Preface

May I first welcome all those students who are enrolled, or are contemplating enrolling, in the Faculty of Mathematics. I assure you that the staff of the Faculty will always be ready to help with your proposed course and to discuss other academic matters with you.

Your desire to study mathematics is, I am sure, based on the conviction that mathematics will be the most enjoyable of all those disciplines open to you—there can be no better reason. If you enjoy mathematics you will welcome the demands it makes upon you and your studies will be most rewarding. May I commend to you the essay on Mathematics by Professor E. C. Zeeman in the book *University Choice* (edited by Klaus Boehm) pp. 261-270, Penguin 1966.

Although Faculties of Mathematics are not uncommon overseas, the Faculty of Mathematics at the University of Newcastle was the first in Australia. This lead has now been followed by other universities in Australia.

In constituting this Faculty the Council of the University recognised the central role of mathematics in most universities, and especially in Newcastle.

The Senate, before recommending the proposal to Council, had considered very carefully two crucial questions:

- how best can the needs of students requiring studies in mathematics, supplementary and complementary to their principal subject of study, be met;
- how best can the needs of students reading mathematics as their major discipline be met?

Senate concluded that the broad applicability and servicing aspects of mathematics constituted the strongest argument for the location of mathematics in an independent faculty. Such a faculty would be able to arrange appropriate combined degree courses emphasising these areas of application. The needs of the student specialising in mathematics would also be best met by an independent faculty.

This handbook details the manner in which the Faculty of Mathematics is implementing the wishes of Council and Senate. The postgraduate course leading to the award of the Diploma in Computer Science, introduced in 1972, has proved particularly successful. A major innovation in 1975 was the provision for concurrent studies leading to the award of two degrees. The first of these would be Bachelor of Mathematics; but the other may be Bachelor of Arts, Commerce, Metallurgy or Science. Full details are given on pp. 18.
A postgraduate Diploma in Mathematical Studies will be available from 1976 onwards. This Diploma will be awarded to candidates who have successfully completed one full time year of advanced work. The course is offered especially for those who graduated some years ago and wish to update and broaden their knowledge of modern developments in mathematics. Details of this Diploma appear on page 130.

The application of mathematics to physical problems has, of course, been well established for centuries, but mathematics is now used in a large number of other endeavours, and this number is rapidly increasing. This wide spectrum of applications is reflected in the provision for joint honours degrees and also in the membership of the Faculty Board, on which almost all departments of the University are represented.

The needs of students who wish to specialise in mathematics are met not only by the provision of topics in the conventional disciplines of pure mathematics, applied mathematics and statistics, but also by the provision of topics in computing science, operations research and other aspects of modern applied mathematics. It is confidently expected that the number of topics offered will increase as the University expands. Summaries of all topics offered in 1976 appear in this handbook.

Finally, may I encourage you to take an active part in other facets of University life. You should find there is time available for these general activities in addition to that required for your studies.

R. G. KEATS
Dean
Faculty of Mathematics
A Guide to Students Enrolling in the Faculty of Mathematics

Postgraduate Courses — Requirements

Diploma in Computer Science

Schedule of Subjects

Description of Subjects

Group I — Core Subjects

Group II — Electives

Group III — Subjects

Diploma in Mathematical Studies

Master of Mathematics

Doctor of Philosophy

Doctor of Science

Research in the Department of Mathematics

Index

FACULTY OF MATHEMATICS

Dean
Professor R. G. Keats

Sub-Dean
Associate Professor W. Brisley

Faculty Secretary
P. W. Day

MATHEMATICS

Professors
J. A. Campbell, MSc(Adelaide), SM(Massachusetts Institute of Technology), MA(Cambridge), PhD(Oxford)
R. G. Keats, BSc, PhD(Adelaide), FIMA, FASA
(Head of Department)
R. W. Robinson, MA(Dartmouth), PhD(Cornell)

Associate Professors
W. Brisley, BSc(Sydney), MSc(New South Wales), PhD; DipEd(New England)
J. R. Giles, BA, PhD; DipEd(Sydney)
W. D. Wallis, BSc, PhD(Sydney)

Senior Lecturers
C. A. Croxton, BSc(Lancaster), MA, PhD(Cambridge)
V. Ficker, Prom.Mat, CSc, RNDr(Comenius)
A. J. Guttmann, MSc (Melbourne), PhD(New South Wales)
W. T. F. Lau, ME(New South Wales), PhD(Sydney), MAIAA
T. K. Sheng, BA(Marian College), BSc(Malaya & London), PhD(Malaya)
P. K. Smrž, PromPhys, CSc, RNDr(Charles)

Lecturers
R. F. Berghout, MSc(Sydney)
J. G. Couper, BSc, PhD(New England)
R. W. Gibberd, BSc, PhD(Adelaide)
M. J. Hayes, BA(Cambridge)
D. L. S. McElwain, BSc(Queensland), PhD(York (Canada))
E. R. Smith, MSc(Melbourne), PhD(London)
W. Summerfield, BSc(Adelaide), PhD(Flinders)
Students are invited to discuss their interests in a particular branch of mathematics with members of the Department who are working in that branch. The appropriate staff members for each branch may be determined by reference to the section entitled “Research in the Department of Mathematics” pp. 138,
(b) A candidate who withdraws after the sixth Monday in second term from a subject in which he has enrolled shall be deemed to have failed in that subject. However, such a candidate may apply to the Dean, who, after consultation with the Head of Department concerned, may allow him to withdraw without penalty.

9. Subjects Offered

(a) A candidate shall select at least five of his subjects from the Schedules appended to these Requirements and shall comply with the rules relating to the selection of subjects set out in the Schedule.

(b) Up to four subjects from those offered in other degree courses in the University may, with the permission of the Dean, be counted as qualifying subjects for the degree. When approving a subject, the Dean shall determine whether the subject concerned shall be classified as Part I; Part II; Part III; or Part IV.

10. Relaxing Clause

In order to provide for exceptional circumstances arising in particular cases, the Senate, on the recommendation of the Faculty Board, may relax any requirement.

SECTION II — THE ORDINARY DEGREE

11. A Subject

(a) To complete a subject qualifying towards the degree, herein-after called a subject, a candidate shall attend such lectures, tutorials, seminars, laboratory classes and field work and submit such written work as the Department concerned shall require.

(b) To pass a subject a candidate shall satisfy the requirements of the previous clause and pass such examinations as the Faculty Board concerned shall require.

12. Degree Patterns

(a) Except as provided in Section IV of these Requirements, to qualify for the ordinary degree a candidate shall pass nine subjects provided that:

(i) at least five are subjects in Mathematics;

(ii) at least two are Part III Mathematics subjects; and

(iii) no more than five are Part I subjects.

(b) Notwithstanding the provisions of subsection (a) of this clause, a candidate may substitute for one Part III Mathematics subject another Part III subject from the Schedule of Subjects with a substantial mathematical content. (Schedule B)

13. Prerequisites and Corequisites

No candidate may enrol in a subject unless he has satisfied the prerequisites and corequisites for that subject.

14. Progression

(a) Progression in the course is by subject. A full-time student is required to pass four subjects and a part-time student is required to pass two subjects in the first two years of his course. A part-time student is required to pass four subjects in the first four years of his course.

(b) The following restrictions on yearly course loads shall apply. The Dean may, in individual cases, relax restrictions (i), (ii), (iii), but only if he is satisfied that the academic merit of the candidate warrants such relaxation.

(i) No one academic year is to involve more than four subjects.

(ii) If four subjects are taken in any one year, at least three of them must be Part I subjects, and none may be a Part III subject.

(iii) If three subjects are taken in any one year, not more than two of them may be Part III subjects.

15. Time Requirements

Except with the special permission of the Faculty Board, a candidate shall complete the Requirements for the ordinary degree within nine calendar years of the commencement of the degree course. A candidate who has been granted standing in recognition of work completed elsewhere shall be deemed to have commenced his degree course from a date to be determined by the Dean.

16. Standing

The Faculty Board may grant standing under the following conditions.

(a) A candidate may be granted standing in recognition of work, completed in another tertiary institution or faculty, provided that:

(i) the subjects for which credit is given shall have a reasonable correspondence with those offered in the Faculty;

(ii) an undergraduate of another tertiary institution shall not receive credit for more than four subjects;
(iii) a graduate or diplomate of another tertiary institution or faculty shall not receive credit for more than four subjects and if granted credit may not include as a qualifying subject any subject equivalent to one counted towards his previous qualification.

(b) Notwithstanding the provision of section (a) (i) of this clause, a graduate or undergraduate of another tertiary institution may be given credit for subjects not offered for the degree of Bachelor of Mathematics in the University of Newcastle provided that:

(i) the candidate complies with all other conditions of these Requirements;

(ii) the candidate has his proposed pattern of course approved at the time at which the concession is granted and does not depart from the proposed pattern without the approval of the Dean.

17. Preparation for Honours

(a) A candidate who wishes to enrol in an Honours course must obtain the approval of the Head of the appropriate Department, or Departments, by the dates specified.

(b) A candidate wishing to enrol in an Honours course will be required to complete extra work concurrently with work for the ordinary degree.

SECTION III — THE HONOURS DEGREE

18. Honours in Mathematics

To qualify for admission to Honours in Mathematics a candidate shall:

(i) have satisfied the requirements for admission to the ordinary degree; the subjects Mathematics IIIA and Mathematics IIIB must be included;

(ii) have completed additional work concurrently with his ordinary degree, as prescribed by the Department of Mathematics;

(iii) pass the subject Mathematics IV.

19. Combined Honours

To qualify for admission to combined Honours, a candidate shall:

(i) have satisfied the requirements for admission to the ordinary degree and have included in his course such prerequisite subjects as may be prescribed for admission to the combined Honours subject or subjects;

(ii) have completed such additional work concurrently with his ordinary degree as may be prescribed by the Department of Mathematics and the other Department concerned;

(iii) pass the combined Honours subject or subjects. (Schedule C).

20. Time Requirements

(a) Except with the special permission of the Faculty Board, a candidate for Honours shall complete the requirements within five years from the commencement of his degree course, provided that where it is deemed practical to allow a part-time student to become a candidate for Honours, the corresponding period shall be seven years.

A candidate wishing to proceed to Honours who has been given standing in recognition of work completed elsewhere shall be deemed to have commenced his degree course from a date determined by the Dean.

(b) The Dean may permit a part-time candidate for Honours to complete the Honours subject or subjects over two successive years.

21. Classes of Honours

There shall be three classes of Honours, namely Class I, Class II and Class III. Class II shall have two divisions, namely Division (I) and Division (II).

22. Medal

In each Honours subject, including combined subjects, the most distinguished candidate of the year may be awarded a University Medal.

23. Equivalent Honours

(a) On the recommendation of a Head of a Department in the Faculty and with the permission of the Dean, a graduate who, in the disciplines concerned, has not completed a fourth year Honours subject either as a full-time or a part-time student at this or at any other Australian university, may enrol in fourth year Honours as a full-time or a part-time student.

(b) Such a graduate who has completed all of the requirements of fourth year Honours shall be issued with a statement to this effect by the Secretary; the statement shall indicate the Honours level equivalent to the standard achieved by the student in completing fourth year Honours.
24. General
A candidate may complete the Requirements for the degree of Bachelor of Mathematics in conjunction with another Bachelor's degree by completing a combined course approved by the Faculty Board of the Faculty of Mathematics and the other Faculty Board concerned provided that:

(i) admission to a combined course shall normally be at the end of the first year and shall be subject to the approval of the Deans of the two Faculties concerned;
(ii) admission to combined courses will be restricted to students with an average of at least Credit level;
(iii) the Deans of both Faculties shall certify that the work in the combined degree course is no less in quantity and quality than if the two courses were taken separately;
(iv) the Requirements for both degrees shall be satisfied except as provided below.

25. Arts/Mathematics
(a) A candidate shall comply with all the provisions of the Requirements for the degree of Bachelor of Arts other than Clause 12 and all the Requirements for the degree of Bachelor of Mathematics.

(b) To qualify for admission to the ordinary degrees of Bachelor of Arts and Bachelor of Mathematics, a candidate shall pass fourteen subjects, five of which shall be Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIIA and either Mathematics IIIIB or a Part III subject chosen from Schedule B of the Schedule of subjects approved for the degree of Bachelor of Mathematics and the remainder of which shall be chosen from the other subjects listed in the Schedule of subjects approved for the degree of Bachelor of Science provided that:

(i) not more than three subjects from Group II of the Schedule of subjects approved for the degree of Bachelor of Arts may be counted;
(ii) not more than five Part I subjects out of the total fourteen may be counted;
(iii) at least three subjects shall be Part III subjects;
(iv) a candidate counting Psychology IIIIC shall not count either Psychology IIIA or Psychology IIIIB;
(v) a candidate counting Economics IIIIC shall not count either Economics IIIA or Economics IIIIB.

26. Mathematics/Science
After completing the first year of study towards either the degree of Bachelor of Mathematics or the degree of Bachelor of Science including a pass at a satisfactory level in the subject Mathematics I, a candidate may enrol in a combined Mathematics/Science course. A candidate who has enrolled in such a combined course shall qualify for admission to the ordinary degrees of Bachelor of Mathematics and Bachelor of Science by passing fourteen subjects, five of which shall be Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIIA and either Mathematics IIIIB or a Part III subject chosen from Schedule B of the Schedule of subjects approved for the degree of Bachelor of Mathematics and the remainder of which shall be chosen from the other subjects listed in the Schedule of subjects approved for the degree of Bachelor of Science provided that:

(a) the maximum total number of Part I subjects shall be six;
(b) the minimum total number of Part III subjects shall be three;
(c) a candidate counting Psychology IIIIC shall not count either Psychology IIIA or Psychology IIIIB;
(d) a candidate counting Economics IIIIC shall not count either Economics IIIA or Economics IIIIB.

27. Mathematics/Metallurgy
After completing a successful first year of study towards either the degree of Bachelor of Mathematics or the degree of Bachelor of Metallurgy, a candidate may enrol in a Mathematics/Metallurgy course. A candidate who has enrolled in such a combined course shall qualify for admission to the ordinary degrees of Bachelor of Mathematics and Bachelor of Metallurgy by passing Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIIA and either Mathematics IIIIB or a Part III subject chosen from Schedule B of the Schedule of Subjects approved for the degree of Bachelor of Mathematics, and by satisfying all the Requirements for the degree of Bachelor of Metallurgy, except that:

(a) Metallurgical Computations shall be replaced by Mathematics IIIIB, which may be taken in two parts, each of three terms duration;
(b) Mathematics I shall be replaced by Chemistry I or Geology I or any other subject approved by the Deans;
(c) No Mathematics subjects shall be taken as electives.
28. Commerce/Mathematics

After completing the first year of study towards either the degree of Bachelor of Commerce or the degree of Bachelor of Mathematics, including a pass at a satisfactory level in the subject Mathematics I, a candidate may enrol in a combined Commerce/Mathematics course. A candidate who has enrolled in such a combined course shall qualify for admission to the ordinary degrees of Bachelor of Commerce and Bachelor of Mathematics by passing eighteen subjects, five of which shall be Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIB and either Mathematics IIIB or a Part III subject chosen from Schedule B of the Schedule of Subjects approved for the degree of Bachelor of Mathematics and the remainder of which shall by themselves satisfy the Requirements for the degree of Bachelor of Commerce.

SCHEDULE A — MATHEMATICS SUBJECTS

<table>
<thead>
<tr>
<th>Subject</th>
<th>Remarks including Prerequisites and Corequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART I</td>
<td></td>
</tr>
<tr>
<td>Mathematics I</td>
<td>It is assumed that students have studied Higher School Certificate Mathematics at second level short course or higher.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART II</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics IIA</td>
<td>Prerequisite Mathematics I</td>
</tr>
<tr>
<td>Mathematics IIB</td>
<td>Prerequisite Mathematics I</td>
</tr>
<tr>
<td>Mathematics IIC</td>
<td>Prerequisite Mathematics I</td>
</tr>
<tr>
<td></td>
<td>Pre- or Corequisite Mathematics IIA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART III</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics IIIA</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC</td>
</tr>
<tr>
<td>Mathematics IIIB</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART IV</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics IV</td>
<td>Prerequisites Mathematics IIIA &amp; Mathematics IIIB</td>
</tr>
</tbody>
</table>

SCHEDULE B — SUBJECTS WITH A SUBSTANTIAL MATHEMATICAL CONTENT

<table>
<thead>
<tr>
<th>Subject</th>
<th>Remarks including Prerequisites and Corequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART I</td>
<td>Civil Engineering IIM</td>
</tr>
<tr>
<td></td>
<td>Civil Engineering IIIC</td>
</tr>
<tr>
<td>Biology IIIB</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC &amp; either Biology IIA or Biology IIB</td>
</tr>
<tr>
<td>Chemical Engineering IIIC</td>
<td>Prerequisites Chemical Engineering IIM, Mathematics IIA &amp; Mathematics IIC (including Topics E &amp; F)</td>
</tr>
<tr>
<td>Civil Engineering IIIM</td>
<td>Prerequisites Civil Engineering IIIM, Mathematics IIA &amp; Mathematics IIC</td>
</tr>
<tr>
<td>Communications &amp; Automatic Control</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC (including Topic E)</td>
</tr>
<tr>
<td>Digital Computers &amp; Automatic Control</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC (including Topics C, D &amp; E)</td>
</tr>
<tr>
<td>Economics IIIC</td>
<td>Prerequisites Economics IIA, Mathematics IIA &amp; Mathematics IIC</td>
</tr>
<tr>
<td>Geology IIIC</td>
<td>Prerequisites Physics IA, Mathematics IIA, Mathematics IIC &amp; Geology IIA</td>
</tr>
<tr>
<td>Industrial Engineering I</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC</td>
</tr>
</tbody>
</table>

1 A candidate with better than pass level in Physics I and Chemistry I and the ability to write real situations in mathematical terms and to read around his subject, could complete the components of Chemical Engineering IIIC without Chemical Engineering I, and may, after interview, be granted exemption by the Head of the Department of Chemical Engineering.
Subject | Remarks including Prerequisites and Corequisites
--- | ---
Mechanical Engineering IIIIC | Prerequisites Mathematics IIA & Mathematics IIC, (including Topics E, F & H)
Physics IIIA | Prerequisites Physics II, Mathematics IIA & Mathematics IIC
Psychology IIIC | Prerequisites Mathematics IIA, Mathematics IIC and one of Psychology IIA or Psychology IIB

SCHEDULE C — COMBINED HONOURS SUBJECTS

Mathematics/Physics IV | Prerequisites Mathematics IIIA & Physics IIIA
Mathematics/ Psychology IV | Prerequisites Mathematics IIIA & Psychology IIIC

NOTES ON COMBINED DEGREE COURSES

ARTS/MATHEMATICS

The details for the combined course follow simply from the Requirements for each degree. Each degree requires nine subjects so the combined degree requires 18 subjects less four subjects for which standing may be given, thus the combined degree should contain 14 subjects. The Bachelor of Mathematics requires Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIIA and either Mathematics IIIIB, or a Part III subject from Schedule B of the Requirements. This leaves nine subjects which must clearly satisfy the Requirements for the Science degree.

