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:

1. how best can the needs of students requiring studies in mathematics, supplementary and complementary to their principal subject of study, be met;
2. 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, and accordingly the Faculty will, in 1977, offer an undergraduate subject, Computer Science II, which will probably lead to a subject, Computer Science III, in 1978. 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. 11 et seq.
A postgraduate Diploma in Mathematical Studies is now available. 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 134.

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 1977 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 (1976)

Faculty of Mathematics

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The colour band on the spine of this Handbook is the lining colour of the hood worn by Bachelor of Mathematics of this University

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Faculty of Mathematics
FACULTY OF MATHEMATICS

Dean
Professor J. A. Campbell

Sub-Dean
Associate Professor W. Brisley

Faculty Secretary
Linda S. Harrigan

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

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W. Brisley, BSc(Sydney), MSc(New South Wales), PhD; DipEd(New England)
C. A. Croxtom, BSc(Leicester), MA, PhD(Cambridge)
J. R. Giles, BA(Sydney), PhD; DipEd(Sydney)
A. J. Guttman, MSc(Melbourne), PhD(New South Wales)
W. D. Wallis, BSc, PhD(Sydney)

Senior Lecturers
V. Ficker, Prom.Mat, CSc, RNDr(Comenius)
R. W. Gibberd, BSc, PhD(Adeaiide)
T. Y. F. Lam, ME(New South Wales), PhD(Sydney), MAIAA
T. K. Sheng, BA(Marist College), BSc(Malaya & London), PhD(Malaya)
E. R. Smith, MSc(Melbourne), PhD(London)
P. K. Smrz, PromPhys, CSc, RNDr(Charles)

Lecturers
R. F. Berghout, MSc(Sydney)
J. G. Couper, BSc, PhD(New England)
R. B. Eggleton, BSc, MA(Melbourne), PhD(Calgary)
M. J. Hayes, BA(Cambridge)
D. L. S. McElwain, BSc(Queensland), PhD(York (Canada))
W. Summerfield, BSc(Adeaiide), PhD(Adelaide)
R. J. Vaughan, BSc, MEngSc, ME(New South Wales), PhD(Adeaiide), FSS
W. P. Wood, BSc, PhD(New South Wales)

Senior Tutors
C. J. Ashman, BA, LitB(New England)
G. W. Southern, BA(New South Wales), DipCompSc

Tutor
C. S. Dibley, BMaTh

Honorary Associate
I. L. Rose, BE(Sydney), PhD(New South Wales)

Computer Programmers
B. R. Check, BMaTh
A. Nymeyer, BMaTh, DipCompSc

Professional Officer
Joan A. Cooper, BMaTh, PhD

Departmental Office Staff
Judy A. Halliday, BSc, DipEd
Anne M. McKim
Joanne L. Duggan
Julie H. Latimer
Vicki M. Piller

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" p. 140.

REQUIREMENTS FOR THE DEGREE OF BACHELOR OF MATHEMATICS

SECTION I — GENERAL

1. Definitions
In these Requirements, unless the contrary intention appears, "the Faculty" means the Faculty of Mathematics and "the Faculty Board" means the Faculty Board of the Faculty of Mathematics.

2. Grading of Degree
The degree of Bachelor of Mathematics may be conferred either as an ordinary degree or as an honours degree.

3. Approval of First Enrolment
A person who enrolling in the Faculty for the first time shall report in person to the Dean, or his nominee, to have his enrolment for that year approved.

4. Timetable Requirements
No candidate may enrol in any year for any combination of subjects which is incompatible with the requirements of the timetable for that year.

5. Annual Examinations
The Annual Examinations shall normally be held at the end of third term and shall be conducted by means of written examinations supplemented by such oral or practical work testing as the examiners think fit.

6. Special Examinations
A candidate may be granted a special examination in accordance with the provisions of By-Law 5.9.3.

7. Examination Grades
The results of successful candidates at Annual Examinations and Special Examinations shall be classified:
High Distinction, Distinction, Credit, Pass.

8. Withdrawal
(a) A candidate may withdraw from a subject only by notifying the Secretary to the University in writing of his withdrawal within seven days of the date of withdrawal.
(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 Faculty Board may recommend the award of a University Medal to the most distinguished candidate or candidates of the year.

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.

SECTION IV — COMBINED DEGREE COURSES

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:
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 II A, Mathematics IIC, Mathematics III A 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 be chosen from the other subjects listed in the Schedule of subjects approved for the degree of Bachelor of Arts, 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 IIC shall not count either Psychology II A or Psychology IIIB;
(v) a candidate counting Economics IIC shall not count either Economics II A or Economics IIIB.

