Aircraft Structures.* McGraw-Hill, *or,*
Niles, A. S. & Newell, J. S. *Airplane Structures.* Vol. 1. Wiley.

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.

TEXTBOOKS

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

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.
Kuhn, P. *Stresses in Aircraft and Shell Structures.* McGraw-Hill.
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 aerodynamics. 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.

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.

REFERENCE BOOKS

Arnott, D. *Design and Construction of Steel Merchant Ships.* Soc. of Naval Architects & Marine Engineers.
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

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. Launching arrangements.

TEXTBOOK

Munro-Smith, R. *Merchant Ship Design.* Hutchinson.

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 Navigation Act.
Manning, G. C. *The Theory and Technique of Ship Design.* Wiley.
Schokker, J. C., Neuerburg, E. M. & Vossnack, E. J. *The Design of Merchant Ships.* Arkenbout-Schokker.
Todd, F. H. *Ship Hull Vibration.* Arnold.

5.932 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 5.931.

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.

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.

Sink, 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.

TEXTBOOK

No set text.

REFERENCE BOOKS

To be selected.

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

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

REFERENCE BOOKS

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

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.

TEXTBOOK

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

REFERENCE BOOKS

Bartee, T. *Digital Computer Fundamentals.* McGraw-Hill.
Gear, C. W. *Computer Organization and Programming.* McGraw-Hill.
Heath, F. G. *Digital Computer Design.* Oliver & Boyd.
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

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

6.041S 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.

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.

6.042S Circuits, Signals and Information 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

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.

6.052 Electrical Engineering

Measurement methods in electrical engineering.

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.

6.065 Computer Science

Computer organization and programming, numerical analysis and information structures with electives from algorithmic languages and com-

pilers, numerical analysis, logical design, digital systems, programming systems, mathematical optimization techniques, simulation and heuristics, and data processing.

A1 Computer Organization and Information Structures

TEXTBOOK

No set text.

REFERENCE BOOKS

Hellerman, H. *Digital Computer System Principles.* McGraw-Hill, 1967.
Iverson, K. E. *A Programming Language.* Wiley, N.Y., 1966.
Knuth, D. E. *The Art of Computer Programming. Vol. 1: Fundamental Algorithms.* Addison-Wesley, 1968.
Wegner, P. *Programming Languages, Information Structures and Machine Organization.* McGraw-Hill, 1968.

A2 Introduction to Computing

TEXTBOOK

Reilly, E. D. & Federighi, F. D. *The Elements of Digital Computer Programming.* Holden-Day, 1968.

REFERENCE BOOK

Knuth, D. E. *The Art of Computer Programming. Vol. 1: Fundamental Algorithms.* Addison-Wesley, 1968.
Maurer, W. D. *Programming.* Holden-Day, 1968.

A3 IBM 360 Architecture and PL360

Now combined with A1.

A4 Introduction to Operations Research

TEXTBOOK

IBM Staff. *Mathematical Programming System/360 (360-CO-14X) Linear Programming User's Manual.* IBM Publication H20-0291-1.

REFERENCE BOOKS

Gass, S. I. *Linear Programming — Methods and Applications.* 2nd ed. McGraw-Hill, 1964.
Smythe, W. R. & Johnson, L. A. *Introduction to Linear Programming with Applications.* Prentice-Hall, 1966.

A5 Programming Systems

TEXTBOOK

Gear, C. W. *Computer Organization and Programming.* McGraw-Hill, 1969.

REFERENCE BOOKS

IBM Staff. *IBM Operating System/360 Concepts and Facilities.* C28-6535.
IBM Staff. *IBM System/360 Operating System Assembler Language.*
Rosen, S. ed. *Programming Systems and Languages.* McGraw-Hill, 1967.
Wegner, P. *Programming Languages Information Structures and Machine Organization.* McGraw-Hill, 1968.

A6 Data Management

TEXTBOOK

IBM Staff. *System/360 Operating System Job Control Language.* C28-6539.
IBM Staff. *System/360 Operating System Supervisor and Data Management Services.* C28-6646.
IBM Staff. *IBM Operating System/360 Concepts and Facilities.* C28-6535. *Storage Devices and Organization Methods.* C20-1649.

REFERENCE BOOK

IBM Staff. *IBM Operating System/360 Concepts and Facilities.* C28-6535.

A7 High-Level Programming Languages

TEXTBOOK

No set text.

REFERENCE BOOKS

Higman, B. *A Comparative Study of Programming Languages.* Macdonald, 1967.
Ingerman, P. Z. *A Syntax-Orient Translator.* Academic Press, 1966.
Rosen, S. ed. *Programming System and Languages.* McGraw-Hill, 1967.
Wegner, P. *Programming Languages Information Structures, and Machine Organization.* McGraw-Hill. 1968.

B1 Logical Design and Switching

TEXTBOOKS

Hill, F. J. & Peterson, G. R. *Introduction to Switching Theory and Logical Design.* Wiley.
Lewin, C. G. *Logical Design of Switching Circuits.* Nelson.

REFERENCE BOOKS

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.
Minsky, M. *Computation: Finite and Infinite Machines.* Prentice-Hall, 1967.

B2 Introduction to Numerical Methods

TEXTBOOKS

Blatt, J. M. *Fortran IV.* Prentice-Hall.
Ledley, R. S. *Fortran IV Programming.* McGraw-Hill.

REFERENCE BOOKS

Conte, S. D. *Elementary Numerical Analysis: An Algorithmic Approach.* McGraw-Hill, 1965.
IBM Staff. *System/360 FORTRAN IV Language.* C28-6515.
McCalla, T. R. *Introduction to Numerical Methods and FORTRAN Programming.* Wiley.

McCracken, D. D. & Dorn, W. S. *Numerical Methods and FORTRAN Programming.* Wiley.
Modern Computing Methods. Notes on Applied Science. No. 16, H.M.S.O., London.

B3 Introduction to Non-Numerical Methods

TEXTBOOK

Griswold, R. E., Peage, J. F. & Polansky, I. P. *The SNOBOL 4 Programming Language.* Prentice-Hall, 1969.

REFERENCE BOOKS

Foster, J. M. *List Processing.* Macdonald, London, 1967.
Knuth, D. E. *The Art of Computer Programming. Vol. 1: Fundamental Algorithms.* Addison-Wesley, 1968.
Rosen, S. ed. *Programming Systems and Languages.* McGraw-Hill, 1967.

B4 Simulation and Heuristics

TEXTBOOK

IBM Staff. *General Purpose Simulation System/360, Introductory User's Manual.* H20-0304-1.

REFERENCE BOOKS

Feigenbaum, E. A. & Feldman, J. *Computers and Thought.* McGraw-Hill, 1963.
Naylor, T. H., Balintfy, J. L., Burdick, D. S. and Chu, K. *Computer Simulation Techniques.* Wiley, N.Y., 1966.

B5 Digital System

TEXTBOOK

No set text.

REFERENCE BOOKS

Alt, F. L. ed. *Advances in Computers. Vol. 7.* Academic Press, 1966.
Flores, I. *The Logic of Computer Arithmetic.* Prentice-Hall, 1963.
Gear, C. W. *Computer Organization and Programming.* McGraw-Hill.
Hellerman, H. *Digital Computer System Principles.* McGraw-Hill.
Richards, R. K. *Electronic Digital Systems.* Wiley, N.Y., 1966.