The course could be pursued in the following manner:

Year I: Mathematics I and three other Part I subjects,
Year II: three Part II subjects including Mathematics IIA and Mathematics IIC and another subject which should be a Part I or Part II subject approved for the degree of Bachelor of Arts,
Year III: Mathematics IIIA plus two other subjects which must include at least one Part III subject,
Year IV: either Mathematics IIIIB or a Schedule B subject from the Requirements for Bachelor of Mathematics, plus two other subjects will complete the Requirements for the Science degree.

MATHEMATICS/SCIENCE

The details for the combined course follow simply from the Requirements for each degree. Each degree requires nine subjects so the combined degree requires 18 subjects less four subjects for which standing may be given, thus the combined degree should contain 14 subjects. The Bachelor of Mathematics requires Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIIA and either Mathematics IIIIB, or a Part III subject from Schedule B of the Requirements. This leaves nine subjects which must clearly satisfy the Requirements for the Science degree.

The course could be pursued in the following manner:

Year I: Mathematics I and three other Part I subjects,
Year II: three Part II subjects including Mathematics IIA and Mathematics IIC and another Part I subject,
Year III: Mathematics IIIA plus two other subjects which must include at least one Part III subject,
Year IV: either Mathematics IIIIB or a Schedule B subject from the Requirements for Bachelor of Mathematics, plus two other subjects will complete the Requirements for the Science degree.

MATHEMATICS/METALLURGY

The details of the combined course in Mathematics and Metallurgy follow simply from the Requirements for each degree. The combined degree course should contain Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIIA and either Mathematics IIIIB or a Part III subject from Schedule B of the Schedule of Subjects approved for the degree of Bachelor of Mathematics, and all the subjects satisfying the Requirements for the degree of Bachelor of Metallurgy, except that:

(a) Metallurgical Computations shall be replaced by Mathematics IIIB, which may be taken in two parts, each of three terms duration;
(b) Mathematics I shall be replaced by Chemistry I or Geology I or any other subject approved by the Deans;
(c) No Mathematics subjects may be taken as electives.

The course could be pursued in the following manner:

Year I: Mathematics I, Physics IIA, CHE101, Met141, Met151, Met181, Met182, Met121, and two of ME131, ME111 and ME112
Year II
Mathematics IIA, Mathematics IIB Part I, Met221, Met212, Met213, Met231, Met252, Met241, Met261, Met271 and one of Chemistry I, Geology I or any other subject approved by the Deans.

Year III
Mathematics IIC, Mathematics IIB Part II, Met301, Met361, Chem331, 6 of Met 300 subjects, Elective I and 2 units of Elective II.

Year IV
Mathematics IIIA and either Mathematics IIB, or a Schedule B Part III subject from the Requirements for the degree of Bachelor of Mathematics and 4 units of Elective II.

Year V
Met401, Met402, and 2 units of Elective II.

1 Mathematics IIA — Topics A, C, D, E.
Mathematics IIB, Part I — Topics F, G.
Mathematics IIB, Part II — Topics B, J.
Mathematics IIC — Topics H, I, K, L.

2 No Mathematics subject may be taken as an elective.

NOTE ON SUBJECT ENTRIES

Subject outlines and reading lists are set out in a standard format to facilitate easy reference. An explanation is given below of some of the technical terms used in this Handbook.

(a) Prerequisites are subjects which must be passed before a candidate enrols in a particular subject. The only prerequisites noted for topics are any topics or subjects which must be taken before enrolling in the particular topic. To enrol in any subject which the topic may be part of, the prerequisites for that subject must still be satisfied.

Where a prerequisite is marked "(advisory)", lectures will be given on the assumption that the subject or topic has been completed as indicated.

(b) Corequisites for subjects are those which the candidate must pass before enrolment, or be taking concurrently.
Corequisites for topics are those which the candidate must take before enrolment, or be taking concurrently.

(c) Examination — see note on progressive assessment below.

(d) Texts are essential books recommended for purchase.

(e) References are books relevant to the subject or topic which, however, need not be purchased.

DESCRIPTION OF SUBJECTS

SCHEDULE A

Preliminary Notes
The Department offers and examines subjects. Each subject is composed of topics, each topic consisting of about 27 lectures and 13 tutorials throughout the year. Each of the Part I, Part II, and Part III subjects consists of four topics. For Mathematics I, there is no choice of topics; for Mathematics II, III, there is some choice available to students; for Mathematics IIIA and IIB there is a wider choice. No topic may be counted twice in making up distinct subjects. (Students who passed some mathematics subjects before this arrangement of subjects was introduced should consult the "transition arrangements" set out on p.155 of the 1970 Faculty of Arts handbook, and p.76 of the 1973 Faculty of Mathematics handbook. Note that the "code letters" for the topics may vary slightly from year to year.)

Progressive Assessment
From time to time during the year students will be given assignments, tests, etc. The student's performance in this work will be taken into account in the following manner.

(a) For the implementation of By-law 5.4.1.1 which deals with unsatisfactory progress. A copy of this By-law appears in the General Supplement supplied with this Handbook.

(b) Where a student's performance during the year has been better than his performance in the final examination, then the former will be taken into account in determining his final result. On the other hand, when a student's performance during the year has been worse than his performance in the final examination, then his performance during the year will be ignored in determining his final result.

PART I SUBJECT

661100 Mathematics I

Prerequisites
Nil

Hours
Four lecture hours and two tutorial hours per week for three terms

Examination
Two 3-hour papers
Content
Topics AN — Real Analysis
AL — Algebra
CA — Calculus
NM — Numerical Mathematics

PART I TOPICS

Topic AN — Real Analysis — M. J. Hayes

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Content

Text
Nil

References
Apostol, T. Calculus Vol. I 2nd edn (Ginn Blaisdell 1967)
Giles, J. R. Real Analysis — an Introductory Course (Wiley 1973)
Spivak, M. Calculus (W. A. Benjamin 1967)

Topic AL — Algebra — W. Brisley

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Content
Introduction to basic algebraic objects and ideas. Matrices, permutations, complex numbers. Linear Algebra: vector spaces, homomorphisms, matrices, determinants; algorithms for solution of equations; rank, nullity: eigenvectors and eigenvalues; applications various.

Text
Nil

References
Apostol, T. Calculus Vol. I 2nd edn (Ginn Blaisdell 1967)
Britton, J. R., Kriegh, R. B. & Rutland, L. W. Calculus and Analytic Geometry (Freeman 1966)
Hille, E. & Salas, S. First Year Calculus (Ginn Blaisdell 1968) (International Textbook Series)

Topic CA — Calculus — R. F. Berghout

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Content

Text
Nil

References
Apostol, T. Calculus Vol. I 2nd edn (Ginn Blaisdell 1967)
Britton, J. R., Kriegh, R. B. & Rutland, L. W. Calculus and Analytic Geometry (Freeman 1966)
Hille, E. & Salas, S. First Year Calculus (Ginn Blaisdell 1968) (International Textbook Series)

Topic NM — Numerical Mathematics — A. J. Guttmann

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight
Content
Introduction to computers, flowcharts and Fortran coding. Elementary
data analysis: calculations of sample moments of discrete distributions
and programming of these operations. Introduction to statistical
analysis and numerical analysis with computer illustrations. The
writing of successful computer programs is a required part of this
topic.

Texts
Blatt, J. M. Basic Fortran IV Programming; Version
   MIDITRAN (Computer Systems of
   Australia Pty Ltd 1969)
Wilkes, M. V. A Short Introduction to Numerical Analysis
   (Cambridge University Press 1971)

References
Hoel, P. G. Introduction to Mathematical Statistics 4th edn
   (New York, Wiley 1971)
Ralston, A. A First Course in Numerical Analysis
   (McGraw-Hill 1965)

PART II SUBJECTS
The Department offers three Part II subjects. Students whose course
restricts them to one subject must study Mathematics IIA or Mathematics
H. The subject Mathematics IIA is a pre- or corequisite for Mathematics
HC, and IIA and HC together a prerequisite for any Part III subject, so
students wishing to take two Part II subjects would normally choose
Mathematics IIA and HC. Students taking all three of the Part II subjects
would study all twelve of the topics listed below.

Summaries and booklists for these topics are given on page 26 et seq.
of this handbook.

List of Topics for Part II Mathematics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Corequisite or Prerequisite Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Mathematical Models</td>
</tr>
<tr>
<td>B</td>
<td>Complex Analysis</td>
</tr>
<tr>
<td>C</td>
<td>Calculus and Vector Calculus</td>
</tr>
<tr>
<td>D</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>E</td>
<td>Differential Equations and Integral Transforms</td>
</tr>
<tr>
<td>F</td>
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The selection rules and definitions of the Part II subjects follow.

662100 Mathematics IIA

Prerequisite Mathematics I

Hours Four lecture hours and two tutorial hours per week for three terms

Examination Each topic is examined separately

Content
Topics B, C, D, and E. In exceptional circumstances and with the consent of the Head of Department, one topic from A, F, G, or H may be substituted for B. Additional substitutions may be allowed in the case of candidates who have passed the subject Mathematics IIB.

662200 Mathematics IIB

Prerequisite Mathematics I

Hours Four lecture hours and two tutorial hours per week for three terms

Examination Each topic is examined separately

Content
Four topics chosen from A to H and approved by the Head of the Department. In exceptional circumstances and with the consent of the Head of the Department one or more of the topics, I, J, K or L may be included. Students in the Faculty of Mathematics may, with the consent of the Dean, take Mathematics IIB in two parts, each consisting of two topics.
662300 Mathematics IIC

Prerequisite
Mathematics I

Pre- or Corequisite
Mathematics IIA

Hours
Four lecture hours and two tutorial hours per week for three terms

Examination
Each topic is examined separately

Content
Either topics G, J, K and L or topics H, I, K and L. Subject to the consent of the Head of the Department one topic from A to J may be substituted for one of the topics I or J.

Notes
1. Students whose course includes a Schedule B subject may have their choice of topics restricted further than is set out in the rules above.
2. Students whose courses include Physics IIIA are advised to include topics C, E, G, H in their Mathematics Part II subjects; this may require the use of the substitution rules.
3. Students who passed a Part II Mathematics subject prior to 1974 and who wish to take further Part II Mathematics subjects should note that the topic coded “L” in 1974, 1975 and 1976 corresponds to the topic coded “A” in previous years. Such students may require special permission for their selection of Part II topics, and should consult with the Head of the Department.

PART II TOPICS


Prerequisite
Topic C

or Corequisite

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
This topic is designed to introduce students to the idea of a mathematical model. Four or five realistic situations will be treated beginning with an analysis of the non-mathematical origin of the problem, the formulation of the mathematical model, solution of the mathematical problem and interpretation of the theoretical results. For example, models involving applications of operations research, probability and differential equations will be developed.

Text
Nil

References
Kemeny, J. G. & Snell, J. L.
Mathematical Models in Social Sciences (Ginn Blaisdell 1963)
Noble, B.
Applications of Undergraduate Mathematics in Engineering (M.A.A./Collier-Macmillan 1967)
Rapoport, Anatol & Chammah, A. M.
Prisoner's Dilemma (University of Michigan Press 1965)
Taha, H. A.
Operations Research — an Introduction (Macmillan 1971)
Wagner, H. M.

662102 Topic B — Complex Analysis — R. W. Gibberd

Prerequisite
Topic C

or Corequisite

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content

Text
Spiegel, M. R.
Theory and Problems of Complex Variables (McGraw-Hill 1964)

References
Churchill, R. V.
Complex Variables and Applications (McGraw-Hill 1960)
Knopp, K.
Theory of Functions Parts I & II (New York, Dover 1954)
Pennisi, Louis L.
Elements of Complex Variables (Holt, Rinehart & Winston 1963)
Polya, G. & Latta, G. E.
Complex Variables (Wiley 1974)
662103 Topic C — Calculus and Vector Calculus — R. J. Vaughan

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
Functions of several variables: graphical representation; domain and range; limits and continuity. Differential calculus of functions of several variables including: partial derivatives; total differentials and the tangent plane, directional derivatives and grad; chain rules, implicit functions, transformations and Jacobians; Taylor's theorem; optimization of functions of two variables and Lagrange multipliers. Integral calculus of functions of several variables: the iterated integral; change of variable. Line and surface integrals: Green's, Gauss' and Stokes' theorems. Vector functions of vectors; vector fields; the gradient field, conservative vector fields; div. Gauss' Theorem in vector form; curl. Stokes' Theorem in vector form; the operator 'Del'.

Text

OR
Marder, L. *Calculus of Several Variables* (Allen Unwin 1972)

OR
Marder, L. *Vector Fields* (Allen Unwin 1972)

OR

References
Courant, R. *Differential and Integral Calculus* Vols I & II (Blackie 1949)

Kaplan, W. *Advanced Calculus* (Addison-Wesley 1952)


O'Neill, P. V. *Advanced Calculus* (Collier-Macmillan 1975)

662104 Topic D — Linear Algebra — W. Brisley

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content

Text
Lipschutz, S. *Linear Algebra* (Schaum 1968)

References
Ayres, F. *Matrices* (Schaum 1962)

Brisley, W. *A Basis for Linear Algebra* (Wiley 1973)

Lange, L. H. *Elementary Linear Algebra* (Wiley 1968)

Nering, E. D. *Linear Algebra and Matrix Theory* (Wiley 1964)


Trooper, Mary A. *Linear Algebra* (Nelson 1969)

662201 Topic E — Differential Equations and Integral Transforms — W. Summerfield

Prerequisite or Corequisite
Topic C

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
First order linear equations. Second order linear equations with constant coefficients. General solution for second order linear homogeneous and nonhomogeneous equations, initial value problems.
Laplace transform and initial value problems for second order linear equations. Series solutions for Legendre's equation and Bessel's equation of integral order. Systems of linear equations, general solution, matrix exponential and systems with constant coefficients. Introduction to nonlinear equations.

Some of the examples, and exercises will be set up by modelling physical problems; the dimensional homogeneity of the derived equations will be emphasised. Particular attention will be paid to the interpretation of solutions of such equations.

Text


662202 Topic F — Numerical Analysis and Computing —

D. L. S. McElwain

Prerequisites

Nil

Hours

One lecture hour per week and one tutorial hour per fortnight

Examination

One 2-hour paper

Content


Text

Nil

References

Balfour, A. & Beveridge, W. T. *Basic Numerical Analysis with Fortran* (Heinemann Educational Books 1973)


662203 Topic G — Fourier Series, Partial Differential Equations and Special Functions — P. K. Smrz

Prerequisite or Corequisite

Topic C

Hours

One lecture hour per week and one tutorial hour per fortnight

Examination

One 2-hour paper

Content


Texts

Weinberger, H. F. AND Sneddon, I. N. *A First Course In Partial Differential Equations* (Ginn Blaisdell 1965)

*Fourier Series* (Routledge 1961)

Reference

Kaplan, W. *Advanced Calculus* (Addison-Wesley 1965)

662204 Topic H — Probability and Statistics — R. G. Keats

Prerequisite or Corequisite

Topic C

Hours

One lecture hour per week and one tutorial hour per fortnight
Examination
One 2-hour paper

Content
This topic is an introduction to the theory of probability and statistics. No previous knowledge of probability or statistics will be assumed. The lectures will include a discussion of the following. Finite probability space, simple random variable, expectation, mean, variance, covariance, correlation, independence, frequency function, distribution function, joint frequency function, moments and binomial variates. Error propagation, Tchebichev inequality and the weak law of large numbers. Elementary random variables, Poisson’s theorem; conditional probability; Bayes’ theorem, tree diagrams. Continuous random variables, frequency function, expectation, joint frequency function, moments. Normal variates. Classification of experimental data, histograms, empirical moments, measures of location and scatter. Statistical inference, hypothesis testing, types of error, power function, sampling theory, maximum likelihood estimation; frequency functions of the mean ($\bar{X}$), difference of two means ($X_1 - X_2$), and the statistics $X^2$, $S^2$, and $F$ with applications.

Text

References
Gnedenko, B. V. *The Theory of Probability* Chapters I & II (Chelsea 1962)
Kolmogorov, A. N. *Foundations of the Theory of Probability* (Chelsea 1950)
Lipschutz, S. *Theory and Problems of Probability* (Schaum 1968)
Loève, M. *Probability Theory* pp.1-18 (Van Nostrand 1960)
Moran, P. A. P. *An Introduction to Probability Theory* (Oxford University Press 1968)

662301 Topic I — Topic in Statistics
e.g. Applications of Statistics—R. W. Gibberd

Prerequisite or Corequisite
Topic H

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
This topic is an introduction to some methods of statistics and its applications. The lectures will include the following topics — descriptive statistics, standardization of data, linear regression and correlation, introductory multiple linear regression, analysis of categorized data, rank statistics, goodness of fit tests and non-parametric statistics.

Text
Nil

References
Hoel, P. G. *Introduction to Mathematical Statistics* (Wiley 1971)

662302 Topic J — Topic in Applied Mathematics
e.g. Mechanics — C. A. Croxton

Prerequisites or Corequisites
Topics C and E

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
Mass and momentum — Newton's First Law, Force, Newton's Second Law, Conservation of Energy, rotating frames of reference, transformation from one reference frame to another, Coriolis forces and centrifugal forces. Rigid bodies, centres of mass, angular momentum, moments of inertia, conservation of angular momentum, gyroscopes. Principle of virtual work and d'Alembert's principle, Hamilton's principle, generalized co-ordinates, Lagrange's equation and the Hamilton-Jacobi formulation of mechanics. The course will involve the study of numerous examples and applications.
### 662303 Topic K — Topic in Pure Mathematics

**e.g. Group Theory — M. J. Hayes**

**Prerequisites**
Nil

**Hours**
One lecture hour per week and one tutorial hour per fortnight

**Examination**
One 2-hour paper

**Content**
Groups, subgroups, isomorphism, direct product. Permutation groups, isometries in \( \mathbb{R}^2 \) and \( \mathbb{R}^3 \) as products of reflections, symmetry groups of regular polygons and polyhedra. Cosets, Lagrange's theorem, normal subgroups, isomorphism theorems, correspondence theorem. Orbits, stabilisers, and their applications to the Burnside-Polya counting procedure and classification of finite groups of isometries in \( \mathbb{R}^2 \) or \( \mathbb{R}^3 \). Patterns, friezes and wallpapers.