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 as follows:

(a) five subjects, being Mathematics I, Mathematics II A, Mathematics II C, Mathematics III A 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
(b) six subjects chosen from the other subjects listed in the Schedule of Subjects approved for the degree of Bachelor of Science and
(c) three subjects chosen, with the approval of the Deans of the Faculties of Mathematics and Science, from the subjects approved for any of the degree courses offered by the University provided that:

(i) the number of Part I subjects shall not exceed six;
(ii) the minimum number of Part III subjects shall be three;
(iii) a candidate counting Psychology IIC shall not be entitled to count either Psychology II A or Psychology IIIB;
(iv) a candidate counting Psychology IIC shall not be entitled to count either Psychology II A or Psychology IIIB;
(v) a candidate counting Economics IIC shall not be entitled to count either Economics II A or Economics IIIB.

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 II A, Mathematics II C, Mathematics III A 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 by satisfying all the Requirements for the degree of Bachelor of Metallurgy, except that:

(a) Metallurgical Computations shall be replaced by Mathematics II B, 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 seventeen subjects, five of which shall be Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIIA 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>Mathematics I</td>
</tr>
<tr>
<td>Mathematics I</td>
<td>It is assumed that students have studied Higher School Certificate Mathematics at the two-unit level or higher</td>
</tr>
<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>Pre- or Corequisite Mathematics IIA</td>
</tr>
<tr>
<td>PART III</td>
<td>Mathematics IIIA</td>
</tr>
<tr>
<td>Mathematics IIIA</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC</td>
</tr>
<tr>
<td>Mathematics IIIB</td>
<td>Pre- or Corequisite Mathematics IIIA</td>
</tr>
<tr>
<td>PART IV</td>
<td>Mathematics IV</td>
</tr>
<tr>
<td>Mathematics IV</td>
<td>Prerequisites Mathematics IIIA &amp; Mathematics IIIB</td>
</tr>
</tbody>
</table>

COMPUTER SCIENCE SUBJECT

<table>
<thead>
<tr>
<th>Subject</th>
<th>Prerequisite Mathematics I</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART II</td>
<td>Computer Science II</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>Civil Engineering IIM</td>
<td>Prerequisites Civil Engineering IIM &amp; Mathematics I</td>
</tr>
<tr>
<td>Psychology IIC</td>
<td>Prerequisites Mathematics I, Psychology I. A candidate counting Psychology IIC shall not be entitled to count Psychology IIA or Psychology IIB</td>
</tr>
<tr>
<td>PART III</td>
<td>Accounting IIC</td>
</tr>
<tr>
<td>Accounting IIC</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC &amp; either Accounting IIA or Accounting IIB</td>
</tr>
<tr>
<td>Biology IIIB</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC &amp; either Biology IIA or Biology IIIB</td>
</tr>
<tr>
<td>Chemical Engineering IIC</td>
<td>Prerequisites Chemical Engineering I, Mathematics IIA &amp; Mathematics IIC (including Topics E &amp; F)</td>
</tr>
<tr>
<td>Civil Engineering IIM</td>
<td>Prerequisites Civil Engineering IIM, Mathematics IIA &amp; Mathematics IIC (including Topic E)</td>
</tr>
<tr>
<td>Communications &amp; Automatic Control</td>
<td>Prerequisites Mathematics IIA &amp; Mathematics IIC (including Topics C, D &amp; E)</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 IIC 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
---|---
Digital Computers & Automatic Control | Prerequisites Mathematics IIA & Mathematics IIC (including Topics C, D & E)
Economics IIIC | Prerequisites Economics IIA, Mathematics IIA & Mathematics IIC
Geology IIIC | Prerequisites Physics I, Mathematics IIA, Mathematics IIC & Geology IIA
Industrial Engineering I | Prerequisites Mathematics IIA & Mathematics IIC
Mechanical Engineering IIIC | Prerequisites Mathematics IIA & Mathematics IIC (including Topics E, F & H)
Physics IIIA | Prerequisites Physics II, Mathematics IIA & Mathematics IIC
Psychology IIIC | Prerequisites 1977—Mathematics IIA, Mathematics IIC and one of Psychology IIA or Psychology IIIB, 1978—Mathematics IIA, Mathematics IIC and either Psychology IIA or Psychology IIIB or Psychology IIC.

SCHEDULE C
COMBINED HONOURS SUBJECTS
Mathematics/Physics IV | Prerequisites Mathematics IIIA & Physics IIIA
Mathematics/ Psychology IV | Prerequisites Mathematics IIIA & Psychology IIC

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 II, Mathematics IIC, Mathematics IIIA and either Mathematics IIIB or a Part III subject from Schedule B of the Requirements. This leaves nine subjects which must clearly satisfy the Requirements for the Arts degree.