6.066 Computer Science (Honours)

Selections from: automata theory, formal languages, logic, numerical analysis, computer simulation, artificial intelligence, advanced logical design and programming systems.

TEXTBOOK

No set text.

6.202S 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.

6.212S Electrical 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.
Kimbark, E. W. *Power System Stability.* Vol. III. Wiley.
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.

6.251 Electric Power Engineering

Introduction to the principles of steady state operation of transformers and rotating machines used for the conversion of energy. Generalized machines. D.C. machines. Metadynes. Transformers. Three phase and single phase synchronous and induction machines.

TEXTBOOK

Hindmarsh, J. *Electrical Machines.* Pergamon.

REFERENCE BOOKS

Clayton, A. E. *Design and Performance of D.C. Machines.* Pitman.
M.I.T. *Magnetic Circuits and Transformers.* Wiley.
Say, M. G. *Design and Performance of A.C. Machines.* Pitman.

6.262 Electrical Machines

Covers aspects of rotating machines as components of power and control systems.

TEXTBOOK

Hindmarsh, J. *Electrical Machines.* Pergamon.

REFERENCE BOOKS

Adkins, B. *The General Theory of Electrical Machines.* Chapman & Hall.
Clayton, A. E. *Design and Performance of D.C. Machines.* Pitman.
Draper, A. *Electrical Machines.* Longmans.
Kimbark, E. W. *Power Systems Stability.* Vol. III. Wiley.
Say, M. G. *Design and Performance of A.C. Machines.* Pitman.
Taylor, E. O. *Performance and Design of A.C. Computator 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.

6.303S 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-device amplifiers.

TEXTBOOK

No set text.

REFERENCE BOOKS

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.
Dix, C. H. & Aldous, W. H. *Microwave Valves.* Iliffe, 1966.
Ghausi, M. S. *Principles and Design of Linear Active Circuits.* McGraw-Hill, 1965.
Goldman, S. *Frequency Analysis Modulation and Noise.* McGraw-Hill.
Hancock, J. C. *An Introduction to the Principles of Communication Theory.* McGraw-Hill.
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.
Steele, E. L. *Optical Lasers in Electronics.* Wiley, 1968.
Stein, S. & Jones, J. *Modern Communication Principles.* McGraw-Hill.
Watson, H. A. ed. *Microwave Semi-Conductor Devices and Their Circuit Applications.* McGraw-Hill, 1969.
Yariv, A. *Quantum Electronics.* Wiley, 1967.

6.313S Antennas, Propagation and Guided Waves

Retarded potentials, the fields due to a current element, Poynting's vector, wave impedance of space. Linear antennas, current distribution, radiation resistance directional characteristics. Effects of ground. Antenna arrays, antenna network theorems, polar diagrams of arrays, gain, directivity and bandwidth. Aperture antennas. Radio wave propagation. Surface, ground, direct and reflected waves. Ionospheric propagation, tropospheric scatter propagation.

Guided Waves: Transmission line theory including losses, dispersion, matching and solution of problems. Types of transmission lines including coaxial lines, microstrip, triplate, surface wave lines, etc. Waveguides: Theory of rectangular and circular waveguides: attenuation, dispersion and discussion on waveguide practice. Microwave circuits including discussion on Irises, corners, tees, directional couplers, hybrids, transformers, etc., non-reciprocal devices; cavities and other resonant structures. Discussion of modern microwave sources.

TEXTBOOK

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

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.

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

6.322S 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. RQ 621.381/9
Schaefer, J. *Rectifier Circuits.* Wiley. 621.3192/17
Storer, J. E. *Passive Network Synthesis.* McGraw-Hill. 621.319/33
Texas Instruments. *Transistor Circuit Design.* McGraw-Hill.

6.333S 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

No set text.

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.
Millman, J. & Taub, H. *Pulse Digital and Switching Waveforms.* McGraw-Hill, 1965.
Olson, H. F. *Elements of Acoustical Engineering.* Van Nostrand.
Terman, F. E. *Electronic and Radio Engineering.* 4th ed. McGraw-Hill, 1955.
Zworykin, V. K. & Morton, G. A. *Television.* Wiley.

6.352 Communications

Theory and practice of certain aspects of communications engineering. Topics include modulation theory, demodulation, calculation, use and measurement of noise factor, oscillators, tuned amplifiers, transmitters and receivers.

TEXTBOOK

Terman, F. E. *Electronic and Radio Engineering.* 4th ed. McGraw-Hill, 1955.

REFERENCE BOOKS

Carlson, A. B. *Communication Systems.* McGraw-Hill.
Goldman, S. *Frequency Analysis Modulation and Noise.* McGraw-Hill.
Hancock, J. C. *An Introduction to the Principles of Communication Theory.* McGraw-Hill.
Lathi, B. *Communication Systems.* Wiley.
Stein, S. & Jones, J. *Modern Communication Principles.* McGraw-Hill.

6.356 Electronics

An introduction to the physical basis of electronics and of electronic circuits. Topics include principles of operation of solid state, vacuum and gas-filled devices. Basic types of electronic amplifiers.

TEXTBOOK

Lin, H. C. *Integrated Electronics.* Holden-Day.

REFERENCE BOOKS

Alley, C. L. & Atwood, K. W. *Electronic Engineering.* 2nd ed. Wiley, 1966.
Gibbons, J. F. *Semiconductor Electronics.* McGraw-Hill, 1966.
Hunter, L. E. *Handbook of Semiconductor Electronics.* 2nd ed. McGraw-Hill, 1962.

Joyce, M. V. & Clarke, K. K. *Transistor Circuit Analysis.* Addison-Wesley.
Myers, R. H., Wong, K. L. & Gordy, H. M. *Reliability Engineering for Electronic Systems.* Wiley, 1964.
Van der Ziel, A. *Solid State Physical Electronics.* 2nd ed. Prentice-Hall.

6.357 Electronics

An extension of 6.356 with topics including rectifiers, amplifiers, oscillators, modulation and demodulation and switching circuits.

TEXTBOOK

Gibbons, J. F. *Semiconductor Electronics.* McGraw-Hill, 1966.

REFERENCE BOOKS

Alley, C. L. & Atwood, K. W. *Electronic Engineering.* 2nd ed. Wiley, 1966.
Angelo, E. J. *Electronic Circuits.* McGraw-Hill.
Fitchen, F. C. *Transistor Circuit Analysis and Design.* Van Nostrand.
Hakim, S. S. & Barrett, R. *Transistor Circuits in Electronics.* Iliffe.
Joyce, M. V. & Clarke, K. K. *Transistor Circuit Analysis.* Addison-Wesley.
Pierce, J. F. *Transistor Circuit Theory and Design.* Merrill.

6.362 Communications

Topics generally include guided propagation, information theory and noise, transmission lines, telephone networks, line communication equipment.

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.
Hancock, J. C. *An Introduction to the Principles of Communication Theory.* McGraw-Hill.
Jordan, E. C. *Electromagnetic Waves and Radiating Systems.* Constable.
Karbowiak, A. E. *Trunk Waveguide Communication.* Chapman & Hall, 1965.
Kimbark, E. W. *Electrical Transmission of Power and Signals.* Wiley.
Lovering, W. F. *Radio Communication.* Longmans.
Ramo, S. & Whinnery, J. R. *Fields and Waves in Communication Electronics.* Wiley, 1965.
Skilling, H. H. *Electric Transmission Lines.* McGraw-Hill.
Starr, A. T. *Telecommunications.* Pitman.