**Text**
Nil

**References**
- Baumslag, B. & Chandler, B.
- Budden, F. J.
  - *The Fascination of Groups* (Cambridge University Press 1972)
- Coxeter, H. S. M.
  - *Introduction to Geometry* (Wiley 1961)
- Rotman, J. J.
- Weyl, H.
  - *Symmetry* (Princeton University Press 1952)

### 662304 Topic L — Analysis of Metric Spaces — J. R. Giles

**Prerequisites**
Nil

**Hours**
One lecture hour per week and one tutorial hour per fortnight

**Examination**
One 2-hour paper

**Content**
Examples of metric and normed linear spaces; the topology of metric spaces, equivalent metrics. Convergence of sequences, completeness. Cluster points and closure, density and separability. Continuity of mappings and of linear mappings on normed linear spaces, uniform continuity. Uniform convergence of sequences and series of real mappings, applications to differentiation and integration of sequences and series of real mappings, power series; Weierstrass' Approximation Theorem. Compactness, the equivalence of the various forms of compactness for metric spaces, application to the topological equivalence of finite dimensional normed linear spaces.

**Text**
Giles, J. R.
- *Analysis of Metric Spaces* (University of Newcastle)

**References**
- Dieudonné, J.
- Giles, J. R.
  - *Real Analysis — an Introductory Course* (Wiley 1973)
- Goldberg, R. R.
  - *Methods of Real Analysis* (Ginn Blaisdell 1964)
- Mendelson, B.
  - *Introduction to Topology* (Blackie 1963)
- Simmons, G. F.
- White, A. J.
  - *Real Analysis* (Addison-Wesley 1968)

### PART III SUBJECTS

The Mathematics Department offers two Part III subjects, each comprising four topics chosen from the list below.

Students wishing to proceed to Honours in Mathematics are required to take both these subjects. Students wishing to proceed to Combined Honours are required to take Mathematics IIIA together with the appropriate subject from Schedule B. Students proceeding to Honours will also be required to study additional topics as prescribed by the Heads of the Departments concerned.
Passes in both Mathematics II A and II C are prerequisite for entry to Mathematics III A, and Mathematics III A is pre- or corequisite for Mathematics III B. It will be assumed that students taking a third-year subject in 1976 have already studied topics C, D, E, K, L in their Part II subjects.

Students from other Faculties who wish to enrol in particular Part III topics, according to the course schedules of those Faculties, should consult the particulars of the list below, and should consult the lecturer concerned. In particular, the prerequisites for subjects may not all apply to isolated topics.

Summaries of these topics, together with texts and references, appear on page 37 et seq. of this handbook.

List of Topics for Part III Mathematics

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The selection rules and definitions of the Part III subjects follow.

663100 Mathematics III A

**Prerequisites** Mathematics II A and Mathematics II C

**Hours** Four lecture hours and two tutorial hours per week for three terms

**Examination** Each topic is examined separately

Content
A subject comprising four topics, which must include O, and at least one of P, PD, Q, R, U or Y. In addition, students taking this subject will be required to complete an essay on a topic chosen from the history or philosophy of Mathematics.

663200 Mathematics III B

**Prerequisite** Mathematics III A

**Hours** Four lecture hours and two tutorial hours per week for three terms

**Examination** Each topic is examined separately

Content
A subject comprising four topics chosen from the fifteen listed above.

Notes
1. In order to take both Mathematics III A and Mathematics III B, a student must study eight topics from M to Z above with the restriction that Topic O, and at least one of P, PD, Q, R, U or Y must be included in these eight topics.
2. Students whose course includes a subject from Schedule B may have their choice of topics further restricted.
3. Students aiming to take Mathematics IV may be required to undertake study of more topics than the eight comprising the two Part III subjects.

PART III TOPICS

663101 Topic M — General Tensors — W. T. F. Lau

**Prerequisites** Nil

**Hours** One lecture hour per week and one tutorial hour per fortnight

**Examination** One 2-hour paper

Content
Vector spaces: basis; change of basis; dual spaces; dual basis; contravariant and covariant components. Point spaces. Tensor algebra. Tensor calculus: derivatives and differentials; Christoffel symbols; differential operators in curvilinear coordinates, Riemannian spaces: tangential and osculating Euclidean metrics; Geodesics; curvature tensor; Riemann-Christoffel tensor. Applications: dynamics; continuum mechanics.
663102  Topic N — Variational Methods — W. P. Wood

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content

Text
Elsgolc, L. E.  Calculus of Variations (Pergamon Press 1963)

References
Hadley, G. & Kemp, M. C.  Variational Methods in Economics (Amsterdam, North-Holland 1971)
Mikhlin, S. G.  Variational Methods in Mathematical Physics (Oxford, Pergamon Press 1964)
Weinstock, R.  Calculus of Variations (New York, McGraw-Hill 1952)

663103  Topic O — Mathematical Logic — R. W. Robinson

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
Introduction: inference rules as a formalisation of deductive processes; sets; axiomatic theories; predicates. The sentential calculus, predicate calculus and predicate calculus with equality. First order theories; consistency, independence and completeness. Examples will be taken from the usual axiometrically defined Mathematical systems, and Gödel's theorem will be discussed.

Text

References
Kleene, S. C.  Introduction to Metamathematics (Van Nostrand 1952)
Kleene, S. C.  Mathematical Logic (Wiley 1967)
Mendelson, E.  Introduction to Mathematical Logic (Van Nostrand 1964)
Shoenfield, J. R.  Mathematical Logic (Addison-Wesley 1967)

663104  Topic P — Differential and Integral Equations — P. K. Smrz

Prerequisite
Topic E

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
Text
Sanchez, D. A. *Ordinary Differential Equations and Stability Theory: an Introduction* (Freeman 1968)

References

663108 Topic PD — Applications of Partial Differential Equations — C. A. Croxton

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
An exhaustive study of linear homogeneous equations of second order arising in a wide variety of fields including aero, hydro and stellar dynamics, mechanics, geology, quantum chemistry, etc. Solutions of these boundary value problems in terms of Bessel, Laguerre, Legendre, Hermite, Tchebycheff, Mathieu functions will be given. Variational and approximate methods for estimating eigenvalues will be treated in detail.

Text

References
Friedman, A. *Generalized Functions and Partial Differential Equations* (Prentice-Hall 1963)
Kellogg, O. D. *Foundations of Potential Theory* (Dover 1953)

Weinberger, H. F. *A First Course in Partial Differential Equations with Complex Variables and Transform Methods* (Blaisdell 1965)

663105 Topic Q — Fluid Dynamics — W. T. F. Lau

Prerequisite
Topic B

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
Introduction: governing equations and boundary conditions; momentum theorem. Potential Flows: uniqueness theorem; kinetic energy; simple solutions; equations of streamlines; combination of solutions; method of images; axisymmetrical motion; Stokes' stream function. Two dimensional motion: complex potential; complex velocity; simple solutions; Milne-Thompson's circle theorem; Blasius' theorem; conformal transformation and its applications. Waves.

Text
Nil

References
Milne-Thompson, L. M. *Theoretical Hydrodynamics* (Macmillan 1968)

663106 Topic R — Probability and Statistics — V. Ficker

Prerequisite
Topic H

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
normal regression theory. Analysis of variance. The complete two and three-factor experimental designs and the Latin square experimental design. If time permits basic results in factor analysis will be discussed.

Text

References


Lindgren, B. W.  *Statistical Theory*  2nd edn  (Collier-Macmillan 1968)


663107  **Topic S — Geometry** — V. Ficker

Prerequisite  Nil

Hours  One lecture hour per week and one tutorial hour per fortnight

Examination  One 2-hour paper

Content
Euclidean geometry: axiomatic and analytic approach, transformations, isometries, decomposition into plane reflections, inversions, quadratic geometry.

Geometry of incidence: the real projective plane, invariance, projective transformation, conics, finite projective planes.

Text  Nil

References
Ayres, F.  *Projective Geometry*  (Schaum 1967)


Fishback, W. T.  *Projective and Euclidean Geometry*  (Wiley 1962)


Moise, E. E.  *Elementary Geometry from an Advanced Standpoint*  (Addison-Wesley 1963)

663201  **Topic T — Group Theory** — R. F. Berghout

Prerequisites  Nil

Hours  One lecture hour per week and one tutorial hour per fortnight

Examination  One 2-hour paper

Content
Finite Abelian groups. Finite groups; Sylow theorems and their application to an analysis of isomorphism classes.

Series: Jordan-Holder theorem, soluble and nilpotent groups.

Infinite Abelian groups; torsion, torsion-free, free Abelian, finitely generated and divisible groups.

Text  Baumslag, B. & Chandler, B.  *Group Theory*  (Schaum 1968)

OR


663202  **Topic U — Operations Research** — R. J. Vaughan

Prerequisites  Nil

Hours  One lecture hour per week and one tutorial hour per fortnight

Examination  One 2-hour paper

Content
In 1976 this course will consider mainly the mathematics of deterministic models in operations research. Topics covered will include game theory; linear programming; networks and flows; activity analysis; dynamic programming.

Text  Nil
References
Bellman, R. E. & Dreyfus, S. E.  
Dantzig, G. B.  
Ford, L. & Fulkerson, D.  
Hall, M. Jr.  
Hillier, F. S. & Lieberman, G. J.  
Luce, R. D. & Raiffa, H.  
Taha, H. A.  
Vajda, S.  

Applied Dynamic Programming (Princeton 1962)  
Linear Programming and Extensions (Princeton 1963)  
Flows in Networks (Princeton University Press 1962)  
Combinatorial Theory (Blaisdell 1967)  
Introduction to Operations Research (Holden-Day 1967)  
Games and Decisions (Wiley 1957)  
Operations Research — An Introduction (Macmillan 1971)  
Mathematical Programming (Addison-Wesley 1961)

663203 Topic V — Measure Theory and Integration — M. J. Hayes

Prerequisite
Topic L — Analysis of Metric Spaces

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content

Text
Nil

References
Bartle, R. G.  
Burkill, J. C.  
de Barra, G.  
Halmos, P. R.  
Kolmogorov, A. N. & Fomin, S. V.  

The Elements of Integration (New York, Wiley 1966)  
The Lebesgue Integral (Cambridge University Press 1961)  
Introduction to Measure Theory (Van Nostrand 1974)  
Measure Theory (Van Nostrand 1950)  
Introductory Real Analysis (Prentice-Hall 1970)

663204 Topic W — Analysis of Normed Linear Spaces — J. R. Giles

Prerequisite
Topic L — Analysis of Metric Spaces

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper

Content
Banach spaces; continuous linear mappings; topological and isometric isomorphisms. Finite dimensional spaces and their special properties. Dual spaces; the form of continuous linear functionals on example spaces. Hilbert space; the representation of continuous linear functionals. Hahn-Banach theorem; reflexivity. Category and Baire’s theorem; the open mapping, closed graph and uniform boundedness theorems. Conjugate mappings; adjoint and self-adjoint operators in Hilbert space. Complete orthonormal sets in Hilbert space.

Text
Brown, A. L. & Page, A.  

Elements of Functional Analysis (Van Nostrand 1969)

References
Banach, S.  
Giles, J. R.  

Théories des Opérations Linéaires 2nd edn (Chelsea)  
Analysis of Metric Spaces (University of Newcastle)

Kolmogorov, A. N. & Fomin, S. V.  

Elements of Functional Analysis (New York, Frederick Unger 1961)  

Liusternik, L. A. & Sobolev, U. J.  

Introduction to Topology and Modern Analysis (McGraw-Hill 1963)  

Simmons, G. F.  
Taylor, A. E.  
Wilansky, A.  

Introduction to Functional Analysis (Wiley 1958)  
Functional Analysis (Blaisdell 1964)

663205 Topic X — Rings and Fields — M. J. Hayes

Prerequisites
Nil

Hours
One lecture hour per week and one tutorial hour per fortnight

Examination
One 2-hour paper
Content


References

Adamson, I. T.  
*Introduction to Field Theory* (Oliver & Boyd 1964)

Birkhoff, G. D. & MacLane, S.  
*A Survey of Modern Algebra* (Macmillan 1953)

Herstein, I. N.  
*Topics in Algebra* (New York, Blaisdell 1965)

Kaplansky, I.  
*Fields and Rings* (University of Chicago 1969)

Lang, S.  
*Structures of Algebra* (Addison-Wesley 1967)

Stewart, I.  
*Galois Theory* (Chapman & Hall 1933)

663206  
**Topic Y — Topic in Applied Probability**

e.g.  
*Information Theory* — W. P. Wood

Prerequisite  
Topic H

Hours  
One lecture hour per week and one tutorial hour per fortnight

Examination  
One 2-hour paper

Content

This topic is an introduction to that theory of information which originated in the work of C.E. Shannon in 1948. The uniqueness theorem for the information content H will be proved followed by proof of several inequalities involving this function. The concept of a channel and its capacity will be introduced and Shannon’s fundamental theorem for discrete channels without memory will be proved.

If time permits some other aspects of information theory, e.g., Wiener prediction and filtering, will be discussed.

Text  
Nil

References

Ash, R.  
*Information Theory* (New York, Wiley 1965)

Brillouin, L.  

Feinstein, A.  

Gallagher, R. G.  
*Information Theory and Reliable Communications* (Wiley 1968)

Khinchin, A. I.  
*Mathematical Foundations of Information Theory* (Dover 1957)

Kotz, S.  
*Recent Results in Information Theory* (London, Methuen 1966)

Reza, F. M.  

663207  
**Topic Z — Mathematical Principles of Numerical Analysis** — W. Summefield

Prerequisites  
Nil

Hours  
One lecture hour per week and one tutorial hour per fortnight

Examination  
One 2-hour paper

Content

The general theory of convergence of linear iterative methods for approximating solutions of linear systems of algebraic equations and its efficient utilization to approximate solutions of boundary value problems by way of finite difference and “continuous” discretizations, including finite elements. Adaptation to the understanding of asymptotic stability of linear marching schemes and the general importance of numerical stability in the numerical handling of initial-value problems. Both ordinary and partial differential equations will be covered. Various applications of the numerical methods will be analysed. Some analysis background and some experience in programming computers is assumed but no prerequisites of numerical analysis courses will be expected.

Text  
Nil

References

Daniel, J. W. & Moore, R. E.  
*Computation and Theory in Ordinary Differential Equations* (Freeman 1970)

Desai, C. & Abel, J.  
*Introduction to the Finite Element Method* (Van Nostrand 1972)

Text  Nil

References
Adamson, I. T.  Introduction to Field Theory (Oliver & Boyd 1964)
Birkhoff, G. D. & MacLane, S.  A Survey of Modern Algebra (Macmillan 1953)
Herstein, I. N.  Topics in Algebra (New York, Blaisdell 1965)
Kaplansky, I.  Fields and Rings (University of Chicago 1969)
Lang, S.  Structures of Algebra (Addison-Wesley 1967)
Stewart, I.  Galois Theory (Chapman & Hall 1933)

663206  Topic Y — Topic in Applied Probability

Prerequisite  Topic H

Hours  One lecture hour per week and one tutorial hour per fortnight

Examination  One 2-hour paper

Content
This topic is an introduction to that theory of information which originated in the work of C.E. Shannon in 1948. The uniqueness theorem for the information content H will be proved followed by proof of several inequalities involving this function. The concept of a channel and its capacity will be introduced and Shannon's fundamental theorem for discrete channels without memory will be proved.

If time permits some other aspects of information theory, e.g., Wiener prediction and filtering, will be discussed.

Text  Nil

References
Ash, R.  Information Theory (New York, Wiley 1965)
Gallagher, R. G.  Information Theory and Reliable Communications (Wiley 1968)
Khinchin, A. I.  Mathematical Foundations of Information Theory (Dover 1957)
Kotz, S.  Recent Results in Information Theory (London, Methuen 1966)

663207  Topic Z — Mathematical Principles of Numerical Analysis

W. Summerfield

Prerequisites  Nil

Hours  One lecture hour per week and one tutorial hour per fortnight

Examination  One 2-hour paper

Content
The general theory of convergence of linear iterative methods for approximating solutions of linear systems of algebraic equations and its efficient utilization to approximate solutions of boundary value problems by way of finite difference and "continuous" discretizations, including finite elements. Adaptation to the understanding of asymptotic stability of linear marching schemes and the general importance of numerical stability in the numerical handling of initial-value problems. Both ordinary and partial differential equations will be covered. Various applications of the numerical methods will be analysed. Some analysis background and some experience in programming computers is assumed but no prerequisites of numerical analysis courses will be expected.

Text  Nil

References
Ash, R.  Information Theory (New York, Wiley 1965)
Daniel, J. W. & Moore, R. E.  Computation and Theory in Ordinary Differential Equations (Freeman 1970)
PART IV SUBJECT

664100 Mathematics IV

Prerequisites
Mathematics IIIA and Mathematics IIIB, and additional work as prescribed by the Head of the Department of Mathematics.

A student desiring admission to this subject must apply in writing to the Head of Department before 7th December of the preceding year.

Hours
At least eight lecture hours per week over one full-time year or four lecture hours per week over two part-time years.

Examination
At least eight final papers, each of two hours duration.

Each student will be required to present a thesis; i.e., a study under direction of a special topic using relevant published material and presented in written form.

The topics offered may be from any branch of Mathematics including Pure Mathematics, Applied Mathematics, Statistics, Computing Science and Operations Research as exemplified in the publication Mathematical Review.

Content
A selection of topics, each of about 27 lectures, will be offered. Summaries of topics which may be offered in 1976 follow.

664131 Categorical Algebra — R. F. Berghout

Prerequisites
Nil

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
The aim of this topic is to provide a conceptual framework for dealing with notions which occur in widely different contexts in various branches of Mathematics. Notable among these notions are those of a natural transformation, of a universal construction, of a functor and of a pair of adjoint functors. The relations between the latter and so-called “monads” or “triples” will also be studied and shown to provide a possible approach to universal algebra.

Text
MacLane, S. Categories for the Working Mathematician (Springer, paperback, 1971)

664132 Origins of Contemporary Mathematics — R. F. Berghout

Prerequisites
Topic T or X, and Topic V or W

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
This topic deals with the emergence of the main branches of mathematics up to about 1900. One term will examine some typical successes and concerns of pre-1600 mathematicians such as polynomial equations (going back to the Babylonians) and problems concerning irrationals and infinitesimals which find echoes in later mathematics. Further lectures will discuss classical mathematics, increasing concerns with rigour and the divergence of various disciplines. While lectures will mainly treat “pure” mathematics, fourth year students will be expected to write two essays, one on the development of an applied mathematics topic, and one on the development of any branch of mathematics into this century.

Text
Nil
References
Bell, E. T.  
The Development of Mathematics (McGraw-Hill 1945)
Kline, M.  
Mathematical Thought from Ancient to Modern Times (Oxford University Press 1972)

and various other articles and books mentioned during the course.

664133 Concrete Group Theory — W. Brisley

Prerequisite  
Topic K

Hours  
About 27 lecture hours

Examination  
One 2-hour paper

Content
A course on some aspects of group construction, which will include discussion of: presentation of a group by generators and relations; presentation of a group as a group of permutations, and as a symmetry group or structure-preserving group; relations between groups and some geometrical objects; representation of a group as a group of matrices; construction of groups in various ways from known groups; constructions preserving varietal and categorical properties; construction of “generating” groups for certain classes.