The course could be pursued in the following manner:
Year I Mathematics I
Year II Mathematics IIA
Year III Mathematics IIIA
Year IV Mathematics IIIB or a Part III Schedule B subject from the Requirements for the B.Math.
Year V Economics & Commerce Group C

Commerce/Mathematics
The details of the combined course in Commerce and Mathematics follow from the Requirements for each degree. The combined course should contain Mathematics I, Mathematics IIA, Mathematics IIC, Mathematics IIIA and either Mathematics IIIB or a Part III subject from Schedule B of the Schedule of Subjects approved for the degree of Bachelor of Mathematics. This leaves twelve subjects which must clearly satisfy the Requirements for the Commerce degree. The course could be pursued in the following manner:
Year I Mathematics I
Year II Mathematics IIA
Year III Mathematics IIIA
Year IV Mathematics IIIB or a Part III Schedule B subject from the
Year V Economics & Commerce Group C

1Introductory Quantitative Methods is not a compulsory subject for students who have successfully completed Mathematics IIIB Topic H and who proceed directly to Economic Statistics II, Statistical Analysis, Quantitative Business Analysis or Commercial Electronic Data Processing.
MA THEMATICS/ 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 IIIB, 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 IIIB or a Schedule B subject from the Requirements for Bachelor of Mathematics, plus two other subjects which will complete the Requirements for the Science degree.

MA THEMATICS/ 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 IIIB 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 IA, ME121, 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, ChE331, 6 of Met 300 subjects, Elective I and 2 units of Elective II
Year IV  Mathematics IIIA and either Mathematics IIIB, or a Schedule B Part III subject from the Requirements for the degree of Bachelor of Mathematics and 4 units of Elective I
Year V  Met401, Met402, and 2 units of Elective II

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

No Mathematics subject may be taken as an elective.

KNOWLEDGE OF TEACHERS IN SPECIFIC SUBJ ECTS

In 1975 the Senate of the University established a number of committees to advise on the level of University studies required to maintain an informed competence in particular disciplines. These enquiries were particularly directed towards secondary school teaching but their application is, in most cases, quite general. The advice tendered by the committees was accepted by Senate and is reproduced below.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Level of Study Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classics</td>
<td>A major in Latin or Greek with some studies</td>
</tr>
<tr>
<td>Commerce &amp;</td>
<td>Two years (preferably three) of Economics</td>
</tr>
<tr>
<td>Economics</td>
<td>including Microeconomics and Macroeconomics;</td>
</tr>
<tr>
<td>English</td>
<td>Accounting I and Legal Studies I</td>
</tr>
<tr>
<td>Geography</td>
<td>Geography IIA, Geography IIB, Geography IIIA</td>
</tr>
<tr>
<td>History</td>
<td>An Honours Degree in Geography would be of</td>
</tr>
<tr>
<td></td>
<td>considerable benefit</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Mathematics IIIA as a minimum</td>
</tr>
<tr>
<td>Modern Languages</td>
<td>Ideally an Honours Degree in the foreign</td>
</tr>
<tr>
<td>Science</td>
<td>language proposed, together with a period</td>
</tr>
<tr>
<td></td>
<td>in the appropriate foreign country</td>
</tr>
<tr>
<td></td>
<td>A Part III subject in the relevant science,</td>
</tr>
<tr>
<td></td>
<td>together with some breadth in scientific</td>
</tr>
</tbody>
</table>

18
Prerequisites for Curriculum and Method Subjects Offered in the Diploma in Education

Students in the Faculty of Mathematics who are intending to study for the postgraduate Diploma in Education may be interested in the following prerequisite subjects for that Diploma. It will be noted that any graduate holding the degree of Bachelor of Mathematics possesses the prerequisites required for the Diploma in Education and the prerequisites for at least one curriculum and method subject, namely Mathematics. These prerequisites are stated in terms of subjects of the University of Newcastle. Applicants with qualifications from other universities, whose courses of study have included subjects which are deemed for this purpose to provide an equivalent foundation, may be admitted by the Dean of the Faculty of Education on the recommendation of the Head of the Department of Education.

Subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) English</td>
<td>(i) A Part I and a Part II subject in English: and</td>
</tr>
<tr>
<td></td>
<td>(ii) one additional subject from English, Linguistics or Drama</td>
</tr>
<tr>
<td>(b) History</td>
<td>A Part II subject in History</td>
</tr>
<tr>
<td>(c) Modern</td>
<td>A Part III subject in French or German</td>
</tr>
<tr>
<td>Languages</td>
<td>(d) Classics</td>
</tr>
<tr>
<td></td>
<td>A Part III subject in Greek or Latin</td>
</tr>
<tr>
<td>(e) Geography</td>
<td>A Part II subject in Geography</td>
</tr>
<tr>
<td>(f) Commerce/</td>
<td>B.A. including Economics II/ or B. Com. including Microeconomics and Macro-</td>
</tr>
<tr>
<td>Economics</td>
<td>economics</td>
</tr>
<tr>
<td>(g) Social Science/</td>
<td>Out of Economics, Geography, History, Psychology, Legal Studies and Economic</td>
</tr>
<tr>
<td>Studies</td>
<td>History</td>
</tr>
<tr>
<td></td>
<td>one subject at Part II level and</td>
</tr>
<tr>
<td></td>
<td>two other subjects at Part I level</td>
</tr>
<tr>
<td>(h) Mathematics</td>
<td>(i) At least four subjects in Mathematics for the degree of B.A., B.Math., or</td>
</tr>
<tr>
<td></td>
<td>B.Sc.</td>
</tr>
<tr>
<td></td>
<td>(ii) A degree in a field of applied science, with experience in the application of mathematics</td>
</tr>
</tbody>
</table>

Subjects

(i) Science

(i) Three subjects from the disciplines of Biology, Chemistry, Geology and Physics, or related fields of applied science, such subjects to be drawn from at least two of the disciplines of Biology, Chemistry, Geology and Physics

and

(ii) at least one other subject drawn from any of the above or from Mathematics, Geography, or Psychology

(j) Primary

No specific prerequisites.

Note

A Part II subject assumes as a prerequisite a pass in a Part I subject in the same discipline. A Part III subject assumes a pass in a Part I subject and a Part II subject in the same discipline.

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 of Mathematics 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 Mathematics subjects consists of four topics. For Mathematics I, there
is no choice of topics; for Mathematics IIA, IIB, IIC there is some choice available to students; for Mathematics IIIA and IIIB 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 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.)

The Part II subject Computer Science II is taught and examined jointly by the Department of Electrical Engineering and the Department of Mathematics. In Computer Science II, there is no choice of topics.

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 4 lecture hours and 2 tutorial hours per week

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 1 lecture hour per week and 1 tutorial hour per fortnight

Content


Text Nil

References

Apostol, T. Calculus Vol. 1 2nd edn (Blaisdell 1967)
Spivak, M. Calculus (Benjamin 1967)

Topic AL — Algebra — R. B. Eggleton

Prerequisites Nil

Hours 1 lecture hour per week and 1 tutorial hour per fortnight

Content

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

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

References

Liebeck, H. Algebra for Scientists and Engineers (Wiley 1971)
Lipschutz, S. Linear Algebra (Schaum 1968)
McCoy, N. Introduction to Modern Algebra (Allyn & Bacon 1968)
Tropper, M. A. Linear Algebra (Nelson 1973)

Topic CA — Calculus — R. F. Berghout

Prerequisites Nil

Hours 1 lecture hour per week and 1 tutorial hour per fortnight

Content

Vector geometry in three dimensions. Revision of differentiation and integration of polynomials and trigonometric functions. Differentiation of rational functions and of implicit and parametrically defined functions. Definition and properties of logarithmic, exponential and hyperbolic functions. Integration by parts and by substitution techniques. Integration of rational functions. First order separable and

Text
Nil

References
Apostol, T. Calculus Vol. 1 2nd edn (Blaisdell 1967)
Ayres, F. Calculus (Schaum Outline Series, McGraw-Hill)
Hille, E. & Salas, S. First Year Calculus Internat. Textbook Series (Blaisdell 1968)

PART II SUBJECTS
The Department of Mathematics offers three Part II Mathematics subjects. Students whose course restricts them to one subject must study Mathematics IA or Mathematics IB. The subject Mathematics IA is a pre-corequisite for Mathematics IC, and IA and IC together a prerequisite for any Part III subject, so students wishing to take two Part II subjects would normally choose Mathematics IA and IC. 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 27 et seq. of this handbook.
The Department of Mathematics also offers jointly with the Department of Electrical Engineering, the subject Computer Science II. No student taking this subject may choose the Mathematics Topic F as a component of another Part II subject. A description and course outline of Computer Science II will be found on page 36 et seq.