6.385S Biomedical Engineering

The practice of engineering techniques applied to the biological and medical fields. The lectures will be supplemented by demonstrations and experimental work, and will deal with the basic physiology of cells, tissues, organs and organisms, instrumentation and measurement techniques and modelling of various types of biological systems.

6.412S 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.

6.422S 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

Class notes will be issued.

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.

6.454 Power Systems and Control

Power Systems — Performance of transformers and power systems under steady load and fault conditions. *Control* — A study of the performance and analysis of automatic control systems.

TEXTBOOK

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

REFERENCE BOOKS

Bewley, L. V. *Travelling Waves on Transmission Systems.* Dover.
Goldman, S. *Transformation Calculus and Electrical Transients.* Constable, London.
Kimbark, E. W. *Power System Stability.* Vols. I, II & III. Wiley.
M.I.T. *Magnetic Circuits and Transformer.* Wiley.
Westinghouse Electric Corp. *Electrical Transmission and Distribution Reference Book.*

Control Systems — A study of the performance and analysis of automatic control systems.

TEXTBOOK

Melsa, J. L. & Schultz, D. G. *Linear Control Systems.* McGraw-Hill, 1969.

REFERENCE BOOKS

Elgard, O. I. *Control System Theory.* McGraw-Hill, 1967.
Shinners, S. M. *Control System Design.* Wiley, 1964.
Raven, F. H. *Automatic Control Engineering.* McGraw-Hill, 1961.
Stockdale, L. A. *Servomechanisms.* Pitman, 1962.

6.512S 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 Electronics.* 2nd ed. Prentice-Hall, 1968.

6.522S 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.

6.612S 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

No set text.

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.
Fifer, S. *Analogue Computation.* Vols. I, II, III & IV. McGraw-Hill.
Flores, I. *The Logic of Computer Arithmetic.* Prentice-Hall.
Gear, C. W. *Computer Organization and Programming.* McGraw-Hill.
Johnson, C. L. *Analogue Computer Techniques.* McGraw-Hill.
Korn, G. A. & Korn, I. M. *Electronic Analogue Computers.* McGraw-Hill.
Lewin, C. G. *Logical Design of Switching Circuits.* Nelson.
Marcus, M. P. *Switching Circuits for Engineers.* Prentice-Hall.
Phister, M. *Logical Design of Digital Computers.* Wiley.
Rogers, A. E. & Connelly, T. W. *Analogue Computation in Engineering Design.* McGraw-Hill.
Smith, G. W. & Wood, R. C. *Principles of Analogue Computations.* McGraw-Hill.
Soroka, W. W. *Analogue Methods in Computation and Simulation.* McGraw-Hill.
Wass, C. A. A. *An Introduction to Electronic Analogue Computers.* McGraw-Hill.

6.622S Computer Application and Software

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

TEXTBOOK

No set text.

REFERENCE BOOKS (for 6.612S and 6.622S)

As for 6.065 Computer Science.

6.801 and 6.801S 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.

TEXT AND REFERENCE BOOKS

As for 6.802 Electrical Engineering.

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.

TEXTBOOK (for 6.801, 6.801S, 6.802 and 6.802S)

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

REFERENCE BOOKS (for 6.801, 6.801S, 6.802 and 6.802S)

Del Toro, V. *Principles of Electrical Engineering.* Prentice-Hall.
Sutcliffe, H. *Electronics for Students of Mechanical Engineering.* Longmans.

6.811 Electronic Instrumentation for Surveys

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

Del Toro, V. *Principles of Electrical Engineering.* Prentice-Hall.
Smith, R. J. *Circuits, Devices and Systems.* Wiley.
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.

TEXTBOOK

No set text.

REFERENCE BOOKS

Golding, E. W. & Widdis, F. C. *Electrical Measurements and Measuring Instruments.* Pitman.
Harris, F. K. *Electrical Measurements.* Wiley.
Terman, F. E. & Pettit, J. M. *Electronic Measurements.* McGraw-Hill.

6.901S Seminar

6.911 Thesis

For pass degree 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

(Civil Engineering Undergraduate Subjects — For subjects taught in the Department of Surveying see prefix 33.)

8.012 Engineering Electives

The student must choose two elective studies which for examination purposes will be grouped into one subject. A supervised project or thesis may be substituted for one elective with the premission of the Head of Department.

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

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

REFERENCE BOOKS

Axelrad, D. R. *Strength of Materials for Engineers.* Pitman, 1966.
Davis, H. E., Troxell, G. E. & Wiskocil, G. T. *Testing and Inspection of Engineering Materials.* McGraw-Hill.
Timoshenko, S. & MacCulloch, G. H. *Elements of Strengths of Materials.* Van Nostrand.

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.

8.131 Structures

Influence lines for statically determinate structures. Strain energy theory, application to analysis of statically indeterminate framed structures, and pin-jointed trusses. Deflections by unit load method. Williot-Mohr diagram. Analysis of frames by moment distribution. Analysis of arches. Timber design, special characteristics of timber. Joints in timber. Beams and columns. Timber structures. Retaining walls and small dams. Design of continuous structures in reinforced concrete. Continuous beams and slabs, simple continuous frame. Introduction to prestressed concrete. Pre-tensioning and post-tensioning.

REFERENCE BOOKS

Cassie, W. F. *Structural Analysis.* Longmans.
Ferguson, P. M. *Reinforced Concrete Fundamentals.* Wiley.
Lin, T. Y. *Design of Prestressed Concrete Structures.* Wiley.
Parcel, J. I. & Moorman, R. B. B. *Analysis of Statically Indeterminate Structures.* Wiley.
Pearson, R. G. et al. *Timber Engineering Design Handbook.* M.U.P.

8.141 Engineering Computations

Intercept charts for three or more variables. Nomograms. Solution of algebraic and transcendental equations by simple iteration methods. Introduction to finite differences. Solution of differential and partial differential equations by using finite differences. Application to instability problems. Relaxation methods applied to solution of problems involving differential equations such as Poisson's equation.

TEXTBOOK

Salvadori, M. G. & Baron, M. L. *Numerical Methods in Engineering.* 2nd ed. Prentice-Hall, 1962.

REFERENCE BOOKS

Hall, A. S. *Construction of Graphs and Charts.* Pitman.
Shaw, F. S. *Relaxation Methods.* Dover.

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

Drucker, D. C. *Introduction to Mechanics of Deformable Solids.* McGraw-Hill.
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.

8.152S 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

S.A.A. Interim Code Nos. 350; CA8. Part 1 — 1965.
S.A.A. Code CA1 — 1968.
S.A.A. Code CA2 — 1963 (incl. 1968 amendments).