Text
Nil

References
Burrow, M.  
Representation Theory of Finite Groups (Academic Press 1965)
Coxeter, H. S. M. & Moser, W. O. J.  
Generators and Relations for Discrete Groups (Springer 1957)
Feit, W. J.  
Characters of Finite Groups (Benjamin 1969)
Hall, Jr, M.  
The Theory of Groups (Macmillan 1962)
Kurosh, A. G.  
Magnus, W., Karrass, A. & Solitar, D.  
Combinatorial Group Theory (New York, Interscience 1966)
Scott, W. R.  
Group Theory (Prentice-Hall 1964)

and other articles and books mentioned during the course.

664136 Current Problems in Elementary-Particle Theory and General Relativity — J. A. Campbell

Prerequisites  
Nil

Hours  
About 27 lecture hours

Examination  
One 2-hour paper

Content
Introduction to the description of elementary particles and their strong, electromagnetic and weak interactions. Methods of classification of families of particles (e.g. group symmetries, Regge trajectories, dual models), together with their original justifications and present shortcomings. Connections between particle theories and theoretical astrophysics, cosmology, and general relativity. Present status of attempts to combine results from quantum field theory and the general theory of relativity.

Text
Nil

References
Frazer, W. R.  
Elementary Particles (Prentice-Hall 1966)
Gasiorowicz, S.  
Elementary Particle Physics (Wiley 1966)
Hawking, S. W. & Ellis, G. F. R.  
The Large-Scale Structure of Space-Time (Cambridge University Press 1973)
Quantum Gravity (Oxford University Press 1975)
Perl, M. L.  
High-Energy Hadron Physics (Wiley 1974)
Weinberg, S.  
Gravitation and Cosmology (Wiley 1972)
Zel’dovich, G. Ya., & Novikov, I. D.  

664111 Fluid Statistical Mechanics — C. A. Croxton

Prerequisites  
Nil

Hours  
About 27 lecture hours

Examination  
One 2-hour paper
Content

Text
Croxton, C. A. 
Introduction to Liquid State Physics (Wiley 1975)

Reference
Croxton, C. A. 

664120 Quantum Mechanics — C. A. Croxton

Prerequisite
Topic G

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content

Texts
Croxton, C. A. 
Introductory Eigenphysics (Wiley 1974)
Matthews, P. T. 
Introduction to Quantum Mechanics (McGraw-Hill 1968)

664128 Transport Theory — C. A. Croxton

Corequisite
Fluid Statistical Mechanics

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
Elementary kinetic theory; Boltzmann transport equation; Fokker-Planck equation; Rice-Allnatt equation; the friction constant; Smoluchowski equation; the velocity autocorrelation.

Radiative transitions in many body systems — elastic and inelastic neutron scattering and spectral functions; the van Hove spectral function, special forms of $S(k,w)$, Mössbauer effect; light scattering by liquids; magnetic scattering. Linear response theory: fluctuation-dissipation theorem: linear response: Kubo relations: applications. Generalised evolution — Feynmann diagrammatic approach and the approach of Prigogine: irreversibility.

Text
Croxton, C. A. 
Introduction to Liquid State Physics (Wiley 1975)

Reference
Croxton, C. A. 
Liquid State Physics — A Statistical Mechanical Introduction (Wiley 1974)

664119 Population Dynamics — R. W. Gibberd

Prerequisites
Nil

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
This course will cover two topics. Firstly, the models and techniques used by demographers for predicting and studying population growth and mobility will be covered. “Computer experiments” will be carried out to determine the effects of varying age-specific fertility, mortality and migration rates on the future population structure in Australia and its regions. Secondly, various mathematical models used to explain spatial interaction in urban areas will be discussed and applied to the Newcastle urban region.

Text
Nil

References
Keyfitz, N. 
Introduction to the Mathematics of Population (Addison-Wesley 1968)
Pollard, J. H. 
Mathematical Models for the Growth of Human Populations (Cambridge 1973)
Rogers, A. 
Matrix Methods in Urban and Regional Analysis (Holden-Day 1971)
Wilson, A. G.  *Entropy in Urban and Regional Modelling* (Pion 1970)

Wilson, A. G.  *Urban and Regional Models in Geography and Planning* (Wiley 1974)

664103  **Banach Algebra** — J. R. Giles

**Prerequisite**  Topic W

**Hours**  About 27 lecture hours

**Examination**  One 2-hour paper

**Content**

A Banach Algebra is a mathematical structure where the two main strands of pure mathematical study — the topological and the algebraic — are united in fruitful contact. The course will cover the following subject matter. Normed algebras; regular and singular elements; the spectrum of an element and its properties; the Gelfand-Mazur theorem; topological divisors of zero; the spectral radius and spectral mapping theorem for polynomials; ideals and maximal ideals.

Commutative Banach algebras; the Gelfand theory and the Gelfand representation theorem.

Weak topologies, the Banach-Alaoglu theorem, the Gelfand topology. Involutions in Banach algebras; hermitian involutions; the Gelfand-Naimark representation theorem for commutative B* algebras. Numerical range of an element in a normed algebra; relation of the numerical range to the spectrum; B* algebras are symmetric, discussion of the Gelfand-Naimark representation theorem for B* algebras.

Applications of Banach algebra theory.

**Text**

Bonsall, F. F. & Duncan, J.  *Complete Normed Algebras* (Springer 1973)

**References**


Gelfand, I. M., Raikov, D. A. & Shilov, G. E.  *Commutative Normed Rings* (Chelsea 1964)

Naimark, M. A.  *Normed Rings* (Noordhoff 1959)


Simmons, G. F.  *Introduction to Topology and Modern Analysis* (McGraw-Hill 1963)

Wilansky, A.  *Functional Analysis* (Blaisdell 1964)

664114  **Linear Operators** — J. R. Giles

**Prerequisites**  Topics V and W

**Hours**  About 27 lecture hours

**Examination**  One 2-hour paper

**Content**

The theory of linear operators on Hilbert and Banach spaces is a very important theory and is valuable for applications.

We consider the algebra of continuous linear operators on a normed linear space, the spectrum and numerical range of a continuous linear operator, and conjugate operators.

We discuss the theory of compact linear operators and the Riesz-Schauder Theory for such operators.

The course concentrates on spectral theory for different types of operator on Hilbert space: compact normal, self-adjoint and normal operators.

**Text**


**References**


Dunford, N. & Schwartz, J.  *Linear Operators* (Interscience 1958)

Lorch, E.  *Spectral Theory* (Oxford University Press 1962)


664116 Mathematical Models of Phase Transitions — A. J. Guttman

**Prerequisite**
Rigorous Statistical Mechanics is strongly advised as a corequisite

**Hours**
About 27 lecture hours

**Examination**
One 3-hour paper

**Content**

**Text**
Thompson, C. J. *Mathematical Statistical Mechanics* (Macmillan 1971)

**References**
Brout, R. H. *Phase Transitions* (Academic Press 1972)


Huang, K. *Statistical Mechanics* (Wiley 1963)


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664127 Topology — M. J. Hayes

**Prerequisites**
Nil

**Hours**
About 27 lecture hours

**Examination**
One 2-hour paper

**Content**
Topological spaces are sets with enough cohesive properties to allow continuity to be defined. These lectures will concentrate on the geometric aspects of these spaces, and will include the following topics: Metric and topological spaces, homeomorphism. Bases, countable bases, separation. Connected spaces, compact spaces. Product spaces, homotopy and the fundamental group. Simplicial complexes, chains and homology. Orientation. Fixed points.

**Text**
Nil

**References**

Lefschetz, S. *Introduction to Topology* (Princeton 1949)

Patterson, E. M. *Topology* 2nd edn (Oliver & Boyd 1959)

Simmons, G. F. *Introduction to Topology and Modern Analysis* (McGraw-Hill 1963)

Wallace, A. H. *An Introduction to Algebraic Topology* (Pergamon 1961)

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664124 Signal Detection — R. G. Keats

**Prerequisites**
Topics H and R

**Hours**
About 27 lecture hours

**Examination**
One 2-hour paper

**Content**
This topic will cover the detection and processing of signals with applications. The topic will discuss the application of likelihood ratio, Bayes and other tests to signal detection and processing in a variety of situations including known signals in white Gaussian noise, and known signals in coloured Gaussian noise. The Shannon sampling theorem, Karhunen-Loève expansion, sequential detection and the effect of clipping will also be discussed.

**Text**
Nil
This topic will cover the theory of stochastic processes and some of its applications. The topic will include the concepts of stationarity, covariance function, regular process, mean square continuity, differentiation, integration, ergodicity, spectrum, processes with uncorrelated or orthogonal increments, Wiener process, Poisson process. Applications to prediction, filtering or signal detection, will also be studied.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Instructor</th>
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<th>Hours</th>
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<tr>
<td>664126</td>
<td>ReclUsion Theory — R. W. Robinson</td>
<td>R. W. Robinson</td>
<td>Topic O</td>
<td>About 27 lecture hours</td>
<td>One 2-hour paper</td>
<td>Recursive functions and Turing reducibility are discussed, along with various more special reducibilities. The structure of the degrees of unsolvability is investigated using various priority method constructions.</td>
<td>Nil</td>
<td>References</td>
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<tr>
<td>664135</td>
<td>Introduction to Differential Geometry — P. K. Smrz</td>
<td>P. K. Smrz</td>
<td>Nil</td>
<td>About 27 lecture hours</td>
<td>One 2-hour paper</td>
<td>Permutations and combinations, inclusion-exclusion and generating functions. Pólya's theorem and its application to counting various kinds of structures and graphs will be discussed. Also asymptotic analysis of many of the exact results.</td>
<td>Nil</td>
<td>References</td>
</tr>
</tbody>
</table>
Content
The course will provide an introduction to what is known as the modern differential geometry. The following subject matter will be covered: manifolds, tangent vectors, vector fields, differential forms, Lie groups and Lie algebras, Principal and associated fibre bundles. Connections. Covariant differentiation. Bundle of frames, vector bundles, Riemannian connections. Examples of applications of the theory in physical sciences.

Text
Nil

References
Lang, S. Differential Manifolds (Addison-Wesley 1970)

664107 Dynamic Oceanography — W. Summerfield

Prerequisites
Nil

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
Structure and physical properties of the oceans. Kinematics; conservation laws; rotating frame of reference; coriolis acceleration. Dynamics; Boussinesq approximation; dimensionless parameters; turbulent flow; vorticity. The introductory lectures will be followed by detailed examinations of a selection of topics from theories of the ocean circulation, surface wave theory and estuarine oceanography.

Text
Nil

References
Krauss, E. Atmosphere-Ocean Interaction (Oxford 1972)
Krauss, W. Methods and Results of Theoretical Oceanography Vol. I (Gebrüder Borntraeger 1973)

Phillips, O. M. The Dynamics of the Upper Ocean (Cambridge University Press 1966)
Sverdrup, H. V., Johnson, M. W. & Fleming, R. H. The Oceans: Their Physics, Chemistry and General Biology (Prentice-Hall 1963)

664112 Geometric Probability — R. J. Vaughan

Prerequisites
Topics C and H

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
The course will examine some properties of points and lines distributed in two dimensional Euclidean space. The multivariate normal distribution will be used to describe possible connections between two different sets of points on a plane. Shortest path curves will be examined when cost varies with both direction and position. Applications to traffic movement and urban geography will be emphasised. The course will rely heavily on continuous probability distribution.

Text
Nil

References
Kendall, M. G. & Moran, P. A. P. Geometrical Probability (Griffin 1963)
Mardia, K. V. Families of Bivariate Distributions (Griffin 1970)

664105 Combinatorial Designs — W. D. Wallis

Prerequisites
Nil

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
An introduction to various types of designs and their properties. Pairwise balanced designs: the basic theory, some existence theorems, Wilson's theorems. Latin squares and balanced incomplete block design; the existence theory using pairwise balanced designs, and various constructions. Partial balance. Room squares. Hadamard matrices. Block designs on graphs, such as handcuffed designs.
Text
References
Hall Jr, M. *Combinatorial Theory* (Blaisdell 1967)
Raghavarao, D. *Constructions and Combinatorial Problems in Design of Experiments* (Wiley 1971)
Ryser, H. J. *Combinatorial Mathematics* (Wiley 1963)
Vajda, S. *Patterns and Configurations in Finite Spaces* (Griffin 1967)
Wallis, W. D., Street, A. P. & Wallis, J. S. *Combinatorics: Room Squares, Sum-Free Sets, Hadamard Matrices* (Springer-Verlag 1972)

**664102 Asymptotic Methods in Analysis — W. P. Wood**

**Prerequisites**
Nil

**Hours**
About 27 lecture hours

**Examination**
One 2-hour paper

**Content**
This topic will outline methods useful in the solution of a wide class of problems occurring in Applied Mathematics. The topic will include an introduction to asymptotics, asymptotic series, implicit functions, summation formulae, Mellin transforms, the Laplace method for integrals, the saddle point method, the method of steepest descents, indirect asymptotics, iterated functions, differential equations with a large parameter, singularities of differential equations, estimation of the remainder in an asymptotic expansion, numerical quadrature and asymptotic expansions, some examples of asymptotic problems in mathematical physics, e.g., motion in a stratified atmosphere, instability of shear flows, spiral structure of disc galaxies.

**Text**
Nil

**References**
Copson, E. T. *Asymptotic Expansions* (Cambridge University Press 1965)
DeBruijn, N. G. *Asymptotic Methods in Analysis* 3rd cdn (North Holland 1970)
Erdelyi, A. *Asymptotic Expansions* (New York, Dover 1956)
Evgrafov, M. A. *Asymptotic Estimates and Entire Functions* (New York, Gordon & Breach 1961)
Jeffreys, H. *Asymptotic Approximations* (Oxford University Press 1962)
Lauwerier, H. A. *Asymptotic Expansions* (Amsterdam, Mathematisch Centrum 1966)
Prerequisites Nil

Hours About 27 lecture hours

Examination One 2-hour paper

Content
Problem of random walk; lattice walks; walks in continuous time; spatial restrictions; correlated walks; self-avoiding walks; diffusion and Brownian motion; applications to polymer physics, astronomy, numerical analysis and solid state physics.

Text Nil

References
Spitzer, F. *Principles of Random Walk* (New York, Van Nostrand 1964)

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SCHEDULE B

PART I

521200 Civil Engineering IM

Prerequisites Mathematics 2S and Science 2S (advisory, see page 20.

Corequisite Mathematics I

Hours Four lecture hours and two tutorial and laboratory hours per week

Examination As prescribed by the Head of the Department

Content
(i) CE111 Statics
(ii) ME131 Dynamics
(iii) CE231 Fluid Mechanics I or ME251 Fluid Mechanics
(iv) CE212 Mechanics of Solids I

(i) 521101 CE111 Statics — N. O. Betts

Hours One lecture hour and one half tutorial hour per week

Examination One paper of three hours duration

Content
Two-dimensional force systems; equilibrium, funicular polygon, rigid bars, shear force, axial force, bending moment; pin-jointed frames, analytical and graphical treatment; equilibrium of three-dimensional force systems, cables under distributed loads.

Text
Hall, A. S. & Archer, F. *Principles of Statics* (University of N.S.W. Students Union 1966)

References
Meriam, J. L. *Statics* (Wiley 1966)
(ii) 541103 ME131 Dynamics — K. L. Hitz

Hours
One and a half hours per week

Examination
One paper of three hours duration

Content
A Study of Force and Motion.
The forces involved in motion; gravity, dry friction, viscous friction, rolling friction. The "free body" and control volume techniques. Internal and external forces and equilibrium.

Newton's laws of motion applied to point masses, rigid bodies and connected bodies moving in straight line or curved paths or in simple rotation. Reference frames and relative motion; inertial frames, accelerating frames and rotating frames, Coriolis acceleration with illustrations.

Momentum and impulse, both linear and angular, related to point masses and rigid bodies.

Energy and the conservation principle applied to mechanical work, strain energy, kinetic energy, potential energy and friction "losses", in the context of point masses and rigid bodies.

Text
Meriam, J. L. Dynamics 2nd edn S.I. Version (Wiley 1966)

Reference

(iii) 522102 CE231 Fluid Mechanics I — W. G. Field

Hours
One lecture hour and one half tutorial hour and laboratory work per week

Examination
One paper of three hours duration

Content

Text

Reference

(iv) 522102 CE212 Mechanics of Solids I — P. W. Kleeman

Hours
One and a quarter lecture hours and three quarters of a tutorial hour per week

Examination
One paper of three hours duration

Content
Uniaxial loading, states of stress and strain, stress and strain relationships; internal forces, internal stresses, deflection of beams, torsion, buckling.
Hall, A. S.  
References  
Crandall, S. H.  
Dahl, N. C. & Lardner, T. J.  
Shanley, F. R.  

References  
Crandall, S. H.  
Dahl, N. C. & Lardner, T. J.  
Shanley, F. R.  

An Introduction to the Mechanics of Solids (Wiley 1973)

An Introduction to the Mechanics of Solids  
2nd edn (McGraw-Hill 1972)


PART II

522700  Civil Engineering II

Prerequisites  
Mathematics I and Civil Engineering I

Hours  
Five lecture hours and two and a half tutorial and laboratory hours per week

Examination  
Two papers of three hours duration and progressive assessment

Content  
(i) CE313A Structural Analysis I
   (ii) CE332 Fluid Mechanics II
   (iii) ME301 Engineering Computations

523105  CE313A Structural Analysis I — A. W. Page/N. O. Betts

Hours  
Two lecture hours and one tutorial hour per week

Examination  
One paper of three hours duration

Content  
Analysis component of CE313 — Structural Analysis and Design I. Analysis of elastic statically determinate and indeterminate systems by classical methods; plastic analysis.

Text  
Nil

References  
Coates, R. C., Coutie, M. G. & Kong, F. K.

(iii) 523301  CE332 Fluid Mechanics II — F. M. Henderson

Hours  
Two lecture hours and one tutorial and laboratory hour per week

Examination  
One paper of three hours duration

Content  
Similitude; flow nets, boundary layers; closed conduit flow; pipe networks; unsteady flow; waterhammer, hydraulic machinery, open channel hydraulics, backwater curves.

Preliminary Reading  
Rouse, H. & Ince, S.  
History of Hydraulics (Dover 1963)

Texts  
Henderson, F. M.  
Olson, R. M.  

Open Channel Flow (Collier Macmillan 1966)

Engineering Fluid Mechanics 3rd edn (Tutext 1973)

References  
Davis, C. V. & Sorenson, K. E.  
Morris, H. M.  


Applied Hydraulics in Engineering (Ronald Press 1963)

Rouse, H.  
Streeter, V. L.  

Engineering Hydraulics (Wiley 1958)

Handbook of Fluid Dynamics (McGraw-Hill 1961)

Vallentine, H. R.  