List of Topics for Part II Mathematics subjects

<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>
<td>Numerical Analysis and Computing</td>
</tr>
<tr>
<td>G</td>
<td>Fourier series, Partial Differential Equations and Special Functions</td>
</tr>
<tr>
<td>H</td>
<td>Probability and Statistics</td>
</tr>
<tr>
<td>I</td>
<td>Topic in Statistics</td>
</tr>
<tr>
<td>J</td>
<td>Topic in Applied Mathematics</td>
</tr>
<tr>
<td>K</td>
<td>Topic in Pure Mathematics</td>
</tr>
<tr>
<td>L</td>
<td>Analysis of Metric Spaces</td>
</tr>
</tbody>
</table>

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

662100 Mathematics IA

Prerequisite Mathematics I

Hours 4 lecture hours and 2 tutorial hours per week
Examination
Each topic is examined separately

Content
Topics B, C, D, and E. In exceptional circumstances and with the consent of the Head of the 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 subjects Mathematics IIB.

662200 Mathematics IIB

Prerequisite
Mathematics I

Hours
4 lecture hours and 2 tutorial hours per week

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
4 lecture hours and 2 tutorial hours per week

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 I 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 IIB are advised to include topics C, E, G, and 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 "I" in 1974, 1975, 1976 and 1977 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

Hours
1 lecture hour per week and 1 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 (Blaisdell 1963)
Noble, B. Applications of Undergraduate Mathematics in Engineering (M.A.A./Collier-Macmillan 1967)
Rapoport, A. & Chammah, A. M. Prisoner's Dilemma (Michigan U.P. 1965)

662102 Topic B — Complex Analysis — R. B. Eggleton

Prerequisite
Topic C

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper

Content
Complex Numbers — polar, exponential forms. Functions of a complex variable — limit, continuity, derivative. Analytic Functions —

Text

References
Paliouras, J. D. *Complex Variables for Scientists and Engineers* (Macmillan 1975)

662103 Topic C — Calculus and Vector Calculus — E. R. Smith

Prerequisites
Nil

Hours
1 lecture hour per week and 1 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)

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
1 lecture hour per week and 1 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)
Tropper, Mary A. *Linear Algebra* (Nelson 1969)
662201 Topic E — Differential Equations and Integral Transforms — W. Summerfield

Prerequisite

or Corequisite

Topic C

Hours

1 lecture hour per week and 1 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 with constant coefficients; general solution, matrix exponential. Higher order linear equations. 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


Prerequisites

Nil

Hours

1 lecture hour per week and 1 tutorial hour per fortnight

Examination

One 2-hour paper

Content


Texts


References

Balfour, A. & Beveridge, W. T. Basic Numerical Analysis with Fortran (Heinemann 1973)
Conté, S. D. & de Boor, C. Elementary Numerical Analysis (McGraw-Hill 1972)
Kreitzberg, C. B. & Shneiderman, B. The Elements of Fortran Style (Harcourt, Brace & Jovanovich 1972)
Ralston, A. A First Course in Numerical Analysis (McGraw-Hill 1965)

662203 Topic G — Fourier Series, Partial Differential Equations and Special Functions — R. J. Vaughan

Prerequisite

or Corequisite

Topic C

Hours

1 lecture hour per week and 1 tutorial hour per fortnight

Examination

One 2-hour paper

Content


Texts

References
Berg, P. W. & McGregor, J. L.
Churchill, R. V.
Kaplan, W.
Keane, A. & Senior, S. A.
Piaggio, H. T. H.

An Elementary Treatise on Differential Equations and their Applications (Bell 1971)

Sneddon, I. N.
Elements of Partial Differential Equations (McGraw-Hill 1957)

Sneddon, I. N.
Special Functions of Mathematical Physics and Chemistry 2nd edn (Oliver & Boyd 1961)

Stephenson, G.
An Introduction to Partial Differential Equations for Science Students 2nd edn (Longman 1970)

Weinberger, H. F.
A First Course in Partial Differential Equations (Blaisdell 1965)

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

Prerequisite or Corequisite
Topic C

Hours
1 lecture hour per week and 1 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 $(\bar{X} - \bar{Y})$, and the statistics $X^2$, $S^2$, $T$ and $F$ with applications.

Text
Freund, J. E.
or
Hoel, P. G.

Mathematical Statistics 2nd edn (Prentice-Hall 1971)

Introduction to Mathematical Statistics 4th edn (Wiley 1971)

References
Allendoerfer, C. B. & Oakley, C. O.
Feller, W.

Principles of Mathematics Chapter 12 (McGraw-Hill 1955)


Gnedenko, B. V.
The Theory of Probability Chapters I & II (Chelsea 1962)

Hine, J. & Wetherill, G. B.
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)

Mendenhall, W. & Scheaffer, R. L.
Moran, P. A. P.