REFERENCE BOOKS

Bresler, B. & Lin, T. Y. *Design of Steel Structures.* Wiley.
Cowan, H. J. & Smith, P. R. *Design of Reinforced Concrete.* A. & R.
Ferguson, P. M. *Reinforced Concrete Fundamentals.* Wiley.
Gray, C. S. et al. *Steel Designer's Manual.* Lockwood.
Hoff, N. J. *The Analysis of Structures.* Wiley.
Laursen, P. G. *Matrix Analysis of Structures.* McGraw-Hill.
McGuire, W. *Steel Structures.* Prentice-Hall.
Pippard, A. J. S. & Baker, J. F. *Analysis of Engineering Structures.* Arnold.
Salvadori, M. G. & Heller, R. *Structure in Architecture.* Prentice-Hall.
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

Beedle, L. S. *Plastic Design of Steel Frames.* Wiley.

Ferguson, P. M. *Reinforced Concrete Fundamentals.* Wiley.

Lin, T. Y. *Design of Prestressed Concrete Structures.* Wiley.

Pearson, R. G. et al. *Timber Engineering Design Handbook.* M.U.P.

Shaw, F. S. *Virtual Displacement and The Analysis of Structures.* Prentice-Hall.

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.

8.161 and 8.161S 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

Hall, A. S. *Construction of Graphs and Charts.* Pitman.

McCracken, D. D. & Dorn, W. S. *Numerical Methods and Fortran Programming.* Wiley, 1964.

Miller, I. & Freund, J. E. *Probability and Statistics for Engineers.* Prentice-Hall, 1965.

Salvadori, M. G. & Baron, M. L. *Numerical Methods in Engineering.* 2nd ed. Prentice-Hall, 1962.

Shaw, F. S. *Relaxation Methods.* Dover.

8.221 Engineering Materials

Concrete Technology — Physical and chemical properties of cements. Production, testing and selection of aggregates. Pozzolans, admixtures. Workability, strength and other properties of concrete. Target strengths and the design and proportioning of mixes.

Soil Mechanics — Physical and mechanical properties affecting capillarity and compressibility and their relevance to seepage, uplift and the settlement of buildings located above buried compressible soil strata. Shearing strength, bearing capacity and earth pressure. Soil identification and testing of physical properties.

Metallurgy — The atomic structure of metals. The grain structure of metals; effects of manufacturing processes. Structure, properties and heat treatment of commercially important alloys. The selection and properties of structural steels. Corrosion.

REFERENCE BOOKS

Refer to subjects 8.252 and 8.252S.

8.222 Engineering Materials

Concrete Technology — Permeability, durability, elastic modulus, creep and other concrete properties; concrete volume changes. Design and proportioning of concrete mixes; lightweight concrete. Manufacture and field control of concrete.

Soil Mechanics — Studies of theoretical and applied sections of soil mechanics relating to foundations and earth dams. Treatments of modern soil technology studies and stabilization work.

TEXTBOOKS

Scott, R. F. *Principles of Soil Mechanics.* Addison-Wesley, 1963, *or,* 1956.
or,
Wu, T. H. *Soil Mechanics.* Allyn & Bacon, 1966.

REFERENCE BOOKS

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.

Cottrell, A. H. *The Mechanical Properties of Matter.* Wiley, 1964.

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

S.A.A. Specifications (current editions).
A.64 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.

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

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

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

Terzaghi, K. & Peck, R. B. *Soil Mechanics in Engineering Practice.* 2nd ed. Wiley, 1967.
Troxell, G. E., Davis, H. E. & Kelly, J. W. *Composition and Properties of Concrete.* 2nd ed. McGraw-Hill, 1968.

8.241 Geo-Mechanics

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.

Text and Reference Books as for 8.243S.

8.243S 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

Terzaghi, K. & Peck, R. B. *Soil Mechanics in Engineering Practice.* 2nd ed. Wiley.
or,
Wu, T. H. *Soil Mechanics.* Allyn & Bacon, 1966.

REFERENCE BOOKS

Grim, R. *Applied Clay Mineralogy.* McGraw-Hill, 1962.
Jaeger, J. C. *Elasticity, Fracture and Flow.* Methuen, 1964.
Scott, R. F. *Principles of Soil Mechanics.* Addison-Wesley, 1963.
Soil Mechanics for Road Engineers. H.M.S.O. Publication, 1959.

8.251 Properties of Materials

Basic structure of solid materials; atomic and molecular bonds; crystal and amorphous structure. Classification and properties of solid materials; monomers and polymers; ceramics; metals and metal phases.

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

TEXTBOOK

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

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.* Melb. U.P.
Polakowski, N. H. & Ripling, E. J. *Strength and Structure of Engineering Materials.* Prentice-Hall, 1966.

8.252 and 8.252S 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

Troxell, G. E., Davis, H. E. & Kelly, J. W. *Composition and Properties of Concrete.* 2nd ed. McGraw-Hill, 1968.
Scott, R. F. *Principles of Soil Mechanics.* Addison-Wesley, 1963.
or,
Wu, T. H. *Soil Mechanics.* Allyn & Bacon, 1966.

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.
Lambe, T. W. & Whitman, R. V. *Soil Mechanics.* Wiley, 1969.
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; A77 Aggregates for Concrete; A100-A111 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.* A. & R., 1965.
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. Multi-phase 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 limitations. 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.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.
Cottrell, A. H. *The Mechanical Properties of Matter.* Wiley, 1964.
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. *Concrete Materials and Practice.* 3rd ed. Arnold.
Parker, E. R. *Brittle Behaviour of Engineering Structures.* Wiley.
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.

TEXTBOOK

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

or,

Wu, T. H. *Soil Mechanics.* Allyn & Bacon, 1966.

REFERENCE BOOKS

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

Earth Manual — 1960. U.S. Bureau of Reclamation.

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

Scott, R. F. *Principles of Soil Mechanics.* Addison-Wesley.

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 — Materials of Construction. The mechanical behaviour of real materials. Structural steel. Specifications for and selection of steels; precautions. Corrosion protection. Structural aluminium alloys, properties, selection, applications and limitations. Mention only of polymers and timber products.

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

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

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.

TEXTBOOKS

Blyth, F. G. H. *Geology for Engineers.* 4th ed. Arnold, 1960.
Wu, T. H. *Soil Mechanics.* Allyn & Bacon, 1966.

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.
Schultz, J. R. & Cleaves, A. B. *Geology in Engineering.* Wiley, 1952.

8.301S Systems Engineering

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

REFERENCE BOOKS

Ashby, W. R. *An Introduction to Cybernetics.* University Paperbacks. Methuen, 1965.
Bellman, R. & Kalaba, R. *Dynamic Programming and Modern Control Theory.* Academic. Paperback.
Chestnut, H. *Systems Engineering Tools.* Wiley, 1965.
Houlden, B. T. ed. *Some Techniques of Operational Research.* E.U.P., 1962. Paperback.
Machol, R. E. ed. *Systems Engineering Handbook.* McGraw-Hill, 1965.
Morris, W. T. *The Analysis of Management Decisions.* R. D. Irwin, Illinois, 1965.

8.511 Hydraulics

Part I: 5.711 Thermodynamics

Part II: Hydraulics: Fluid properties, hydrostatics, stability of floating bodies. Incompressible inviscid flow, patterns of flow; continuity; Euler, Bernoulli and momentum equations, with applications; jets and trajectories, vortices. Effects of viscosity, laminar and turbulent flow, boundary layer concepts; surface and form drag. Pipe flow resistance, Reynolds criterion, pipe combinations, minor losses. Channel flow resistance, flow classification; continuity, Bernoulli, Chezy and Manning equations. Principles of flow measurement in pipes and channels.