Applied Hydrodynamics (Butterworths 1959)

(iii) 543101  ME301 Engineering Computations — L. W. B. Browne

Hours  
One and a half hours per week

Examination  
Progressive assessment

Text  
Heyman, J.  

Horne, M. R.  
Plastic Theory of Structures (Nelson 1971)

Norris, C. H. & Wilber, J. B.  
Elementary Structural Analysis (McGraw-Hill 1960)

References  
Davis, C. V. & Sorenson, K. E.  


Handbook of Applied Hydraulics in Engineering (Ronald Press 1963)

Rouse, H.  
Streeter, V. L.  

Engineering Hydraulics (Wiley 1958)

Handbook of Fluid Dynamics (McGraw-Hill 1961)

Vallentine, H. R.  

Applied Hydrodynamics (Butterworths 1959)
Content

Texts
Duncan, A. K. *Fortran* (Dataset Pty Ltd 1973)
McCracken, D. P. & Dorn, W. S. *Numerical Methods with Fortran IV Case Studies* (Wiley International 1972)

References
Forsythe, G. & Moler, C. B. *Computer Solution of Linear Algebraic Systems* (Prentice-Hall 1967)

PART III

413900 Accounting IIIIC

Prerequisites
Mathematics IIIA, Mathematics IIC and either Accounting IIA or Accounting IIB

Hours
Four lecture hours and one tutorial hour per week

Examination
Two papers of three hours duration and two papers of two hours duration

Content
Either Accounting IIIA or Accounting IIIIB and two appropriately chosen Part III topics (e.g. topics U and R) offered by the Department of Mathematics and approved by the Head of the Department.

Either

(i) 413100 Accounting IIIIA

Prerequisite
Accounting IIA

Hours
Two lecture hours per week

Examination
Two papers of three hours duration

Content
Selected contemporary problems in the theory and practice of financial accounting, company financial reporting and public practice including a study of current approaches to the formulation of accounting theory; governmental and institutional accounting.

Texts
Beck, G. W. *Public Accountants in Australia — Their Social Role* (Australian Accounting Research Foundation)
Levy, V. M. *Public Financial Administration* (Law Book Co.)

References
American Accounting Association
American Institute of C.P.A.'s
Backer, M. (ed) *A Statement of Basic Accounting Theory*
Baxter, W. T. & Davidson, S. *Studies in Accounting Theory* (Sweet & Maxwell 1966)
Chambers, R. J. *The Effectiveness of Accounting Information* (Praeger 1967)
Gilman, S. *Readings in Accounting Theory* (Houghton Mifflin 1966)
Goldberg, L. *Accounting Concepts of Profit* (Ronald)
Hendriksen, E. S. *An Inquiry into the Nature of Accounting* (American Accounting Association 1965)
Hendriksen, E. S. & Budge, B. P. *Concepts of Depreciation* (Law Book Co. 1960)
Goldberg, L. *Accounting Theory* (Irwin 1970)
Hendriksen, E. S. & Budge, B. P. *Contemporary Accounting Theory* (Dickenson)
(ii) 413200 Accounting IIIb

Prerequisite Accounting IIB

Hours Two lecture hours per week

Examination Two papers of three hours duration

Content

Selected contemporary problems in the theory and practice of managerial accounting. Topics studied include the development of management accounting, decision theory and information systems, profit planning, cost-volume-profit analysis, incremental analysis, intra company pricing and divisional performance evaluation, product pricing direct costing, allocation of costs, cost accounting for income determination, feedback for accounting control, behavioural considerations in management accounting and general concepts of management accounting including decision making for small and medium sized manufacturers.

Texts

Articles are selected from Abacus, The Accounting Review, Journal of Accounting Research, Journal of Business, etc. Text books should not be purchased until the course has commenced.

References


Benston, G. J. Contemporary Cost Accounting and Control (Dickenson 1970)


Greenwood, W. T. Decision Theory and Information Systems (South Western 1969)

Hofstede, G. H. The Game of Budget Control (Associated Book Publishers 1967)

Hornbaken, C. T. Accounting for Management Control (Prentice-Hall 1965)


National Association of Accountants Research Reports and Research Monographs
Parker, R. H. Management Accounting: An Historical Perspective (Macmillan 1969)
Rosen, L. S. Topics in Managerial Accounting (McGraw-Hill 1970)
Stedry, A. C. Budget Control and Cost Behaviour (Prentice-Hall — Ford Foundation Series 1961)
Thomas, W. E. (ed.) Readings in Cost Accounting Budgeting and Control (South Western 1968)

713200 Biology IIIb — D. Angus/B. A. Conroy/R. C. Jones/J. W. Patrick
Prerequisites Mathematics IIA and Mathematics IIC and either Biology IIA or Biology IIB
Hours Four lecture hours and eight tutorial and laboratory hours per week. A field excursion
Examination Two papers of three hours duration

Content
Fundamentals of Population and Quantitative Genetics

Community Analysis
Structure and dynamics of biological communities.

Environmental Physiology
Functional adaptations (homeostatic and developmental) of organisms to their environments.

Texts
Falconer, D. S. Introduction to Quantitative Genetics (Oliver & Boyd)
Ford, E. B. Ecological Genetics (Methuen)
Hoar, W. S. General & Comparative Physiology 2nd edn (Prentice-Hall 1975)

Zar, J. H. Biostatistical Analysis (Prentice-Hall)

References
Briggs, D. & Walters, S. M. Plant Variation and Evolution (World University Library 1969)
C.S.I.R.O. The Australian Environment (Melbourne University Press)
Kershaw, K. A. Quantitative and Dynamic Plant Ecology 2nd edn (Edward Arnold)
Leopold, A. C. & Kriedemann, P. E. Plant Growth and Development (McGraw-Hill 1975)
Phillipson, J. Ecological Energetics (Edward Arnold 1966)

513900 Chemical Engineering IIIc
Prerequisites Chemical Engineering I, (but see note on page 17, Mathematics IIA and Mathematics IIC (including topic E & F).

Hours See under individual topics below

Examination As prescribed by the Head of the Department of Chemical Engineering

Content
Six of the following eight topics:
(i) ChE301 Computations
(ii) ChE312 Reaction Engineering
(iii) ChE313 Transport Principles (2 topics)
(iv) ChE314 Process Control
(v) ChE322 Particulate Systems (2 topics)
(vi) ChE331 Process Economics
(vii) ChE412 Radiant Heat Transfer
(viii) ChE413 Selected Topics in Heat and Mass Transfer
ChE301 Computations — J. Roberts

Hours
Approx. 21 hours

Content
Computations for heat and mass transfer, thermodynamic functions and data processing will be used as an introduction to numerical methods emphasizing iterative techniques. Extensive use of FORTRAN IV and Input/Output operations, sub-programs, subroutines, ICL computer packages and efficient programming in FORTRAN will be made.

Topic Outlines
Curve fitting by classical graphical methods. Curve fitting with data transformed by least squares polynomial approximation, mini-max polynomials; coefficient errors. Iterative solution of algebraic and transcendental single-simultaneous equations by first or second order methods, weighting factors on convergence efficiency. Matrix methods in solving sets of equations. Solution of single/simultaneous differential equations of first or higher order. ICL Analogue Simulation package.

Texts
Scheid, F. Numerical Analysis (McGraw-Hill 1968)

References

Chemical Reaction Engineering 2nd edn (Wiley 1972)

ChE312 Reaction Engineering — T. F. Wall

Hours
One and a half hours a week for half a year

Examination
To be advised

Content
Design and operation of chemical reactors for homogeneous and heterogeneous reacting systems. Elementary reaction kinetics leading to interpretation of experimental data needed to design batch and continuous reactors. Effect of heat of reaction and changes of temperature and pressure on design, use of catalysts and residence time estimation. An introduction to design for heterogeneous reacting systems.

Text
Levenspiel, O.

ChE313 Transport Principles — K. L. Smith

Hours
One and a half hours per week for one year

Content
Heat and mass transfer in unsteady state conditions, transport theory for momentum, heat and mass transfer in laminar and turbulent flow conditions. Boundary layer theory. The course stresses the application of mathematics to the solution of engineering problems. Analogies between heat mass and momentum transfer.

Text

ChE314 Process Control — W. G. Kirchner

Hours
One and a half hours a week for half a year

Examination
To be advised

Content
Introduction to process dynamics, the well stirred vessel, treatment of experimental data, Laplace Transform Applications. Block diagram rotation, open loop and closed loop systems, the transfer function application and limitations, Control modes, Stability of closed loop system, elementary root locus, Bode diagram. Feed forward, Control, cascade control with applications to control of temperature, flow pressure and composition.

Text
ChE322 Particulate Systems — J. Roberts/I. McC. Stewart

Hours
One and a half hours per week

Examination
To be advised

Content
Definition of size and shape of solid particles, laws of breakage, analytical description of size distributions, matrix description of breakage and classification operations, crushing and grinding equipment, separation of solids; partition curves; pressure and flow of granular material. Drying operations, movement of moisture in solids; drying systems, drying equipment; design methods. Furnace and kiln analysis by heat and mass balance on well-stirred and parallel flow reactors. Size and solids separation in gas or liquids; action of gravitational and centrifugal fields, design and performance of separation and pollution control equipment under these conditions — settling chambers, gas and liquid cyclones, centrifuges; flocculation, hindered settling, sludge thickening; Flow through fixed beds; Fluidisation-Filtration-analytical and design methods. Agitation and mixing-scale up and shape considerations; Evaporation and crystallisation. Dust and gas removal for environmental control.

Text

References
Kuni & Levenspiel Fluidization Engineering (Wiley 1968)

ChE331 Process Economics — B. D. Henry

Hours
One and a half hours a week for half a year

Examination
To be advised

Content
2. Cost estimation procedures — cost indices — six tenths rule and economy of scale.
3. Economic production charts (break even analysis). Capacity factors, incremental costs.
4. Depreciation — Purpose of depreciation studies in process costs — types and requirements of depreciation methods — taxation allowances in process plant and equipment — economic life — depletion.
5. Project profitability — Concept of equivalence and discounted cash flows — methods for measuring project profitability including rate of return, payout time, interest rate of return (DCF) net present value, annual cost and capitalised cost — continuous discounting.
6. Economic Balances — General considerations for economic balance — brief introduction to optimisation — Economic balances applied to selected operations, i.e. mass transfer, cyclic operation, yield and recovery operation.
7. Feasibility studies — selected examples.

Text

References
Buchanan & Sinclair Costs and Economics of the Australian Chemical and Process Industries 2nd edn (Wests 1967)
Peters, M. S. & Timmerhaus Plant Design and Economics for Chemical Engineers (McGraw-Hill 1968)

ChE412 Radiant Heat Transfer — I. McC. Stewart

Hours
One and a half hours a week for half a year

Examination
As prescribed by the Head of the Department

Content

Text
Hottel, H. C. & Sarofim, A. C. Radiative Transfer (McGraw-Hill 1968)
ChE413 Selected Topics in Heat and Mass Transfer
I. McC. Stewart/K. L. Smith

Hours
One and a half hours a week for half a year

Examination
As prescribed by the Head of the Department

Content
Special Topics from:
Analytical and finite difference methods for mass and heat transfer in packed beds. Break through curves. Application to regenerators, blast furnaces and solid-bed absorbers and ion-exchange equipment.
Separation problems arising from bubble and droplet coalescence. Heat and mass transfer with reaction in porous and ash-coated particles.
More advanced gas radiation studies.
Gas radiation problems, scatter.

Text
To be advised

References
Astarita, G. Mass Transfer with Chemical Reaction (Elsevier 1967)

Civil Engineering IIM

Prerequisites
Mathematics IIA and Mathematics IIC (including Topic E) and Civil Engineering IIM

Hours
Seven lecture hours and four tutorial and laboratory hours per week

Examination
As prescribed by the Head of the Department of Civil Engineering

Content
Topics CE414A and CE324, and any two of the other four topics.

(i) CE324 Soil Mechanics
(ii) CE414A Structural Analysis II
(iii) CE415 Elastic Continua
(iv) CE416 Plastic Frame Design
(v) CE433 Theoretical Hydrodynamics
(vi) CE434 Open Channel Flow

CE324 Soil Mechanics — J. B. Berrill

Corequisite
CE332 Fluid Mechanics II

Hours
Two lecture hours and one laboratory hour per week

Examination
To be advised

Content
Index properties, classification of soils; permeability, capillarity, seepage and flow nets; stresses in soils; introduction to finite element methods; settlement and consolidation; compaction, shear strength and failure criteria; stability of retaining walls.

Text
Wu, T. H. Soil Mechanics (Allyn & Bacon 1966)

References
Lambe, T. W. Soil Testing for Engineers (Wiley 1961)
A.S. A89 Methods of Testing Soils for Engineering Purposes (Standards Association of Australia)

CE414A Structural Analysis II — P. W. Kleeman

Hours
One and a half lecture hours and one and a half tutorial hours per week

Examination
One paper of three hours duration

Content
Matrix displacement method of analysis, stability of frames, dynamic behaviour of beams and frames, influence lines in indeterminate structures, non-uniplanar bending and torsion.

Text
Nil

References
Bresler, B., Lin, T. Y. & Scalzi, J. B. Design of Steel Structures (Wiley 1968)
Coates, R. C., Coutie, M. G. & Kong, F. K. Structural Analysis (Nelson 1972)
Livesley, R. K.  Matrix Methods of Structural Analysis  
(Pergamon 1964)  
Martin, H. C.  Introduction to Matrix Methods of Structural Analysis  
(McGraw-Hill 1966)  
Morris, C. H. & Wilbur, J. B.  Elementary Structural Analysis  
(McGraw-Hill 1960)

(iii) 524029  CE415  Elastic Continua — P. W. Kleeman

Corequisite
CE414A Structural Analysis II

Hours
One and a half hours per week

Examination
One two hour final paper

Content

Text
Nil

References
Desai, C. S. & Abel, J. F.  Introduction to the Finite Element Method  
(Van Nostrand Reinhold 1972)  
Timoshenko, S. P. & Goodier, J. N.  Theory of Elasticity 3rd edn  
(McGraw-Hill 1970)  
(McGraw-Hill 1965)

(iv) 524030  CE416  Plastic Frame Design — P. W. Kleeman

Corequisite
CE414A Structural Analysis II

Hours
One and a half hours per week

Examination
One two hour final paper

Content
Review of upper and lower bound theorems, beams, columns, connections, design of braced frames, column deflection curves, subassemblages, unbalanced frames.

Text
Nil

References
Davis, C. V. & Sorenson  Handbook of Applied Hydraulics 3rd edn  
(McGraw-Hill 1961)  
Morris, H. M.  Applied Hydraulics in Engineering  
(Ronald Press 1963)  
Rouse, H.  Engineering Hydraulics  
(Wiley 1951)  
Streeter, V.  Handbook of Fluid Dynamics  
(McGraw-Hill 1961)  
Vallentine, H. R.  Applied Hydrodynamics  
(Butterworths 1967)
Communications and Automatic Control

**Prerequisites**
Mathematics IIA & Mathematics IIC (including Topics C, D, E)

**Hours**
Six hours of lectures, tutorials and laboratory work per week

**Examination**
Progressive assessment and final examination

**Content**
1. EE341 Automatic Control
2. EE342 Automatic Control
3. EE443 Optimization Techniques
4. EE444 Communications Systems

(i) 533213 EE341 Automatic Control — G. C. Goodwin
See page 122

(ii) 533210 EE342 Automatic Control — K. L. Hitz
See page 123

(iii) 534132 EE443 Optimization Techniques — B. D. O. Anderson
See page 124

(iv) 534116 EE444 Communication Systems — G. C. Goodwin

**Prerequisite**
(EE331 Circuits is advisory)

**Hours**
Three hours per week for the first half of the year

**Examination**
Progressive assessment and final examination

**Content**
Introduction to the common forms of analog modulation, as well as pulse modulation systems including pulse code modulation. Performance in the presence of noise is considered.

**Text**

**Reference**

Digital Computers and Automatic Control

**Prerequisites**
Mathematics IIA and Mathematics IIC (including Topics C, D, E)

**Hours**
Six hours of lectures, tutorials and practical work per week

**Examination**
Progressive assessment and final examination

**Content**
1. EE341 Automatic Control
2. EE342 Automatic Control
3. EE361 Computer Structure: Machine and Assembly Languages
4. EE362 Logical Design and Switching Theory

(i) 533213 EE341 Automatic Control — G. C. Goodwin
See page 122

(ii) 533210 EE342 Automatic Control — K. L. Hitz
See page 123

(iii) 533211 EE361 Computer Structure: Machine and Assembly Languages
—K. K. Saluja See page 115

(iv) 533212 EE362 Logical Design and Switching Theory — K. K. Saluja
See page 116

Economics IIC

**Prerequisite**
Mathematics IIA and Mathematics IIC and Economics IIA

**Hours**
Five and a half lecture hours per week and one seminar hour per fortnight

**Examination**
As prescribed by the Head of the Department of Economics
(i) 423208 Econometrics I — R. W. McShane

Prerequisite
(Economic Statistics II or Statistical Analysis is advisory)

Hours
Two lecture hours per week

Examination
One paper of three hours duration

Content
A knowledge of matrix algebra and of the mathematical statistics
dealt with in Statistical Analysis is recommended for students
attempting this course. The course is concerned with examining the
usefulness of single equation regression analysis in applied economic
research and also with providing an introduction to simultaneous
estimation procedures.

Text

References
Benavie, Arthur  Mathematical Techniques for Economic
Analysis (Englewood Cliffs, Prentice-Hall 1972)

Bishir, J. W. & Drewes, D. W.  Mathematics in the Behavioural and Social
Sciences (New York, Harcourt, Brace & World 1970)

Chiang, Alpha C.  Fundamental Methods of Mathematical

Gandolfo, Giancarlo  Mathematical Methods and Models in
Economic Dynamics (Amsterdam, North-Holland 1971)

Hadley, G. & Kemp, M. C.  Finite Mathematics in Business and Economics
( Amsterdam, North-Holland 1972)

Intriligator, M. D.  Mathematical Optimization and Economic
Theory (Englewood Cliffs, Prentice-Hall 1971)

Naylor, T. H. & Vernon, J. M.  Microeconomics and Decision Models of the
Firm (New York, Harcourt, Brace & World 1969)

Read, R. C.  A Mathematical Background for Economists
and Social Scientists ( Englewood Cliffs, Prentice-Hall 1972)

Takayama, Akira  Mathematical Economics (Hindale, Dryden
Press 1974)


(iii) 423104  **Growth and Development**—N. J. Dickinson/C. W. Stahl

**Hours**  Two lecture hours per week

**Examination**  One 3-hour paper

**Content**  
The first two terms of this course deal with the dynamics of fluctuations and growth in the framework of an advanced economy. A critical appraisal is undertaken of leading contributions in this field. Topics such as the production function, technical progress and various models of growth are dealt with in detail.

The third term will be devoted to an examination of some problems of economic growth in developing countries. This part of the course will involve a discussion of some simple models of economic development and will continue with reference to some case studies from countries in Asia.