Mathematical Statistics with Applications (Duxbury Press 1973)
An Introduction to Probability Theory (Oxford U.P. 1968)

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

Prerequisite or Corequisite
Topic H

Hours
1 lecture hour per week and 1 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, markov chains, analysis of categorized data, rank statistics, goodness of fit tests and non-parametric statistics.

Text
Nil
References
Draper, N. R. & Smith, H.  
Kemeny, J. G. & Snell, J. L.  
Noether, G. E.

*Applied Regression Analysis* (Wiley 1966)
*Finite Markov Chains* (van Nostrand 1967)

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

Prerequisites or Corequisites  
Topics C and E

Hours  
1 lecture hour per week and 1 tutorial hour per fortnight

Examination  
One 2-hour paper

Content

Text  
Nil

References

662303 Topic K — Topic in Pure Mathematics  
e.g. Group Theory — R. F. Berghout

Prerequisites  
Nil

Hours  
1 lecture hour per week and 1 tutorial hour per fortnight

Examination  
One 2-hour paper

Content
Groups, subgroups, isomorphism, direct product, Permutation groups, groups of linear transformations and matrices, isometries, 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 $\mathbb{R}^3$ or $\mathbb{R}^3$

Text  
Nil

References
Baumslag, B. & Chandler, B.  *Group Theory* (Schaum 1968)
Weyl, H.  *Symmetry* (Princeton U.P. 1952)

662304 Topic L — Analysis of Metric Spaces — M. J. Hayes

Prerequisites  
Nil

Hours  
1 lecture hour per week and 1 tutorial hour per fortnight

Examination  
One 2-hour paper

Content

Text  
Nil

References
Goldberg, R. R.  *Methods of Real Analysis* (Blaisdell 1964)
Simmons, G. F.  *Introduction to Topology and Modern Analysis* (McGraw-Hill 1963)
White, A. J.  *Real Analysis* (Addison-Wesley 1968)
Prerequisite
Mathematics I

Hours
168 hours of lectures, tutorials and practical work as listed below

Examination
See components descriptions below

Content

Topics
SI—Introduction to Structuring of Information
SP—Systematic Programming
ML—Computer Structure: Machine and Assembly Languages
F—Numerical Analysis and Computing

Topic SI—Introduction to Structuring of Information—J. A. Campbell and P. J. Moylan

Prerequisite
Mathematics I

Corequisite
Topic SP

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper

Content
Influence of structuring of information on design of programming languages.

Data structures: lists, trees, queues, deques and stacks. Examples of and methods for implementing these structures. Storage allocation for complex data items. Scatter storage and hash addressing. Elementary string processing, and list processing.

Searching and sorting. A description of several sorting algorithms and comparison of their efficiencies.

Text
Elson, M.

References
Bates, F. & Douglas, M. L.
Dahl, O. J. et al.
Guttmann, A. J.

International Computers Ltd
International Computers Ltd
Katzan, H. Jr

Introduction to Computer Science (Petrocelli-Charter 1975)

Knuth, D. E.
The Art of Computer Programming Vols.
I—Fundamental Algorithms,
II—Semi-numerical Algorithms,
III—Sorting and Searching
(Addison-Wesley 1968, 1969, 1973)

Wirth, N.
Algorithms + Data Structures = Programs
(Prentice-Hall 1976)

Topic SP—Systematic Programming—J. A. Campbell and P. J. Moylan

Prerequisite
Mathematics I

Hours
1 lecture hour and ½ tutorial or practical work hour per week

Examination
One 2-hour paper

Content
The case for high level programming languages. The formal definition of the syntax of high level languages.

An overview and comparison of several high level languages, including FORTRAN, ALGOL 60, PL/I and COBOL. Comparison of compiler languages and interpretive languages. A brief introduction to list processing languages and macrogenerators.

Structured programming: its objectives and the techniques used to achieve them. Modular design, top-down programming, good coding style. The role of 'goto' constructs, conditional statements, looping, 'case' statements. The virtues and faults of existing programming languages.

Procedures, co-routines, re-entrancy. Recursive programming. Appropriate and inappropriate uses of recursion.

Text
Elson, M.

References
Bates, F. & Douglas, M. L.
Dahl, O. J. et al.
Guttmann, A. J.