TEXTBOOKS

Giles, R. B. ed. *Fluid Mechanics and Hydraulics.* Schaum's Outline Series, Schaum Pub. Co., N.Y.
Streeter, V. L. *Fluid Mechanics.* 4th ed. McGraw-Hill.

8.521 Hydraulics

Dimensional analysis, hydraulic model theory, surface resistance in flow in pipes and channels. Pipe networks, waterhammer. Channel flow steady non-uniform flow. Flow measurement. Hydraulic machinery, characteristic curves. Graphical flow nets, percolation.

REFERENCE BOOKS

Charts for the Design of Channels. H.M.S.O. Hydraulics Research Paper No. 2.
Parmakian, J. *Water Hammer Analysis.* Prentice-Hall.
Resistance of Fluids Flowing in Channel Pipes. H.M.S.O. Hydraulics Research Paper No. 1.
Rouse, H. *Engineering Hydraulics.* Wiley.
Stepanoff, A. J. *Axial and Centrifugal Pumps.* Wiley.
Vallentine, H. R. *Applied Hydrodynamics.* Butterworth.
Chow, V. T. *Open Channel Hydraulics.* McGraw-Hill.

8.531 and 8.531S 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, waterhammer. 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

Fair, G. M. & Geyer, J. C. *Water Supply and Waste Water Disposal.* Wiley, 1954.
Giles, R. B. ed. *Fluid Mechanics and Hydraulics.* Schaum's Outline Series. Schaum Pub. Co., N.Y.
Henderson, F. M. *Open Channel Flow.* Macmillan.
Linsley, R. K., Kohler, M. A. & Paulhus, J. L. *Hydrology for Engineers.* McGraw-Hill, 1958.
Streeter, V. L. *Fluid Mechanics.* 4th ed. McGraw-Hill.

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.
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

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

REFERENCE BOOKS

Chow, V. T. ed. *Handbook of Applied Hydrology.* McGraw-Hill.
Linsley, R. K. & Franzini, J. B. *Water Resources Engineering.* McGraw-Hill, 1964.
Raudkivi, A. J. *Loose Boundary Hydraulics.* Pergamon.
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.

8.611 Civil Engineering

Public Health Engineering — Processes of decomposition and decay; chemical and biochemical measurement of degree of pollution; basic principles of the treatment of polluted waters. Water supply schemes; principles and practice of water treatment; sewerage systems; construction of sewers; pumping stations; sewage treatment and disposal; swimming pools; refuse disposal.

Engineering Hydrology — A basic course dealing with principles and modern techniques. Topics covered are: meteorology, climatology, evaporation, analysis of hydrologic data, stream gauging, the runoff process, infiltration, design storm synthesis, unitgraphs, synthetic unitgraphs, flood frequency studies, rational method, water balance, water losses, rainfall runoff relationships, stream flow correlations, storage determination, groundwater.

TEXTBOOKS

Fair, G. M. & Geyer, J. C. *Water Supply and Waste Water Disposal.* Wiley, 1954.
Linsley, R. K., Kohler, M. A. & Paulhus, J. L. *Hydrology for Engineers.* McGraw-Hill, 1958.

REFERENCE BOOKS

Bruce, J. P. & Clark, R. H. *Introduction to Hydrometeorology*. Pergamon, 1966.
Chow, V. T. ed. *Handbook of Applied Hydrology*. McGraw-Hill, 1964.
Johnstone, D. & Cross, W. P. *Elements of Applied Hydrology*. Ronald, 1949.
Wisler, C. O. & Brater, E. F. *Hydrology*. 2nd ed. Wiley, 1959.

8.612 Civil Engineering

Road Engineering — Road location and surveys, road design standards, road alignment, design of curves and intersections; types and functions of pavements. Pavement thickness. Road maintenance. Urban stormwater drainage. Economic analysis of routes and schemes.

Engineering Construction and Administration — Construction plant and equipment; drilling and tunnel equipment, earthmoving plant, hoisting and conveying equipment, pumping and pile-driving plant, workshop plant. Construction methods; earthworks foundations, coffer-dams, caissons, piling, steel, timber, and concrete construction. Prestressed concrete, bridges, wharves, dams, pipeline and multi-storyed buildings. Engineering administration; contracts, tenders, contract documents, estimates, quantities, specifications, costing, financial comparison of projects, personnel, management and organization.

Irrigation Engineering — Sources of water, water requirements, methods of application to land. Soil deterioration. Investigation and design. Maintenance and operation of irrigation systems; water metering.

TEXTBOOKS

Antill, J. M. & Ryan, P. W. S. *Civil Engineering Construction*. A. & R.
O'Neill, L. V. *Fundamentals of Estimating and Construction Cost Control*. Tait, 1966.
Ryan, P. W. S. *Engineering Administration*. A. & R.

REFERENCE BOOKS

Ackerman, A. J. & Locher, C. H. *Construction Planning and Equipment*. McGraw-Hill.
Brown, J. G. *Hydro-Electric Engineering Practice*. Blackie.
Creager, W. P., Justin, J. D. & Hinds, F. H. *Engineering for Dams*. Wiley.
Du-Plat-Taylor, F. M. G. *Docks, Wharves and Piers*. Eyre & Spottiswoode.
Fair, G. M. & Geyer, J. C. *Water Supply and Waste-Water Disposal*. Wiley.
Houk, I. E. *Irrigation Engineering*. Wiley.
Webb, W. L. *Railroad Constructions*. Wiley.

8.621 Engineering Construction

Construction plant and equipment; compressed air services, drilling, earthmoving, 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.* A. & R.
O'Neill, L. V. *Fundamentals of Estimating and Construction Cost Control.* Tait, 1966.
Ryan, P. W. S. *Engineering Administration.* A. &. R.

REFERENCE BOOKS

Refer to subject 8.612.

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

Australian Rainfall and Runoff. Institution of Engineers, Australia, 1958.
Bruce, J. P. & Clark, R. H. *Introduction to Hydrometeorology.* Pergamon, 1966.
Chow, V. T. ed. *Handbook of Applied Hydrology.* McGraw-Hill, 1964.
Elliott, A. & Dickson, J. H. *Laboratory Instruments — Their Design and Application.* Chapman & Hall.
Linsley, R. K., Kohler, M. A. & Paulhus, J. L. *Hydrology for Engineers.* McGraw-Hill.
Timoshenko, S. & MacCullough, G. H. *Elements of Strengths of Materials.* Van Nostrand.
Vennard, J. K. *Elementary Fluid Mechanics.* 4th ed. Wiley.
Whitehead, T. N. *Instruments and Accurate Mechanisms.* Dover, N.Y.

8.712 and 8.712S 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

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

Technology of Manufacturing — Work materials: mechanical tests, stress-strain curves, work hardening. Important physical properties in manufacture. Tool materials: iron-carbon system, hardening and heat treatment, T.T.T. curves. Plain carbon, alloy and high speed steel. Sintered tool materials. Theories of machining, Cutting forces and power consumption. Tool wear, life, and failure, tool performance. Surface finish. Servicing of tools. Machinability. Economics of machining. Electrical machining processes.