**Preliminary Reading**

Bober, Stanley  *The Economics of Cycle and Growth* (New York, Wiley 1968)


Enke, S.  *Economics for Development* (London, Dobson 1963)


Szentes, T.  *The Political Economy of Underdevelopment* (Budapest, Akademiai Kiado 1973)

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(iv) 423102  **International Economics** — P. W. Sherwood

**Hours**  Three lecture hours and one seminar hour per fortnight

**Examination**  One 3-hour paper

**Content**  
The course begins with an analysis of balance of payments problems and of various policies of adjustment, such as internal expenditure changes, devaluation and revaluation, floating exchange rates and direct controls. It goes on to examine the present international monetary system and its reform. The course then considers certain theoretical aspects of international capital movements and the implications of overseas investment in Australia. This is followed by a study of the theories of international trade in its non-monetary aspects. The theory of restrictions on trade is then discussed, with particular emphasis on the role of tariffs and of customs unions, followed by an assessment of Australian tariff policy. Finally, the course examines the effects of economic growth on trade as well as the role of international trade in economic development.

**Preliminary Reading**


**Texts**


OR


**ALSO**

References
Kindleberger, C. P. *International Economics* 5th edn (Homewood, Ill., Irwin 1973)

(v) 423103 Public Economics—N. J. Dickinson/P. W. Sherwood

Hours
Three lecture hours per fortnight

Examination
One paper of three hours duration

Content
The course considers the effect of government intervention in the economy through the budget and through the operation of various publicly-owned business undertakings. At the microeconomic level there is an analysis of tax and expenditure policies. In particular, the effects of these policies on community welfare and on incentives are examined.

The macroeconomic aspects of the budget are also discussed. Aggregate models are used to analyse the relation of fiscal policy to other economic policies for stability and growth. Inter-governmental fiscal relationships and the place of fiscal policy in less developed countries are briefly considered.

Preliminary Reading
Eckstein, O. *Public Finance* 3rd edn (Prentice-Hall 1973)

Texts
Allan, C. M. *The Theory of Taxation* (Penguin 1971)
Neville, J. W. *Fiscal Policy in Australia* (Cheshire 1971)

References
Buchanan, J. M. *The Public Finances* (Irwin 1970)
Johansen, L. *Public Economics* (North Holland 1971)
Shoup, C. S. *Public Finance* (Weidenfeld & Nicolson 1970)
543500 Industrial Engineering I

Prerequisites
Mathematics IA and Mathematics IIC

Hours
Six lecture hours per week

Examination
Progressive assessment

Content
(i) ME381 Methods Engineering
(ii) ME383 Quality Engineering
(iii) ME384 Design for Production
(iv) ME483 Production Engineering

(i) 543501 ME381 Methods Engineering — G. D. Butler

Hours
One and a half hours per week

Examination
Progressive assessment

Content

Text
Niebel, B. W. Motion and Time Study (Irwin 1972)

References
Barnes, R. M. Motion and Time Study (Wiley 1968)
Krick, E. V. Methods Engineering (Wiley 1966)

(ii) 543502 ME383 Quality Engineering — D. S. R. Karamchetty

Hours
One and a half hours per week

Examination
Progressive assessment

Content

Text
Vaughn, R. C. Quality Control (Iowa State Univ. Press)

References
Duncan, A. J. Quality Control and Industrial Statistics (Irwin 1965)
Grant, E. L. Statistical Quality Control (McGraw-Hill 1964)
Juran, J. M. & Gryna, F. M. Quality Planning and Analysis (McGraw-Hill 1962)
Kirkpatrick, E. G. Quality Control for Managers and Engineers (Wiley 1970)

(iii) 543503 ME384 Design for Production — J. W. Hayes

Hours
One and a half hours per week

Examination
Progressive assessment

Content
The application of economics, methods engineering, ergonomics and mechanical engineering to the development and design of a product. Its production (particularly in quantity), distribution and marketing. Operation methods; metrology, tools, jigs and fixtures, assembly and inspection procedures. Plant facilities.

Text
Nil

References
American Society of Tool & Manufacturing Engineers Fundamentals of Tool Design (Prentice-Hall 1962)
American Society of Tool & Manufacturing Engineers Value Engineering in Manufacturing (Prentice-Hall 1967)
Kempster, M. H. A. Principles of Jig and Tool Design (E.U.P. 1968)
Niebel, B. W. & Baldwin, E. N. Design for Production (Irwin 1963)
(iv) 544104 ME483 Production Engineering — J. W. Hayes

**Hours**
One and a half hours per week

**Examination**
Progressive assessment

**Content**
Production planning, Inventory functions, Forecasting, scheduling and control of production. Design of a production control system. Quality and quantity control. Production inventory systems.

**Text**
Riggs, J. L. *Production Systems* (Wiley 1970)

**References**

Brown, R. G. *Management Decision for Production Operations* (Holt, Rinehart & Winston 1971)

Buffa, E. S. *Modern Production Management* (Wiley 1969)

Magee, J. & Boodman, D. H. *Production Planning & Inventory Control* (E.U.P. 1967)


553900 Mechanical Engineering IIIIC

**Prerequisites**
Mathematics IIA and Mathematics IIC (including Topics E, F and H)

**Hours**
Six hours per week

**Examination**
Progressive assessment

**Content**
Students enrolling in this subject may choose one of the following alternatives (a), (b), (c) or (d). However it is not anticipated that all four alternatives will be available each year.

(a) (i) ME361 Automatic Control
(ii) ME401 Systems Analysis
(iii) ME402 Systems Planning, Organisation and Control
(x) ME487 Operations Research — Deterministic Models

(b) (iii) ME402 Systems Planning, Organisation and Control
(x) ME487 Operations Research — Deterministic Models
(xi) ME488 Operations Research — Probabilistic Models

(c) (iii) ME402 Systems Planning, Organisation and Control
(iv) ME403 Resources Planning and Allocation
(v) ME404 Mathematical Programming
(xi) ME488 Operations Research — Probabilistic Models

(d) (i) ME361 Automatic Control
(vi) ME434 Advanced Kinematics and Dynamics of Machines

(iii) ME487 Operations Research — Deterministic Models

(vii) ME446 Introduction to Plastic Analysis

(viii) ME448 Introduction to Photomechanics

(i) 543204 ME431 Automatic Control — K. L. Hitz

**Hours**
One and a half hours per week

**Examination**
Progressive assessment

**Content**

**Text**
Nil

**References**
Desoer, C. A. *Notes for a Second Course in Linear Systems* (Van Nostrand-Reinhold 1970)


(ii) 544451  ME401 Systems Analysis — A. W. Roberts

**Hours**
One and a half hours per week

**Examination**
Progressive assessment

**Content**
An introduction to systems concepts. Mathematical modelling and some probability concepts. Deterministic and probabilistic models, stochastic models.

**Text**
Nil

**References**
Haberman, C.: *Engineering Systems Analysis* (Merril 1965)

(iv) 544452  ME402 Systems Planning, Organization and Control — A. Roberts/G. D. Butler

**Hours**
One and a half hours per week

**Examination**
Progressive assessment

**Content**
Types of resources. Resources availability, approach and classification. Analysis and projection for world, national and corporate levels of operation. Tactical and strategic problems, conservation of resources. Generation of resources. Capital and technological resources. The planning, organisation and control of resources, with particular emphasis on long-range planning. The need at levels for a resources policy. Optimal use of resources allocation. The importance of mineral resources to Australia. Prediction of resources.
Notions of corporate planning with special reference to the steel industry.

**Text**
Nil

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### References

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
</tr>
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<tbody>
<tr>
<td>National Academy Science</td>
<td><em>Resources and Man</em> (Freeman 1969)</td>
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<tr>
<td>Zimmerman, E. W.</td>
<td><em>World Resources and Industries</em> (New York, Harper 1951)</td>
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### ME404 Mathematical Programming — K. L. Hitz

**Hours**
One and a half hours per week

**Examination**
Progressive assessment

**Content**
Introduction to the solution of static optimisation problems. Dynamic programming; computational refinements of the basic algorithm, Linear programming; the Simplex algorithm and its revised form; duality theory; sensitivity analysis; decomposition algorithms. Transportation and assignment problems.

**Texts**

### ME446 Introduction to Plastic Analysis — E. Betz

**Hours**
One and a half hours per week

**Examination**
Progressive assessment

**Content**

Applications where there exists: (i) no elastic-plastic interface; (ii) an elastic-plastic interface.


**Text**
- Ford, H. *Advanced Mechanics of Materials* 1st edn (Longmans 1963)
- Hill, R. *Plasticity* (Oxford 1950)
- Prager, W. *Introduction to Plasticity* (Addison-Wesley 1959)
(viii) ME444 Introduction to Photomechanics — E. Betz

Hours
One and a half hours per week

Examination
Progressive assessment

Content

Text
Nil

References
Dally, J. W. & Riley, W. F. Experimental Stress Analysis (McGraw-Hill 1965)
Frocht, M. M. Photoelasticity Vols. I & II (Wiley 1945 & 1948)

(b) ME449 Reliability Analysis for Mechanical Systems — A. J. Chambers/A. W. Roberts

Hours
One and a half hours per week

Examination
Progressive assessment

Content

Text

References
Haviland, R. P. Engineering Reliability and Long Life Design (Van Nostrand 1964)

(c) ME447 Operations Research — Deterministic Models — G. D. Butler

Hours
One and a half hours per week

Examination
Progressive assessment

Content
Concept of optimisation; optimisation approaches; formulation of models; linear programming; allocation and assignment; simplex method; duality; theory of games, parametric programming; integer programming; zero-one programming; quadratic programming; decomposition principle. Network theory; dynamic programming. Geometric programming. Applications.

Text
Nil

References
Taha, H. A. Operations Research (Macmillan 1971)

(d) ME448 Operations Research — Probabilistic Models — G. D. Butler

Hours
One and a half hours per week

Examination
Progressive assessment

Content
Statistical decision theory; forecasting, methods moving average, exponentially smoothed average. Inventory control theory. Fixed order quantity; fixed order cycle systems; production — inventory systems. Queueing theory; simple queue, multiserver queues. Queues in series. Transients in queues; simulation of systems. Applications.

Text
Nil
References
Brown, R. G. 
Hadley, G. & Whitin, T. M. 
Taha, H. A.

Smoothing, Forecasting and Prediction of Time Series (Prentice-Hall 1963)
Management Decision Making under Uncertainty (Macmillan 1969)
Analysis for Inventory Systems (Prentice-Hall 1963)
Operations Research (Macmillan 1971)

(xii) 544843 Operations Research — Applications in Industry — G. D. Butler

Hours
One and a half hours per week

Examination Progression assessment

Content
The case study approach to industrial cases. The application of operations research to industrial problems.

Text Nil

References
Duckworth, E. A Guide to Operational Research (Methuen 1965)
Eilon, S., Hall, R. I. & King, J. R. Exercises in Industrial Management (Macmillan 1966)
McKenny, J. L. & Rosenbloom, R. S. Cases in Operations Management (Wiley 1969)
Schnelle, K. E. Case Analysis and Business Problem Solving (McGraw-Hill 1967)

743100 Physics IIIA

Prerequisites
Physics II, Mathematics IIIA, or Mathematics IIC (including Topics C, E, G and H or B or D)

Hours
Four lecture hours and eight laboratory hours per week

Examination Assessment will be by written papers and special assignments to the equivalent of three three-hour papers, and on laboratory and regular assignment work

Content
Physics IIIA deals primarily with the more basic and fundamental aspects of Physics treated at third year level and covers the areas of classical and quantum physics which are essential to the understanding of both advanced pure physics and also the many applications of physics.

The course can be broadly summarized under the headings of Classical Physics and Modern or Quantum Physics. A sub-section, Electronics, treats electron device physics and the use of these devices in electronic circuit design.

Classical Physics
Mathematical methods, advanced mechanics, special theory of relativity, electromagnetics including waveguide and antenna theory.

Modern Physics
Quantum mechanics, atomic and molecular physics, statistical physics, solid state physics, nuclear physics, electronics.

Laboratory
The laboratory course is intended to parallel the lecture course in overall content, having at least one experiment available in each topic listed above, although students are not expected to carry out all the experiments available.

Texts A list of required text books is available from the Physics Department office. Students should retain their Physics II texts.

753300 Psychology IIC

Prerequisites
Mathematics IIA, Mathematics IIC, and Psychology IIA or Psychology IIB

Hours
Four lecture hours and three laboratory hours per week

Examination As prescribed by the Head of the Department

Content
Experimental Design
Personality Assessment
Mathematical Models in Perception and Learning
Cognition
Perception and Physiological Psychology.
One or more additional topics to be selected from Psychology IIIA or IIIIB. Students will also be required to complete an independent investigation in mathematical psychology under supervision.

Text
Nil

References
Flavell, J. H. *The Developmental Psychology of Jean Piaget* (Van Nostrand 1963)
Mandler, J. M. & Mandler, G. *Thinking: From Association to Gestalt* (Wiley 1964)

SCHEDULE C

664300 Mathematics/Physics IV

Prerequisites
Mathematics IIIA and Physics IIIA and such additional work as is required for combined honours students by the Department of Mathematics.

A student desiring admission to this subject must apply in writing to the Dean of the Faculty of Mathematics before 7th December of the preceding year.

Hours
As prescribed by the Heads of the Departments of Mathematics and Physics.

Examination
Each student shall present a minor thesis in Mathematics, written with physical applications in view, and complete a major project in Physics, which will be experimental. Examinations will be held on the Mathematics and Physics topics.

Content
The student shall also complete four topics from Mathematics IV, chosen for their application to Physics. He must also attend selected topics in Physics IV.

664200 Mathematics/Psychology IV

Prerequisites
Mathematics IIIA and Psychology IIIIC.

A student desiring admission to this subject must apply in writing to the Dean of the Faculty of Mathematics before 7th December of the preceding year.

Hours
As prescribed by the Heads of the Departments of Mathematics and Psychology.

Examination

Content
Four Mathematics topics chosen from the Part IV Mathematics topics (see page 49).

Psychological Measurement (see below).

Mathematical Models in Perception and Learning (see below).

(i) Psychological Measurement — J. A. Keats

Prerequisites
Nil

Hours
One and a half hours per week

Examination
As prescribed by the Head of the Department of Psychology

Content
The series is introduced by lectures on the logic of measurement and its application to psychological phenomena after which each student is required to present at least one paper on one of the more recently developed psychological scaling methods.

Text
Nil

References
Atkinson, R. C. (ed) *Studies in Mathematical Psychology* (California Stanford University Press 1964)
Campbell, N. R. *Foundations of Science: The Philosophy of Theory and Experiment* (New York, Dover 1957)
Coombs, Clyde H. *A Theory of Data* (John Wiley 1964)
Lord, F. M. & Novick, M. R. *Statistical Theories of Mental Test Scores* (Addison-Wesley 1968)
Ross, S. *Logical Foundations of Psychological Measurements* (Aarhus Stiftsbogtrykkerie A-S, Denmark 1964)
Torgerson, W. S. *Theory and Methods of Scaling* (John Wiley 1958)
Mathematical Models in Perception and Learning — R. A. Heath

Prerequisites
Nil

Hours
One and a half hours per week

Examination
As prescribed by the Head of the Department of Psychology

Content
An introduction to the application of stochastic process models to the analysis of psychological processes involved in perception and learning. Use of a real-time computer will form an integral part of the course.

Text
Nil

References
Atkinson, R. C., Bower, G. H. & Crothers, E. J.
Cox, D. R., & Miller, H. D.
Laming, D.

An Introduction to Mathematical Learning Theory (N.Y., Wiley 1965)
The Theory of Stochastic Processes (London, Methuen 1965)
Mathematical Psychology (N.Y., Academic 1973)

A GUIDE TO STUDENTS ENROLLING IN THE FACULTY OF MATHEMATICS

1. Students have received approval to enrol in the following non-mathematics subjects in the past.

PART I

<table>
<thead>
<tr>
<th>Accounting I</th>
<th>Biology I</th>
<th>Chemistry I</th>
<th>Classical</th>
<th>Civilisation I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology I</td>
<td>German Introductory</td>
<td>German IS &amp; IN</td>
<td>Greek I</td>
<td>Legal Studies I &amp; II</td>
</tr>
</tbody>
</table>

*Economic History I
Microeconomics
Engineering I
English I
French I
Geography I

PART II

<table>
<thead>
<tr>
<th>Biology IIA, IIB &amp; IIIA</th>
<th>Chemistry IIA</th>
<th>Economics IIA &amp; IIB</th>
<th>Education II</th>
<th>English IIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>French IIA</td>
<td>Geography IIA, IIB</td>
<td>IIB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics I &amp; IB</td>
<td>Geology IIA &amp; IIB</td>
<td>History IIA &amp; IIB</td>
<td>Philosophy IIA</td>
<td>Physics II</td>
</tr>
<tr>
<td>Sanskrit I</td>
<td>Psychology IIA &amp; IIB</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Students transferring to the Faculty of Mathematics in the past have been granted standing in the following non-mathematics subjects, completed while enrolled in other Faculties.

PART I                  PART II
Accounting I             Economics IIA
Chemistry I              German I
Economics I              History I
Engineering I             Philosophy I
English I                Physics I or II
French I                 Psychology I
Geography I              Psychology IIA

3. Enrolment in the following subjects is restricted as indicated below

Accounting I — Students who include this subject in their course as a Part I subject are advised to discuss with the Dean the possibility of including Accounting IIA or Accounting IIB in their Part II subjects.

Economics IIA — Students should study Macroeconomics and Money and Banking. They should also include the Part II Mathematics Topic H, Probability and Statistics, in their course.

Economics IIB — This subject would not normally be included in the Bachelor of Mathematics course. However if permission is given to include this subject then the content should be discussed with the Dean.

A student may not include both Physics IA and Physics IB in his course.
A student may not include both Engineering I and Civil Engineering 1M in his course.

4. Permission will normally be given for the inclusion in a student’s course of subjects which are prerequisites or corequisites of subjects appearing in the schedule.

* A student who passes both Microeconomics and Economic History I may be credited with one Part I subject towards the degree of Bachelor of Mathematics.
REQUIREMENTS FOR THE DIPLOMA IN COMPUTER SCIENCE

1. In these Requirements, unless the context or subject matter otherwise indicates or requires, "the Faculty Board" means the Faculty Board of the Faculty of Mathematics and "the Board" means the Board of Studies established to supervise the course of the Diploma in Computer Science.

2. An applicant for registration as a candidate for the Diploma shall:
   (i) have satisfied all the requirements for admission to a degree in the University of Newcastle, or
   (ii) have satisfied all the requirements for admission to a degree in another university or institution approved for this purpose by the Board, or
   (iii) hold other qualifications approved for this purpose by the Senate on the recommendations of the Board and the Faculty Board.

3. The Board may require a candidate to complete additional work and/or examinations if, in its opinion, he has not reached the assumed standard of attainment on which the content of any of the subjects is based.