International Computers Ltd
International Computers Ltd
Katzan, H. Jr

Introduction to Computer Science (Petrocelli-Charter 1975)

Concepts of Programming Languages (Science Research Associates 1973)

Programming Language/One 3rd edn
(Prentice-Hall 1975)

Structured Programming (Academic 1972)

Programming and Algorithms (Heinemann 1977)

ALGOL Programming Manual

1900 series COBOL Manual

Introduction to Computer Science (Petrocelli-Charter 1975)
Kernighan, B. W. & Plauger, P. J.
The Elements of FORTRAN Style (Harcourt, Brace, Jovanovich 1972)
Wirth, N.
Systematic Programming (Prentice-Hall 1973)
Yourdan, E. J.
Techniques of Program Structure and Design (Prentice-Hall 1975)

Topic ML—Computer Structure: Machine and Assembly Languages — K. K. Saluja

Prerequisite
Mathematics I

Hours
1½ lecture and practical work hours per week

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, 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
Eckhouse, R. H. Jr

References
Chu, Y. H.
Computer Organization and Micro Programming (Prentice-Hall 1972)
Donovan, J. J.
Systems Programming (McGraw-Hill 1972)
Stone, H. S.
Introduction to Computer Organization and Data Structures (McGraw-Hill 1972)


Prerequisite
Mathematics I

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper

Content

Text
Nil

References
Balfour, A. & Beveridge, W. T.
Basic Numerical Analysis with Fortran (Heinemann 1973)
Carnahan, B. et al.
Applied Numerical Methods (Wiley 1969)
Conté, S. D. & de Boor, C.
Elementary Numerical Analysis (McGraw-Hill 1972)
Kreitzberg, C. B. & Shneiderman, B.
The Elements of FORTRAN Style (Harcourt, Brace & Jovanovich 1972)
Ralston, A.
A First Course in Numerical Analysis (McGraw-Hill 1965)

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 IIIA and IIC are prerequisite for entry to Mathematics IIIA, and Mathematics IIIA is pre- or corequisite for Mathematics III B. It will be assumed that students taking a third-year subject in 1977 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 41 et seq. of this handbook.

List of Topics for Part III Mathematics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Prerequisite</th>
<th>Corequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>General Tensors</td>
<td>C</td>
</tr>
<tr>
<td>N</td>
<td>Variational Methods</td>
<td>C, E</td>
</tr>
<tr>
<td>O</td>
<td>Mathematical Logic</td>
<td>K, L</td>
</tr>
<tr>
<td>P</td>
<td>Differential and Integral Equations</td>
<td>E</td>
</tr>
<tr>
<td>PD</td>
<td>Partial Differential Equations</td>
<td>E</td>
</tr>
<tr>
<td>Q</td>
<td>Fluid Dynamics</td>
<td>B, C, E</td>
</tr>
<tr>
<td>R</td>
<td>Probability and Statistics</td>
<td>H</td>
</tr>
<tr>
<td>S</td>
<td>Geometry</td>
<td>C</td>
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<tr>
<td>T</td>
<td>Group Theory</td>
<td>D, K</td>
</tr>
<tr>
<td>TC</td>
<td>Theory of Computing</td>
<td>C, F</td>
</tr>
<tr>
<td>U</td>
<td>Operations Research</td>
<td>D</td>
</tr>
<tr>
<td>V</td>
<td>Measure Theory and Integration</td>
<td>L</td>
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<tr>
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The selection rules and definitions of the Part III subjects follow.

663100 Mathematics IIIA

**Prerequisites**  Mathematics IIA & IIC

**Hours**  4 lecture hours and 2 tutorial hours per week

**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 IIIB

**Prerequisite**  Mathematics IIIA

**Hours**  4 lecture hours and 2 tutorial hours per week

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

**Prerequisite**  Topic C

**Hours**  1 lecture hour per week and 1 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.

**Text**  Nil

**References**
- Lichnerowicz, A. Elements of Tensor Calculus (Methuen 1962)
- Sokolnikoff, I. S. Tensor Analysis—Theory and Applications to Geometry and Mechanics of Continua (Wiley 1964)
- Willmore, T. J. An Introduction to Differential Geometry (Oxford 1972)

663102 Topic N — Variational Methods — W. P. Wood

**Prerequisites**  Topics C & E

**Hours**  1 lecture hour per week and 1 tutorial hour per fortnight
Examination
One 2-hour paper

Content

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

References
Arthurs, A. M. Complementary Variational Principles (Pergamon 1964)
Hadley, G. & Kemp, M. C. Variational Methods in Economics (North-Holland 1971)
Mikhlin, S. G. Variational Methods in Mathematical Physics (Pergamon 1964)
Weinstock, R. Calculus of Variations (McGraw-Hill 1952)

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

Prerequisites
Topics K & L

Hours
1 lecture hour per week and 1 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 axiomatically defined Mathematical systems, and Gödel's undecidability theorem will be discussed.