Metrology — Principles of measurement and measuring systems. Basic design concepts, accuracy and precision, linear and angular measurements, screwthread measurements, gear measurement.

TEXTBOOKS

Alexander, J. M. & Brewer, R. C. *Manufacturing Properties of Materials.* Van Nostrand, 1963.
A.S. CZ-1. 1966. *Engineering Drawing Practice.*
B.S. 1916, 1953. *Limits and Fits.* Parts I and II.

REFERENCE BOOKS

Datsko, J. *Material Properties and Manufacturing Processes.* Wiley, 1966.
Dieter, G. D. *Mechanical Metallurgy.* Int. ed. McGraw-Hill, 1961.
Hume, K. J. *Engineering Metrology.* 2nd ed. Macdonald.
Wilson, F. W. ed. *Tool Engineers Handbook.* 2nd ed. McGraw-Hill, 1959.

18.012 Industrial Engineering IIA

Technology of Manufacturing — Theories of deformation processes; extrusion, tube making, forming and deep drawing. Introduction to industrial experimentation; prediction of tool performance; design and analysis of shop trials.

Design for Production — Interchangeable manufacture; standardisation, selective assembly; design presentation. Design analysis, geometrical tolerancing; linear and non-linear loop equations.

Metrology — Measuring system — optical, pneumatic and electrical; straightness, flatness; surface texture and machine tool testing.
Theory of errors — quality control by variables.

TEXTBOOKS

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

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.

REFERENCE BOOKS

Bowman, E. H. & Fetter, R. B. *Analysis for Production and Operations Management.* 3rd ed. Irwin, 1967.
Hoffman, O. & Sachs, G. *Introduction to the Theory of Plasticity for Engineers.* McGraw-Hill, 1953.
Hume, K. J. *Engineering Metrology.* 2nd ed. Macdonald.

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

Barish, N. N. *Economic Analysis.* McGraw-Hill, 1962.
Bowman, E. H. & Fetter, R. B. *Analysis for Production and Operations Management.* 3rd ed. Irwin, 1967.

REFERENCE BOOKS

Karmel, P. H. & Brunt, M. *The Structure of the Australian Economy.* Cheshire, 1966.
Moroney, M. J. *Facts from Figures.* Penguin, 1965.
Samuelson, P. A. *Economics: An Introductory Analysis.* Int. ed. McGraw-Hill, 1961.

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

Greene, J. H. *Production Control: Systems and Decisions.* Irwin, 1965.
Niebel, B. W. *Motion and Time Study.* 4th ed. Irwin, 1967.

REFERENCE BOOKS

Carson, G. B. ed. *Production Handbook.* 2nd ed. Ronald, 1958.
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.

18.041 Thesis

For students in the full-time course in Industrial Engineering.

18.321 Methods Engineering

Planning and installation of manufacturing plants; location and site analysis; buildings and facilities; process and equipment selection; plant layout; maintenance problems. Ergonomics; work and effort; the dimensions of the workplace; workplace layout; the working environment and performance efficiency; fitting the job to the worker. Work measurement; motion and time study; recording and charting; work sampling; estimates for pre-determined motion times. Process analysis for production efficiency. Incentives: methods, improvement and work simplification.

Laboratory Work — Application of the laws of motion economy; workplace layout; the sequencing of manufacturing operations, time study; operation analysis and charting; the normal range of human movements and application to design of machine controls. Parameters and manifestations of physical fatigue.

REFERENCE BOOKS

Barnes, R. M. *Motion and Time Study.* 5th ed. Wiley, 1963, *or,*
Niebel, B. W. *Motion and Time Study.* 4th ed. Irwin, 1967.

REFERENCE BOOKS

Carson, G. B. ed. *Production Handbook.* 2nd ed. Ronald, 1958.
Maynard, H. B. ed. *Industrial Engineering Handbook.* 2nd ed. McGraw-Hill, 1963.

18.422 Design for Production II (Interchangeable Manufacture)

Theory — Interchangeable manufacture: manufacturing, assembly and servicing costs; advantages and disadvantages of pursuing interchangeable principle. The use of standards. Tolerancing and the determination of accumulated tolerances. Design for interchangeable or unit assembly: design, dimensioning and tolerancing to fulfil functioning and manufacturing and inspection requirements. Metrology: basic principles of precision measurement, metrological practice in measurement, principles of construction, care and use of measuring equipment.

Laboratory — Metrology: assignments associated with gauging and tooling. Surface finish, inspection: non-destructive testing, quality control and sampling inspection.

TEXTBOOKS

A.S. CZ-1. 1966. *Engineering Drawing Practice.*
B.S. 1916, 1953. *Limits and Fits.* Parts I and II.
Gladman, C. A. *Manual of Geometric Analysis of Engineering Designs.* Aust. Trade Pub., 1966.
Hume, K. J. *Engineering Metrology.* 2nd ed. Macdonald.

REFERENCE BOOKS

Parker, S. *Drawings and Dimensions.* Pitman, 1956.
Wilson, F. W. ed. *Manufacturing, Planning and Estimating Handbook.* McGraw-Hill, 1963.

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. 1916, 1953. *Limits and Fits.* Parts I and II.
Gladman, C. A. *Manual for Geometric Analysis of Engineering Designs.* Aust. Trade Pub., 1966.

REFERENCE BOOK

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

18.521 Industrial Marketing

Marketing in the Economy — The basic tasks of marketing. The economic environment of the market. Considerations of demand and supply. *Nature and Organization of Buying and Selling* — The sales practices and problems of manufacturers and distributors. Standardization differentiation and non-price competition. *Specialization and Integration* — Channels of distribution. Transfer of ownership between manufacturers, wholesalers, and retailers. Agents and distributors. Stability and change in marketing channels. *Pricing and Product Policy* — Established and new product policy. Mechanism of pricing. Pricing problems and policies. Price structures. *Marketing Efficiency and Control* — Objectives and form of control. Market research. Budgeting and accounting control. Measures of efficiency and performance. Sales aids. Selection and training of personnel. Government regulations. Characteristics of regional markets. Planning of marketing areas. Transportation economics.

TEXTBOOK

Alexander, R. S., Cross, J. S. & Cunningham, R. M. *Industrial Marketing.* 2nd ed. Irwin, 1961.

REFERENCE BOOK

Ferber, R. *Statistical Techniques in Market Research.* McGraw-Hill.

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

Houlden, B. T. ed. *Some Techniques of Operational Research.* E.U.P., 1962. Paperback.

REFERENCE BOOKS

Bowman, E. H. & Fetter, R. B. *Analysis for Production and Operations Management.* 3rd ed. Irwin, 1967.
Gass, S. I. *Linear Programming.* 2nd ed. McGraw-Hill, 1964.

18.621 Engineering Economics

The Australian Economic Structure: National Income, role of Government, Australian labor structure, international trade. Economics of Industrial Organisation: Competition, profit maximization, demand and cost analysis, prices and pricing. Theory of investment: Interest, depreciation, choice between alternatives, economic life of capital equipment and replacement policy. An introduction to accounting and accounting controls.

TEXTBOOK

Barish, N. N. *Economic Analysis.* McGraw-Hill, 1962.