4. An applicant for registration as a candidate for the Diploma may be granted standing by the Board for work completed in this University, or in another university or institution approved for this purpose by the Board. Such standing shall not be given for more than half of the course and shall not be given for work on the basis of which a degree or diploma has already been conferred or awarded or approved for conferment or award.

5. (a) To complete a subject qualifying towards the Diploma, a candidate shall attend such lectures, tutorials, seminars and laboratory classes, and submit such written work as the Board may require.
   (b) To pass a subject, a candidate shall complete the subject and pass such examinations as the Board may require.

6. The Board shall approve a programme of studies for each candidate. This programme may be varied only with the approval of the Board.

7. (a) A candidate may withdraw from a subject only by informing the Secretary to the University in writing and the withdrawal shall take effect from the date of receipt of such notification.
   (b) A candidate who after:
      the eighth Monday in First Term, in the case of a subject lasting only the first half-year; the sixth Monday in Second Term, in the case of a subject lasting the whole year; the second Monday in Third Term, in the case of a subject lasting only the second half-year; withdraws from a subject in which he has enrolled shall be deemed to have failed in that subject, unless granted permission by the Dean of the Faculty of Mathematics to withdraw without penalty.

8. In order to qualify for the Diploma, a candidate shall, in not less than two years of part-time or one year of full-time enrolment, complete satisfactorily a course of studies, comprising 11 units of work chosen from the Schedule of Subjects provided that the subjects passed:
   (a) shall include all the subjects in Group I, unless, in order to satisfy provisions of sub-section (c) of this Section, the Board has prescribed for the candidate concerned an alternative subject or subjects for one or more of the subjects in this Group;
   (b) shall not include more than two units from subjects in Group III;
   (c) shall not include a subject which, in the opinion of the Board, substantially overlaps the content of a course completed or work presented for another degree or diploma; and
   (d) shall be those prescribed in the programme approved by the Board.

9. The Diploma shall be awarded in two grades, namely:
   Diploma in Computer Science with merit
   Diploma in Computer Science.

10. Group I subjects shall be offered each year, but subjects listed in Groups II and III may not necessarily all be offered in any one year.

11. Notwithstanding the provisions of Section 8, the Board may from time to time approve a subject to be counted as a Group II or Group III subject for one specific year.

12. In order to provide for exceptional circumstances arising in particular cases, the Senate, on the recommendation of the Faculty Board, may relax any provision of these Requirements.
SCHEDULE OF SUBJECTS

1. The lecturer in the course will assume that all students have a good understanding of the content of items in this column.
2. Subjects with a prefix CS are subjects offered in the Faculty of Mathematics specifically for the Diploma in Computer Science.

GROUP I

Core Subjects

<table>
<thead>
<tr>
<th>Subject</th>
<th>Department</th>
<th>Offering</th>
<th>Assumed Standard of Attainment</th>
<th>No. of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE361</td>
<td>Electrical Engineering</td>
<td>Computer</td>
<td>Mathematics I, Topic</td>
<td>1</td>
</tr>
<tr>
<td>CS-Topic</td>
<td>Computer Programming</td>
<td>Commercial</td>
<td>Mathematics I, Topic</td>
<td>1</td>
</tr>
<tr>
<td>EE362</td>
<td>Electrical Engineering</td>
<td>Engineering</td>
<td>Mathematics I, Topic</td>
<td>1</td>
</tr>
<tr>
<td>CS-Topic</td>
<td>Computer Programming</td>
<td>Commercial</td>
<td>Mathematics I, Topic</td>
<td>1</td>
</tr>
<tr>
<td>EE363</td>
<td>Electrical Engineering</td>
<td>Engineering</td>
<td>Mathematics I, Topic</td>
<td>1</td>
</tr>
<tr>
<td>CS-Topic</td>
<td>Computer Programming</td>
<td>Commercial</td>
<td>Mathematics I, Topic</td>
<td>1</td>
</tr>
<tr>
<td>EE364</td>
<td>Electrical Engineering</td>
<td>Engineering</td>
<td>Mathematics I, Topic</td>
<td>1</td>
</tr>
<tr>
<td>CS-Topic</td>
<td>Computer Programming</td>
<td>Commercial</td>
<td>Mathematics I, Topic</td>
<td>1</td>
</tr>
</tbody>
</table>

GROUP II

Subjects with substantial application to computer science

<table>
<thead>
<tr>
<th>System Analysis and Design</th>
<th>Department</th>
<th>Offering</th>
<th>Assumed Standard of Attainment</th>
<th>No. of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE341</td>
<td>Electrical Engineering</td>
<td>Automatic Control</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE342</td>
<td>Electrical Engineering</td>
<td>Automatic Control</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE343</td>
<td>Electrical Engineering</td>
<td>Digital Electronics</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE344</td>
<td>Electrical Engineering</td>
<td>Modern Control</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE345</td>
<td>Electrical Engineering</td>
<td>Modern Control</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE346</td>
<td>Electrical Engineering</td>
<td>Optimization Techniques</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE347</td>
<td>Electrical Engineering</td>
<td>Computer Operating Systems</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE348</td>
<td>Electrical Engineering</td>
<td>Computer Science</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE349</td>
<td>Electrical Engineering</td>
<td>Pattern Recognition</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE350</td>
<td>Electrical Engineering</td>
<td>Automated and Computing Machines</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE351</td>
<td>Electrical Engineering</td>
<td>Computer Process Control</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE352</td>
<td>Electrical Engineering</td>
<td>Advanced Computer Architecture</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EE353</td>
<td>Electrical Engineering</td>
<td>Formal Languages and Automata</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>CS-Topic</td>
<td>Operations Research</td>
<td>Mathematics</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>CS-Topic</td>
<td>Mathematical Logic</td>
<td>Mathematics</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>EME402</td>
<td>Systems Planning, Organization and Control</td>
<td>Mathematics</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
</tbody>
</table>

GROUP III

Subjects approved by the Board but not included in Group I or Group II

<table>
<thead>
<tr>
<th>Subject</th>
<th>Department</th>
<th>Offering</th>
<th>Assumed Standard of Attainment</th>
<th>No. of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME401</td>
<td>Mechanical Engineering</td>
<td>Mathematical Programming</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>ME402</td>
<td>Mechanical Engineering</td>
<td>Deterministic Models</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>ME403</td>
<td>Mechanical Engineering</td>
<td>Probabilistic Models</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>ME501</td>
<td>Mechanical Engineering</td>
<td>Mathematical Programming</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>ME502</td>
<td>Mechanical Engineering</td>
<td>Deterministic Models</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
<tr>
<td>ME503</td>
<td>Mechanical Engineering</td>
<td>Probabilistic Models</td>
<td>Mathematics II, Topics</td>
<td>1</td>
</tr>
</tbody>
</table>

The Board may approve the inclusion in a student's programme of a project. This project would be in lieu of Group III subjects and may not count more than two units.

A student may suggest to the Dean for consideration by the Board the inclusion in his programme of a subject not listed in the Schedule of Subjects.

Students interested in positions as Computer Systems Officers in the Australian Public Service are strongly advised to include the subjects Systems Analysis and Design A and B in their course.
SUBJECTS OVERLAPPING IN CONTENT

The Board of Studies in Computer Science has decided that pursuant to Section 8 of the Requirements for the Diploma in Computer Science a student is not permitted to include in his programme both of the subjects of a pair listed in the Table below, nor may he include a subject if he has previously included the content of that subject in his work for a degree or diploma which has already been conferred or awarded or approved for conferment or award.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. ME404—Mathematical Programming</td>
<td>ME581G—Mathematical Programming</td>
</tr>
</tbody>
</table>

DESCRIPTION OF SUBJECTS

GROUP I—CORE SUBJECTS

410103 Commercial Programming—I. R. Beaman

Assumed Standard of Attainment
Mathematics I, Topic NM or Commercial E.D.P.

Hours
A course of two lecture hours per week for half of the year plus readings and extensive practical work throughout the second half of the year

Examination
Two 3-hour papers (first paper at mid-year—Theory; second paper at end of year—Cobol)

Content
Basic concepts of file handling and file maintenance, including file creation and processing.

Flow charting; file merging and updating of transactions; tape blocking and buffering.

General run types including editing, searching and sorting. Direct access versus serial: random or sequential organisation; Re-run techniques; verifying programme accuracy; table lookup; programme documentation and use of test data.

COBOL as a business data processing and file organisation language. Extensive practical work in COBOL, including case studies.

Texts
International Computers Ltd. Cobol Programming (Heinemann 1970)

References


533211 EE361 Computer Structure: Machine and Assembly Languages—K. K. Saluja

Assumed Standard of Attainment
Mathematics I

Hours
Three hours of lectures and practical work per week for the first half of the year

Examination
Progressive assessment and final examination

Content
Basic computer elements and peripherals, representation and organization of information, number systems and arithmetic, logical operations. Hardware components, processor structure, addressing modes and instruction set, machine-language programming, subroutines, traps and interrupts, use of the stack. Assembly: pseudo-ops, macros, recursion and re-entrancy, relocation, linking and loading. System software: assemblers, linkers, loaders, dumpers, interpreters, simulators, compilers.

Lectures will be supplemented with practical assignments using the PDP-11 computer.

Texts

— Processor Handbook PDP-11/20
References
Stone, H. S. Introduction to Computer Organization and Data Structures (McGraw-Hill 1972)

533212 EE362 Logical Design and Switching Theory — K. K. Saluja

Assumed Standard of Attainment
Mathematics I

Hours
Three hours of lectures, tutorials and practical work per week for the second half of the year

Examination
Progressive assessment and final examination

Content
Boolean algebra, combinational logic, logical circuits, minimization techniques, threshold logic. Data representation, binary arithmetic, codes, error checking and correcting. Sequential logic, flip-flops, state diagrams, state reduction, races and hazards. Logic subsystems; registers, adders, counters, converters, coders, etc. Basic architecture of digital computers.

Text
Friedman, A. D. Logical Design of Digital Systems (Computer Science Press 1975)

References
Mano, M. M. Computer Logic Design (Prentice-Hall 1972)

660111 CS—Programming and Algorithms — A. J. Guttmann

Assumed Standard of Attainment
Mathematics I

Hours
Two lecture hours and one tutorial hour per week for the first half of the year

Examination
One paper of three hours duration. There may also be a second examination on programming techniques

Content
Boolean algebra, propositional logic, binary and other number systems, representation of numbers and instructions. Flow charts. Description of machine code, assemblers, etc. Introduction to FORTRAN, ALGOL and the conversational language BASIC. Use of higher level languages to solve problems of a non-numerical nature. Programming techniques, efficient programming, evaluation of expressions, sources of error, programme development, diagnostics, testing, etc. Nature of algorithms and heuristics. Analysis of algorithms. Programme structure, procedures, subroutines, scope of variables. Recursion. Graphs, trees and the Travelling Salesman Problem.

Text
References
Knuth, Donald E. The Art of Computer Programming
Vol. I—Fundamental Algorithms
Vol. II—Semi-numerical Algorithms


Day, A. C. Introduction to FORTRAN IV Programming (Goodyear 1967)


Kreitzberg, C. B. & Shneiderman, B. The Elements of FORTRAN Style (Harcourt, Brace, Jovanovich 1972)

Ralston, A. Introduction to Programming and Computer Science (McGraw-Hill 1971)

660112 CS—Data Structures and Programming — J. A. Campbell

Assumed Standard of Attainment
Programming and Algorithms

Hours
Two lecture hours and one tutorial hour per week for the first half of the year

Examination
One paper of two hours duration

Content
Introduction to data structures: lists, strings, arrays, trees, graphs, searching and sorting; list processing.
Higher level programming languages: Syntax and semantics. Backus normal form. Polish notation. Declarations, storage allocation, subroutines and linkage. Compilation, interpretation and translation. Study and comparison of data structures in several languages, e.g. ALGOL 60, ALGOL 68, COBOL, FORTRAN, LISP, etc.

Text
Nil

References
Day, A. C. Fortran Techniques: with Special Reference to Non-numerical Applications (Cambridge University Press 1972)
Galler, B. A. & Perlis, A. J. A View of Programming Languages (Addison-Wesley 1970)
Sammet, Jean E. Programming Languages: History and Fundamentals (Prentice-Hall 1969)

GROUP 1

Subjects with substantial application to computer science

OFFERED BY THE DEPARTMENTS OF COMMERCE

410124 Systems Analysis and Design A — I. R. Beaman

Assumed Standard of Attainment Nil

Hours Two lecture hours per week for the first half of the year and associated practical work

Examination One 3-hour paper

Content
This subject will consist of seminar and practical sessions covering readings and case studies concerned with the analysis and documentation of typical computer based systems, e.g. an order processing, stock recording and invoicing system.

Topics covered include the role of a systems analyst; an overview of organizational functions and inter-relationships.

Fact finding, recording and analysis techniques: methods of observation, interviewing, sampling and questionnaires including associated estimates of reliability; use of standards for recording and documentation, flow charting conventions for systems analysis, organizational
charts, clerical procedure flow charts; use of decision tables to record procedures; project management procedures.

Feasibility study: determination of systems objectives; relationship of proposed system to other systems and procedures; cost benefit analysis on general estimates; the feasibility report.

Document and output form design: including batch and demand processing systems comparisons; choice of alternative output media; techniques of document handling and copying; control of document output; code design.

Data capture and input techniques: revision of range of input media, comparison of cost and capacities; comparison of batch and on-line systems for data capture; key to disc systems; data transmission; data control procedures.

Text

The National Computing Centre Systems Analysis and Design Student Notes will be supplied.

References


Daniels, A. & Yeates, D. Basic Training in Systems Analysis (Pitman 1969)


Hare, Van Court Systems Analysis: A Diagnostic Approach (Harcourt, Brace & World 1967)

Optner, S. L. Systems Analysis for Business Management (Prentice-Hall 1968)


Content

This subject is a development of Systems Analysis and Design A, with the inclusion of the following topics:

Detailed File Design—file organization and accessing techniques; revision of current hardware file handling devices, in terms of capacities, speeds and costs; file organization techniques, serial, sequential, random and list; methods of record location, index sequential, address generation algorithm, chaining, tagging and simple list processing; criteria for selection of bucket and seek area packing densities; fixed and variable field and record processing.

Detailed Systems Design—run design; system and program specifications; program and systems timing; system construction.

Administrative controls: division of responsibilities; control of operator procedures, with or without interface of operating systems; control of files; environmental control.

Systems development controls: imposition of standards for documentation; system and program testing; file conversion; acceptance and authorization procedures; system and program amendment; the role of both auditor and input control sections.

Procedural controls: input controls; processing controls; output controls; master and intermediate file controls; system recovery.

An appreciation of the detailed techniques of Systems Analysis and Design involved in the development of computer-based information systems from a range of applications—i.e. Inventory and Production Control; Order Entry and Processing: General Ledger accounting systems; Sales Analysis; Payroll.

At least one such system will be observed in depth, as an attempt at detailed Systems Analysis.

Systems implementation: problems of changeover, parallel running; file set up and conversion; systems maintenance, including interface with existing systems, both A.D.P. and manual.

Text

The National Computing Centre Systems Analysis and Design Student Notes will be supplied.

References


Daniels, A. & Yeates, D. Basic Training in Systems Analysis (Pitman 1969)

Hare, Van Court  
Optner, S. L.  
Orilia, L.,  
Stern, N. B. &  
Stern, R. A.  
Weiss, E.A.  

Systems Analysis: A Diagnostic Approach  
(Harcourt, Brace & World 1967)  
Systems Analysis for Business Management  
(Prentice-Hall 1968)  
Business Data Processing Systems  
(Wiley 1972)  
Computer Usage/ Applications (McGraw-Hill 1970)

ELECTRICAL ENGINEERING

533213 EE341 Automatic Control — G. C. Goodwin

Assumed Standard of Attainment
Mathematics II Topics C, D, E, H

Hours
Three hours of lectures, tutorials and laboratory work per week for the first half of the year

Examination
Progressive assessment and final examination

Content

Text
Nil

References
Chen, C.  
Introduction to Linear System Theory (Holt, Rinehart & Winston 1970)

Desoer, C. A.  
Notes for a Second Course on Linear Systems (Van Nostrand 1970)

Gupta, S. C. & Hasdorff, L.  
Fundamentals of Automatic Control (Wiley 1970)

Melsea, J. L. & Schulz, D.  
Linear Control Systems (McGraw-Hill 1960)

Ogata, K.  
Modern Control Engineering (Prentice-Hall 1969)

Raven, F. H.  
Automatic Control Engineering 2nd edn (McGraw-Hill 1968)
534119 EE441 Modern Control — J. M. Moore

Assumed Standard of Attainment

EE342 Automatic Control

Hours

Three hours of lectures, tutorials and laboratory work per week for the first half of the year

Examination

Progressive assessment and final examination

Content

Digital filtering and digital control systems, z-transforms, state-variable techniques, sampling and reconstruction, fast Fourier transforms.

Text

To be advised

References


Kuo, B. C. Discrete-Data Control Systems (Prentice-Hall 1970)

534115 EE442 Modern Control (Nonlinear Optimal Control Theory) — Not offered in 1976

534132 EE443 Optimization Techniques — B. D. O. Anderson

Assumed Standard of Attainment

Mathematics II, Topics C, D, E

Hours

Three hours per week for the second half of the year

Content

Mathematical background to optimization. Comparison of optimization methods; engineering applications — such as to problems of identification, control, pattern recognition and resource allocation.

Text

Luenberger, D. G. Introduction to Linear and Non-linear Programming (Addison-Wesley 1973)

Reference

Luenberger, D. G. Optimisation via Vector Space Methods (Wiley 1969)

534124 EE463 Computer Operating Systems — A. Cantoni

Assumed Standard of Attainment

EE361 Computer Structure: Machine and Assembly Languages

Hours

Three hours per week for the first half of the year

Examination

Progressive assessment and final examination

Content


Text


References


Hansen, P. B. Operating Systems Principles (Prentice-Hall 1973)

534125 EE464 Compilers, Assemblers and Interpreters — P. J. Moylan

Assumed Standard of Attainment

EE361 Computer Structure: Machine and Assembly Languages

Hours

Three hours per week for the second half of the year

Examination

Progressive assessment and final examination

Content

The design of assemblers. Introduction to the theory of grammars, parsing techniques, construction of compilers, object code generation. Construction of interpreters.

Text

Gries, D. Compiler Construction for Digital Computers (Wiley 1971)

References


530108 EE565 Pattern Recognition — Not offered in 1976

530119 EE566 Automata and Computing Machines — Not offered in 1976

530125 EE567 Computer Process Control — Not offered in 1976

530121 EE568 Advanced Computer Architecture — A. Cantoni
Assumed Standard of Attainment
EE361 Computer Structure; Machine and Assembly Languages

Hours
Three hours of lectures, tutorials and seminars per week for the second half of the year

Examination
Progressive assessment and final examination

Content

Text
Nil

References
Foster, C. C. Computer Architecture (Van Nostrand 1970)
Iliffe, J. K. Basic Machine Principles (Macdonald 1972)

530122 EE569 Formal Languages and Automata — Not offered in 1976

MATHEMATICS

660114 CS—Mathematical Logic — Mathematics III Topic 0,
For details see page 39.

660115 CS—Operations Research — Mathematics III Topic U,
For details see page 43.

660116 CS—Topic in Applied Probability — Mathematics III Topic Y,
For details see page 46.

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MECHANICAL ENGINEERING

Details of these subjects will be found where indicated below.

544452 ME402 Systems Planning, Organization and Control — see page 98

544417 ME404 Mathematical Programming — see page 100

544416 ME487 Operations Research — Deterministic Models — see page 103

54442 ME483 Operations Research — Probabilistic Models — see page 103

540119 ME561G Mathematical Programming — K. L. Hitz
Assumed Standard of Attainment
Mathematics II Topics C, D

Hours
Three hours per week

Examination
Progressive assessment

Content
A survey on methods for the solution of static, deterministic optimisation problems.
Linear programming, the simplex algorithm and its revised form; duality theory; sensitivity analysis; decomposition algorithms; transportation and assignment problems.
Linear programming in integers; cutting plane algorithms; branch-and-bound methods; implicit enumeration algorithms for binary integer programmes.
Network, scheduling and other combinatorial problems.
Introduction to the theory of convex nonlinear programmes; the Kuhn-Tucker theorem; applications to quadratic programming and geometric programming.
Dynamic programming methods.

Texts

Geoffrion, A. M. (ed) Perspectives Optimisation (Addison-Wesley 1972)

Nemhauser, G. L. Introduction to Dynamic Programming (Wiley 1966)

References

GROUP III — SUBJECTS

Listed below are a number of subjects which the Board regards as suitable for Group III. This list is not, however, intended to be exhaustive and other subjects will be considered.

OFFERED BY THE DEPARTMENTS OF

ELECTRICAL ENGINEERING

533202 EE322 Electronics
533207 EE323L Electronics Laboratory
534108 EE421 Electronics
534126 EE423L Electronics Laboratory
534116 EE444 Communication Systems
534127 EE445 Communication Systems
530100 EE516 Computer-aided Analysis of Power Systems
Not offered in 1976

For details consult the Engineering Faculty Handbook.

MATHEMATICS

660117 CS—Probability and Statistics
See Mathematics III Topic R
For details see page 41.

660118 CS—Asymptotic Methods in Analysis
See Mathematics IV
For details see page 65.

660119 CS—Random and Restricted Walks
See Mathematics IV
For details see page 66.

660120 CS—Signal Detection
See Mathematics IV
For details see page 57.

660121 CS—Stochastic Processes
See Mathematics IV
For details see page 58.

MECHANICAL ENGINEERING

544418 ME449 Reliability Analysis for Mechanical Systems
see page 102

544843 ME489 Operations Research — Applications in Industry,
see page 104

540101 ME503G Design of Experiments for Engineering Research
1
For details consult the Engineering Faculty Handbook.

PHYSICS

660126 CS—Instrumentation Techniques

Assumed Standard of Attainment
Physics IA or Physics IB

Hours
Thirty lecture hours and a twelve hour project assignment

Examination
Project assessment and one paper of two hours duration

Content
The course will consist of selected lectures from the subject Electronics and Instrumentation 2, as follows:

Specialist Instrumentation — 8 lectures
Instrumentation Systems — 8 lectures
Measurement Devices — 14 lectures

Texts
Malmstadt, H.V. et al. Instrumentation for Scientists Series (Vols 1-4)
Text with Experiments or Text only or combined volume (Benjamin 1973)
REQUIREMENTS FOR THE DIPLOMA IN
MATHEMATICAL STUDIES

1. In these Requirements, unless the context or subject matter otherwise indicates or requires, "the Faculty Board" means the Faculty Board of the Faculty of Mathematics and "the Dean" means the Dean of the Faculty of Mathematics.

2. An applicant for registration as a candidate for the Diploma shall:
   (a) have satisfied all the Requirements for admission to a degree in the University of Newcastle or another institution approved for this purpose by the Faculty Board, OR
   (b) in exceptional circumstances produce evidence of possessing such other qualifications as may be approved by the Faculty Board.

3. The Faculty Board will appoint an adviser for each candidate.

4. An applicant for registration as a candidate for the Diploma may be granted standing on conditions to be determined by the Faculty Board, provided that standing may not be granted in respect of any studies for which credit has been given for admission to a degree or for the award of another diploma.

5. In order to qualify for the Diploma, a candidate shall, in not less than three terms in the case of a full-time student or not less than six terms in the case of a part-time student, complete a course of studies comprising 12 units of advanced work offered by the Department of Mathematics or another department offering courses with considerable mathematical content. Two units of this advanced work may be a project approved by the Faculty Board. Each unit will require attendance at lectures, seminars and tutorials, reading exercises, laboratory work and examinations as may be prescribed by the Faculty Board.

6. (a) To complete a unit qualifying towards the Diploma, a candidate shall attend such lectures, tutorials, seminars and laboratory classes, and submit such written work as the Faculty Board may require.
   (b) To pass a unit, a candidate shall complete the unit and pass such examinations as the Faculty Board may require.

7. (a) A candidate may withdraw from a unit or units only by notifying the Secretary to the University in writing and the withdrawal shall take effect from the date of receipt of such notification in writing.

(b) A candidate who after:
   the eighth Monday in First Term, in the case of a unit lasting only the first half-year,
   the sixth Monday in Second Term, in the case of a unit lasting the whole year,
   the second Monday in Third Term, in the case of a unit lasting only the second half-year,
withdraws from a unit in which he has enrolled, shall be deemed to have failed in that unit, unless granted permission by the Dean to withdraw without penalty.

8. In exceptional circumstances the Senate may, on the recommendation of the Faculty Board, relax any of the above requirements.
REQUIREMENTS FOR THE DEGREE OF
MASTER OF MATHEMATICS

1. An application to register as a candidate for the degree of Master of Mathematics shall be made on the prescribed form which shall be lodged with the Secretary at least one full calendar month before the commencement of the term in which the candidate desires to register.

2. A person may register for the degree of Master of Mathematics if—
   (a) he is a graduate or graduand of the University of Newcastle or other approved University with Honours in the subject to be studied for that degree; or
   (b) he is a graduate or graduand of the University of Newcastle or other approved University; or
   (c) in exceptional cases, he produces evidence of such academic and professional attainments as may be approved by the Senate, on the recommendation of the Faculty Board.

3. In the case of applicants desiring to register under provision 2(b), and (c), the Faculty Board may require the candidates to carry out such work and sit for such examinations as the Board may determine before registration as a candidate for the degree of Master of Mathematics is confirmed.

4. In every case, before permitting an applicant to register as a candidate, the Faculty Board shall be satisfied that adequate supervision and facilities are available.

5. An applicant approved by the Faculty Board shall register in one of the following categories:—
   (i) Student in full-time attendance at the University.
   (ii) Student in part-time attendance at the University.

6. (i) Every candidate for the degree shall be required to submit a thesis embodying the results of research carried out by him during his candidature, to take such examination and to perform such other work as may be prescribed by the Faculty Board. The candidate may submit also for examination any work he has published, whether or not such work is related to the thesis.
   (ii) The research and other work as provided in paragraph 6 (i) shall be conducted under the direction of a supervisor appointed by the Faculty Board or under such conditions as the Faculty Board may determine.
   (iii) A part-time candidate shall, except in special circumstances — i. conduct the major proportion of his research in the University; and

ii. take part in research seminars within the Department in which he is working.
   (iv) Every candidate shall submit annually a report on his work to his supervisor for transmission to the Higher Degree Committee.
   (v) Every candidate shall submit three copies of the thesis as provided under paragraph 6(i). All copies of the thesis shall be in double-spaced typescript, shall include a summary of approximately 200 words, and a certificate signed by the candidate to the effect that the work has not been submitted for a higher degree to any other University or institution. The ORIGINAL copy of the thesis for deposit in the Library shall be prepared and bound in a form approved by the University1. The other two copies of the thesis shall be bound in such manner as allows their transmission to the examiners without possibility of their disarrangement.
   (vi) It shall be understood that the University retains the three copies of the thesis and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act (1968) the University may issue the thesis in whole or in part in photostat or microfilm or other copying medium.

7. No candidate shall be considered for the award of the degree until the lapse of six complete terms from the date from which the registration becomes effective, save that in the case of a candidate who has obtained the degree of Bachelor with Honours or a qualification deemed by the Faculty Board to be equivalent or who has had previous research experience, this period may, with the approval of the Faculty Board, be reduced by up to three terms.

8. For each candidate there shall be two examiners appointed by the Senate, one of whom shall be an external examiner.

9. A candidate who fails to satisfy the examiners may be permitted to resubmit his thesis in an amended form. Such a resubmission must take place within twelve months from the date on which the candidate is advised of the result of the first examination. No further resubmission shall be permitted.

1 A separate sheet on the preparation and binding of higher degree thesis is available on application.
REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

1. The degree of Doctor of Philosophy may be awarded by the Council on the recommendation of the Senate to a candidate who has satisfied the following requirements.

2. A candidate for registration for the degree of Doctor of Philosophy shall:—
   (i) have satisfied all of the requirements for admission to the degree of master or the degree of bachelor with first or second class honours in the University of Newcastle or a degree from another University recognised by the Senate as having equivalent standing;
   or
   (ii) have satisfied all of the requirements for admission to the degree of bachelor with third class honours or without honours in the University of Newcastle or a degree from another University recognised by the Senate as having equivalent standing, and have achieved by subsequent work and study a standard recognised by the Senate as equivalent to at least second class honours;
   or
   (iii) in exceptional cases submit such other evidence of general and professional qualifications as may be approved by the Senate.

3. The Senate may require a candidate, before he is permitted to register, to undergo such examination or carry out such work as it may prescribe.

4. A candidate for registration for a course of study leading to the degree of Ph.D. shall:—
   (i) apply on the prescribed form at least one calendar month before the commencement of the term in which he desires to register;
   and
   (ii) submit with his application a certificate from the Head of Department in which he proposes to study stating that the candidate is a fit person to undertake a course of study or research leading to the Ph.D. degree and that the Department is willing to undertake the responsibility of supervising the work of the candidate.

5. Before being admitted to candidacy, an applicant shall satisfy the Senate that he can devote sufficient time to his advanced study and research.

6. Subsequent to registration, the candidate shall pursue a course of advanced study and research for at least nine academic terms, save that any candidate who before registration was engaged upon research to the satisfaction of the Senate, may be exempted from three academic terms.

7. A candidate shall present himself for examination not later than fifteen academic terms from the date of his registration, unless special permission for an extension of time be granted by the Senate.

8. The course, other than field work, must be carried out in a Department of the University, under the direction of a supervisor appointed by the Senate, or under such conditions as the Senate may determine, save that a candidate may be granted special permission by the Senate to spend a period of not more than three academic terms in research at another institution approved by the Senate.

9. Not later than three academic terms after registration, the candidate shall submit the subject of his thesis for approval by the Senate. After the subject has been approved it may not be changed except with the permission of the Senate.

10. A candidate may be required to attend a formal course of study appropriate to his work.

11. On completing his course of study every candidate shall submit a thesis which complies with the following requirements:—
   (i) The greater proportion of the work described must have been completed subsequent to registration for the Ph.D. degree.
   (ii) It must be a distinct contribution to the knowledge of the subject.
   (iii) It must be written in English or in a language approved by the Senate and reach a satisfactory standard of literary presentation.

12. The thesis shall consist of the candidate’s own account of his research. In special cases work done conjointly with other persons may be accepted provided the Senate is satisfied on the candidate’s part in the joint research.

13. Every candidate shall be required to submit with his thesis a short abstract of the thesis comprising not more than 300 words.

14. A candidate may not submit as the main content of his thesis any work or material which he has previously submitted for a University degree or other similar award.
15. The candidate shall give in writing three months' notice of his intention to submit his thesis and such notice shall be accompanied by the appropriate fee.

16. Four copies of the thesis shall be submitted together with a certificate from the supervisor that the candidate has completed the course of study prescribed in his case and that the thesis is fit for examination.

17. The thesis shall be in double-spaced typescript. The original copy for deposit in the Library shall be prepared and bound in a form approved by the University. The other three copies shall be bound in such manner as allows their transmission to the examiners without possibility of disarrangement.

18. It shall be understood that the University retains four copies of the thesis and is free to allow the thesis to be consulted or borrowed. Subject to the provisions of the Copyright Act (1968) the University may issue the thesis in whole or in part in photostat or microfilm or other copying medium.

19. The candidate may also submit as separate supporting documents any work he has published, whether or not it bears on the subject of the thesis.

20. The Senate shall appoint three examiners of whom at least two shall not be members of the teaching staff of the University.

21. The examiners may require the candidate to answer, viva voce or in writing, any questions concerning the subject of his thesis or work.

22. The result of the examination shall be in accordance with the decision of a majority of the examiners.

23. A candidate permitted to re-submit his thesis for examination shall do so within a period of twelve months from the date on which he is advised of the result of the first examination.

REQUIREMENTS FOR THE DEGREE OF DOCTOR OF SCIENCE

1. The degree of Doctor of Science may be awarded by the Council, on the recommendation of the Senate, for an original contribution or contributions of distinguished merit adding to the knowledge or understanding of any branch of learning with which the Faculty is concerned.

2. An applicant for registration for the degree of Doctor of Science shall hold a degree of the University of Newcastle or a degree from another University recognised by the Senate as being equivalent or shall have been admitted to the status of such a degree.

3. The degree shall be awarded on published work although additional unpublished work may also be considered.

4. Every candidate in submitting his published work and such unpublished work as he deems appropriate shall submit a short discourse describing the research embodied in his submission. The discourse shall make clear the extent of originality and the candidate's part in any collaborative work.

5. An applicant for registration for the degree shall submit in writing to the Secretary a statement of his academic qualifications together with:—

(a) four copies of the work, published or unpublished, which he desires to submit; and

(b) a Statutory Declaration indicating those sections of the work, if any, which have been previously submitted for a degree or diploma in any other University.

6. The Senate shall appoint three examiners of whom at least two shall not be members of the teaching staff of the University.

7. The examiners may require the candidate to answer, viva voce or in writing, any questions concerning his work.

8. The result of the examination shall be in accordance with the decision of a majority of the examiners.

1 In these requirements, the term "published work" shall mean printed in a periodical or as a pamphlet or as a book readily available to the public. The examiners are given discretion to disregard any of the work submitted if, in their opinion, the work has not been so available for criticism.
Algebra
Mr. R. F. Berghout is pursuing some topics in ring theory and ring-like categories, making use of the theory of radicals, and is also engaged in the extension of this theory to additive categories.
Associate Professor W. Brisley is working on some problems occurring in the laws defining certain varieties of groups, the subsequent lattice of sub-varieties of given varieties, and the location and construction of generating critical groups for varieties of groups.

Basic Biological Forces
Dr. E. R. Smith is studying the role of Van de Waals and related forces in the stabilisation of biological arrays and colloids.

Chemical Kinetics
Dr. D. L. S. McElwain is working on the mathematical modelling of non-equilibrium phenomena in gases, using the Master Equation approach. A stochastic theory of the dissociation of diatomic gases and exchange reactions is being investigated.

Combinatorial Theory and Operations Research
Associate Professor W. D. Wallis is carrying out research on various parts of graph theory, including graph factorisation. He is also working on rostering and scheduling problems.
Dr. R. J. Vaughan is interested in the application of optimisation methods to industrial production problems.
Professor R. W. Robinson is applying combinatorics to the counting of various structures, such as graphs and search trees.

Differential Equations
Dr. J. G. Couper has been working on the geometric theory of autonomous systems of ordinary differential equations.

Differential Geometry and Relativity
Dr. P. Smrz is working on generalizations of Einstein's theory of relativity using modern differential geometry — in particular, the theory of Lie groups and fibre bundles.

Dynamic Oceanography
Dr. W. Summerfield is interested in the interactions of the various oceanic motions with continental boundaries. He is also studying the various river and lake systems on the N.S.W. coastline.

Environmental and Urban Studies
Dr R. J. Vaughan is investigating mathematical models in urban geography.
Associate Professor W. D. Wallis is interested in mathematical models in urban geography.
Dr. R. W. Gibberd is studying models of urban structure and urban development. He is also interested in urban sociology, voting patterns and urban demographic models.

Fluid Mechanics
Dr W. T. F. Lau is concerned with potential flow and viscous flow problems.

Functional Analysis
Dr. J. R. Giles is involved in determining properties of Banach spaces which can be derived from relations between the points of the space and their support functionals. In particular, he is examining differentiability properties of the norm. He is also working on the development of the theory of the numerical range of operators on locally convex spaces, and of elements of locally m-convex algebras.
Dr V. Ficker and Mr C. J. Ashman are working in measure theory, particularly in some problems on classes of null sets.

History of Mathematics
Mr R. F. Berghout is pursuing research into the development of algebra, notably modern algebra, as well as the relations between this and classical occidental and oriental algebra.
Mr Berghout, together with Mrs Frost, is working on Greek algebra. Mrs Frost is currently translating into English some of Euclid's as yet untranslated works.

Information Theory
Professor R. G. Keats is continuing to work in co-operation with research scientists at the Weapons Research Establishment who are active in the study of signal processing. This work, which is supported by a grant from the Department of Defence, involves the study of non-linear systems with stochastic inputs.

Mathematical Logic
Professor R. W. Robinson is studying the structure of the recursively enumerable degrees and the degrees below O.

Mathematical Models of Tumour Growth
Dr D. L. S. McElwain is investigating models for the growth of isolated tumours.
Number Theory
Dr T. K. Sheng studies the structure of humanly manageable numbers, application of dispersive and explosive linear operators, distribution of algebraic numbers in the complex plane, and functions defined on rational numbers.

Numerical Analysis and Computing
Dr A. J. Guttmann is interested in methods of function approximation, particularly from the viewpoint of using a linear differential equation representation. He is also interested in the analysis of theoretical and experimental data.

Statistical Mechanics
Dr A. J. Guttmann is working on the theory of equilibrium critical phenomena. He is particularly interested in the analysis of power series expansions which are frequently used to study systems exhibiting phase transitions.

Dr E. R. Smith is working on the theory of non-homogeneous systems and the theory of polar liquids.

Dr W. P. Wood is investigating the dynamical behaviour of long chain molecules in solution.

Dr R. W. Gibberd is interested in most aspects of statistical mechanics.

Dr C. A. Croxton is working on the statistical mechanics of liquids and liquid interfaces.

Statistics
Associate Professor W. D. Wallis is working on the theory and application of Room square designs.

Transportation Problems
Dr R. J. Vaughan is continuing his work in the application of mathematics to traffic engineering, traffic accidents and transportation planning.