REFERENCE BOOKS

Karmel, P. H. & Brunt, M. *The Structure of the Australian Economy.* Cheshire, 1966.
Kingshott, L. *Investment Appraisal.* Hutchinson Benham, 1967.
Samuelson, P. A. *Economics: An Introductory Analysis.* Int. ed. McGraw-Hill, 1961.

DEPARTMENT 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

Clark, D. *Plane and Geodetic Surveying.* Vol. I. 6th ed. Constable, 1969.

Curtin, W. & Law, R. *Concise Practical Surveying.* 1st ed. E.U.P.

Morris, G. & Flooks, F. *Background to Surveying.* 1st ed. Basil Blackwell, 1964.

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

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

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.

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

Clark, D. *Plane and Geodetic Surveying.* Vol. I. 6th ed. Constable, 1969.
Clark, D. *Plane and Geodetic Surveying.* Vol. II. 5th ed. Constable, 1963.
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.
Bannister, A. & Raymond, S. *Surveying.* Pitman, 1959.
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.

29.803S Surveying III

Graduation errors, linear and angular. Optical and electronic distance measurement. Mining and tunnel surveys. Survey methods for engineering projects.

TEXTBOOKS

Clark, D. *Plane and Geodetic Surveying.* Vol. I. 6th ed. Constable, 1969.
Clark, D. *Plane and Geodetic Surveying.* Vol. II. 5th ed. Constable, 1963.
Laurila, S. H. *Electronic Surveying and Mapping.* 2nd ed. Farrar, 1967.

REFERENCE BOOKS

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.
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.

29.805 Instruments and Cartography

Subject-matter same as Part A of 29.802.

29.806 Optics

Geometrical optics, lens systems and thick lenses, aberrations of optical systems, applications.

29.821 and 29.821S 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.

TEXTBOOKS

Bomford, G. *Geodesy.* O.U.P., 1962.
Clark, D. *Plane and Geodetic Surveying.* Vol. II. 5th ed. Constable, 1963.

REFERENCE BOOKS

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.
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.

TEXTBOOK

Bomford, G. *Geodesy*. O.U.P., 1962.

REFERENCE BOOKS

Jordan, W. & Eggert, O. *Handbook of Geodesy*. Carta, M. W. trans. Vols. I and III. U.S. Army Map Service, 1962.

Laurila, S. H. *Electronic Surveying and Mapping*. 2nd ed. Farrar, 1967.

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 and 29.831S Astronomy I

The celestial sphere and the astronomical triangle. Time. Latitude, longitude and azimuth determinations; best position, balancing, circum- and ex-meridian methods. Position lines. Sun observations.

TEXTBOOKS

Mackie, J. B. *The Elements of Astronomy for Surveyors*. 6th ed. Griffin, London, 1964.

Star Almanac for Land Surveyors for Current Year. H.M.S.O.

Textbook of Field Astronomy. H.M.S.O., 1960.

29.832 Astronomy II

Precise time of observation. Geodetic methods for determination of precise latitude, longitude and azimuth. 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 BOOK

Richardus, P. *Project Surveying.* North Holland, 1966.

29.842 and 29.842S Surveying Computations II

Transformations. Resection, intersection. Error theory. Adjustment by least squares, variance-covariance matrix.

TEXTBOOKS

Richardus P. *Project Surveying.* North Holland, 1966.

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

Shortrede, R. *Logarithms of Sines and Tangents for Every Second.* Layton.

Vega, G. *Seven Figure Logarithmic Tables.* Hafner Pub. Co., N.Y.

29.851 and 29.851S Photogrammetry I

Photogrammetric optics, sterescopic vision. Geometry of air photo, central perspective projection. Survey cameras, photographic materials. Radial triangulation, rectification, mosaics.

TEXTBOOK

Moffat, 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. Flight planning, auxiliary instruments. Aerial mapping.

TEXTBOOK

Moffat, 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 and 29.881S 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.

TEXTBOOK

Murray, J. F. N. *Principles and Practice of Valuation.* C'wealth Inst. of Valuers, 1966.

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

29.893 Survey Camp

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.

1.011 Higher Physics I

Subject matter same as 1.001, but in greater depth.

Text and Reference Books for 1.001 and 1.011 (for students taking two full years of Physics):

TEXTBOOKS

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

REFERENCE BOOKS

Feynman, R. P., Leighton, R. B. & Sands, M. *The Feynman Lectures on Physics*. Vols. I and II. Addison-Wesley.
Stephenson, R. J. *Mechanics and Properties of Matter*. 2nd ed. Wiley, 1960.
Wiedner, R. T. & Sells, R. L. *Elementary Classical Physics*. Vols. I and II. Allyn & Bacon.

(For 1.011 only)

Tomboulian, D. H. *Electric and Magnetic Fields*. Harcourt, Brace & World, N.Y., 1965.

1.041 Physics IC

For students in the Faculty of Science, Department of Surveying, and Industrial Arts course; also available as an elective in the Faculty of Arts. Consists of Units 1-9.

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, 7-11.

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. *Physical Optics* Nature of light. Velocity of light. Interference. Interference in thin films. Interferometer. Huygens' principle. Fraunhofer diffraction by slit. Diffraction grating. 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.
7. *Electrostatics and Electrodynamics* Electrostatics charge. Electric field and potential. Gauss' theorem. Capacity. Dielectrics. Magnetic fields. Biot-Savart and Ampere's circuital laws. Electromagnetic induction. Magnetic circuit.
8. *D.C. Circuits* Conductance. E.M.F. Resistivity and temperature coefficient. Power. Kirchhoff's rules and Thevenin's theorem. D.C. measurements. D.C. transients in RL and RC 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.
11. *Electronics* Diode as rectifier. Filters. Triodes, and triode parameters, Load line. Triode as amplifier and oscillator. Transistor amplifier. Instruments.
12. *Heat* Temperature measurement. Heat capacity. First law of thermodynamics. Calorimetry. Atomic heat of solids. Kinetic theory. Non-ideal gases. Van de Waals' equation. P-V isotherms. Conduction and radiation of heat. Pyrometers.

13. *Biophysics* Radioactivity, detectors, radioisotopes. Radiation, radiation biology. X-ray methods, structure of macromolecules. Mechanical and electrical properties of muscle. The nerve impulse.

14. *Geometrical Optics* Reflection, refraction, image formation, aberrations. Optical instruments, microscope, spectroscope and the eye.

Text and Reference Books for 1.041 Physics IC and 1.051 Physics IC (for students taking one year of Physics only):

TEXTBOOKS

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.

For 1.051 only:

Pollard, H. F. & Harris, R. W. *Introductory Physical Acoustics.* Univ. of N.S.W. Press.

REFERENCE BOOKS

Richards, J. A., Sears, F. W., Wehr, M. R. & Zemansky, M. W. *Modern University Physics.* Addison-Wesley, 1960.

Richtmyer, F. K., Keanard, E. H. & Lauritsen, T. *Introduction to Modern Physics.* 5th ed. McGraw-Hill.

Stephenson, R. J. *Mechanics and Properties of Matter.* 2nd ed. Wiley.

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:

1.112A Electricity and Magnetism

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.

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. *Concepts of Modern Physics.* Rev. ed. McGraw-Hill, 1967.

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 Thermodynamics and Mechanics

Thermodynamics: First and second laws of thermodynamics. Entropy and the entropy principle. Thermodynamic functions. Phase changes. Joule-Kelvin effect. Kinetic theory of gases. Equipartition of energy. Maxwell-Boltzmann distribution law. *Mechanics:* Kinematics of a particle. Dynamics of a particle in one, two and three dimensions. Harmonic oscillations, simple coupled oscillator. Orbital motion. Fields and gradients. Vector properties of fluids and flow. Wave motion.

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

Corso, D. & Lorrain, P. *Introduction to Electromagnetic Fields and Waves.* Freeman, N.Y.

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.

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 — fluid, stretched wire, surface film, reversible electric cell, paramagnetic solid. Clapeyron-Clausius equation. Joule-Kelvin effect. Thermoelectricity. Thermodynamics of radiant heat. Maxwell-Boltzmann velocity distribution law. Mean free path. Transport properties of a gas.

Motion of a particle in one, two and three dimensions. Motion of a system of particles. Moving co-ordinate systems. Mechanics of continuous media; Lagrange's and Hamilton's equations.

TEXTBOOKS

Pippard, A. B. *Classical Thermodynamics.* C.U.P., 1964.
Symon, K. R. *Mechanics.* 2nd ed. Addison-Wesley, 1965.

REFERENCE BOOKS

Goldstein, H. *Classical Mechanics.* Addison-Wesley.

Spiegel, M. R. *Theory and Problems of Theoretical Mechanics.* Schaum Pub. Co.

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

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

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.

2.011 Higher Chemistry I

Subject-matter same as 2.001, but treated in greater depth.

TEXTBOOKS

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

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.* Vols. I-V. Benjamin, N.Y., 1967.

Chemistry I — Laboratory Manual. Univ. of N.S.W., 1969.

Hart, H. & Schuetz, R. D. *Organic Chemistry.* Feffer & Simons, 1967.

Sorum, C. H. *General Chemistry Problems.* 4th ed. Prentice-Hall, N.J., 1969.

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,. 1967.
Chemistry IE. Laboratory Manual. Univ. of N.S.W., 1969.
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.
Purcell, E. J. *Calculus with Analytic Geometry.* Appleton-Century-Crofts.

It is expected that Professor G. M. Kelly's textbook will be available in its preliminary edition.

REFERENCE BOOKS

Bere, L. *Calculus.* Holt, Rinehart & Winston.
Birkhoff, G. & MacLane, S. *A Shorter Survey of Modern Algebra.* Collier-Macmillan.
Campbell, H. F. *Matrices with Applications.* Appleton-Century-Crofts.
Lange, I. H. *Elementary Linear Algebra.* Wiley.
McCoy, N. H. *Introduction to Modern Algebra.* Allyn & Bacon.
Pedoe, D. *A Geometric Introduction to Linear Algebra.* Wiley.
Polya, G. *How to Solve It.* Doubleday Anchor.
Smith, W. K. *Limits and Continuity.* Collier-Macmillan.
Spivak, M. *Calculus.* Benjamin.

SUPPLEMENTARY READING LIST

Adler, I. *The New Mathematics.* Mentor Press.
Allendoerfer, C. B. & Oakley, C. O. *Principles of Mathematics.* McGraw-Hill.
Courant, R. & Robbins, H. *What is Mathematics?* O.U.P.
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.
Spivak, M. *Calculus.* Benjamin.

It is expected that Professor G. M. Kelly's textbook will be available in its preliminary edition.

REFERENCE BOOKS

As for 10.001 Mathematics I plus:
Abraham, R. *Linear and Multilinear Algebra.* Benjamin.
Brauer, F. & Nohel, J. *Ordinary Differential Equations.* Benjamin.
Burkhill, J. C. *A First Course in Mathematical Analysis.* C.U.P.
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.

SUPPLEMENTARY READING LIST

As for 10.001 Mathematics I plus:
Arnold, B. H. *Intuitive Concepts in Elementary Topology.* Prentice-Hall.
Bell, E. T. *Men of Mathematics.* 2 vols. Pelican.
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.
Purcell, E. J. *Calculus with Analytic Geometry.* Appleton-Century-Crofts.

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.
Keane, A. & Senior, S. A. *Mathematical Methods.* Science.
Wylie, C. R. *Advanced Engineering Mathematics.* 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

Betz, H., Burcham, P. B. & Ewing, G. M. *Differential Equations with Applications.* I.S.R. Harper.
Churchill, R. V. *Complex Variables and Applications.* I.S.E. McGraw-Hill.

REFERENCE BOOK

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

Meserve, B. E. *Fundamental Concepts of Geometry.* Addison-Wesley.
Miller, K. *Elements of Modern Abstract Algebra.* I.S.R. Harper.

REFERENCE BOOKS

Birkhoff, G. & MacLane, S. *A Survey of Modern Algebra.* Macmillan.
Lederman, W. *Introduction to the Theory of Groups.* Oliver & Boyd.

10.341 and 10.341S 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

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.

10.371S Statistics

Subject matter same as 10.341.

10.381 Statistics

Subject matter same as 10.351.

TEXTBOOKS (for 10.341, 10.341S, 10.351, 10.371S and 10.381.)

Freund, J. E. *Mathematical Statistics.* 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.

11.411 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.

14.061 Accounting

An examination of basic accounting theory and its application to the accounting needs of various types of business enterprise. The preparation, analysis and interpretation of accounting reports. An introduction to the use of accounting in the area of management decision making.

TEXTBOOKS

Anthony, R. N. *Essentials of Accounting.* Addison-Wesley, 1964.
Moore, C. L. & Jaedicke, R. K. *Managerial Accounting.* 2nd ed. South-Western, 1967.

REFERENCE BOOKS

Gordon, M. J. & Shillinglaw, G. *Accounting: A Management Approach.* 4th ed. Irwin, 1968.
Li, D. H. *Accounting for Management Analysis.* Merrill, 1964.

14.062 Accounting for Engineers

Problems related to industrial situations will be examined and consideration given to their relevance in decision making. This will involve a broad study of such matters as manufacturing and cost accounts, budgeting and budgetary control, cost analysis and control and profit planning.

TEXTBOOKS

Burke, W. L. & Smyth, E. B. *Accounting for Management.* Law Book Co., 1966.
Moore, C. L. & Jaedicke, R. K. *Managerial Accounting.* 2nd ed. South-Western, 1967.

REFERENCE BOOKS

Horngren, C. T. *Cost Accounting—A Managerial Emphasis.* 2nd ed. Prentice-Hall, 1967.
Solomons, D. *Studies in Cost Analysis.* Irwin, 1968.

25.101 Geology for Engineers

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

TEXTBOOK

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

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

Jacobs, J. A. *The Earth's Core and Geomagnetism.* Pergamon, 1963.

Sumner, J. S. *Geophysics, Geologic Structures and Tectonics.* Wm. C. Brown, 1969.

REFERENCE BOOKS

Bullen, K. E. *Introduction to Theory of Seismology.* C.U.P., 1963.

Chapman, S. *The Earth's Magnetism.* Methuen, 1951.

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., Russell, R. D. & Wilson, J. T. *Physics and Geology.* McGraw-Hill, 1959.

STUDENT'S TIMETABLE

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9-10					
10-11					
11-12					
12-1					
1-2					
2-3					
3-4					
4-5					
5-6					
6-7					
7-8					
8-9					