Text
Enderton, H. B. A Mathematical Introduction to Logic (Academic 1972)

References
Cochran, J. A. The Analysis of Linear Integral Equations (McGraw-Hill 1972)
Kanwal, R. P. Linear Integral Equations: Theory and Techniques (Academic 1971)
Lovitt, W. V. Linear Integral Equations (Dover 1950)

663108 Topic PD — Partial Differential Equations — W. T. F. Lau

Prerequisite
Topic E

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper
Content
First order equations and second order equations. The Laplace equation, the wave equation and the diffusion equation. Integral transforms, Green's function and other methods. Applications on fluid mechanics, heat flow, potential theory, etc.

Text
Nil

References
Croston, C. A. Introductory Eigenphysics (Wiley 1974)
Friedman, A. Generalised 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. Sommerfield

Prerequisites
Topic B, C & E

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper

Content
Basic concepts: continuum, density, pressure, viscosity. Derivation of governing equations for the motion of an ideal (non-viscous) fluid. Investigation of simple flows; particularisation to cases where motion irrotational, and further, to instances where the flow can also be considered two dimensional (e.g., surface wave motion). Introduction to the powerful complex variable method of solution for the latter type of motion. Comparison between ideal and real fluid flows; boundary layers.

Text
Nil

References
Batchelor, G. K. An Introduction to Fluid Dynamics (Cambridge U.P. 1967)
Coulson, C. A. Waves (Oliver & Boyd 1958)
Curle, N. & Davies, H. J. Modern Fluid Dynamics Vol. 1 (Van Nostrand 1968)
Milne-Thompson, L. M. Theoretical Hydrodynamics (Macmillan 1963)
Rutherford, D. E. Fluid Dynamics (Oliver & Boyd 1959)

663106 Topic R — Probability and Statistics — V. Ficker

Prerequisite
Topic H

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper

Content
This topic consolidates and extends the study of probability and statistics made in Topic H. Items studied include random vectors, generating functions of random vectors, multinomial and multivariate normal random vectors. Sampling theory, the T and F distributions. Point and interval estimation, Decision theory, Bayes decision rules, Hypothesis-testing, Neyman-Pearson Lemma, likelihood ratio, Cochran's theorem. Linear statistical estimation. Linear regression analysis, 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
Johnson, N. L. & Leone, F. C. Statistics and Experimental Design in Engineering and the Physical Sciences (2 Vols) (Wiley 1964)
Lindgren, B. W. Statistical Theory 2nd edn (Collier-Macmillan 1968)
Sveshnikov, A. A. Problems in Probability Theory, Mathematical Statistics and Theory of Random Functions (Saunders 1968)
663107  Topic S — Geometry — T. K. Sheng

Prerequisite

Topic C

Hours

1 lecture hour per week and 1 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, field planes.

Text

Nil

References

Albert, A. A. & Sandler, R. *An Introduction to Finite Projective Planes* (Holt, Rinehart & Winston 1968)

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 — W. Brisley

Prerequisites

Topics D & K

Hours

1 lecture hour per week and 1 tutorial hour per fortnight

Examination

One 2-hour paper

Content

Structure of groups: Sylow theorems for finite groups; Series decomposition of groups; soluble groups; nilpotent groups. Finite and infinite abelian groups. Free groups, and presentation of groups in terms of generators and relations.

Text

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

OR


Reference


663209  Topic TC — Theory of Computing — A. J. Guttmann

Prerequisites

Topics C & F

Hours

1 lecture hour per week and 1 tutorial hour per fortnight

Examination

One 2-hour paper and assignments throughout the year

Content

This course will interest science, mathematics and engineering students who are interested in the theoretical foundations of computer science. Mathematical Models of Computers: Finite Automata are introduced as a first approximation to a model of a computer and some of its properties are studied. Three equivalent models of computation are then introduced and compared. These models are Turing machines, computer machines, and recursive functions. Some of the limits of models of computation (unsolvability) are also discussed.

Algorithmic Aspects of Computation: How "good" an algorithm do we have for performing some computation? Is there any way in which we can say that some algorithm is the "best" for accomplishing some task?

Program Correctness: Methods of program verification are introduced and discussed.

Formal Languages and Parsing: Methods of systematically and formally specifying the syntax of programming languages are discussed. Some parsing methods are introduced.

Text

Nil

References


Hopcroft, J. E. & Ullman, J. D. *Formal Languages and Their Relation to Automata* (Addison-Wesley 1969)

Wirth, N. *Algorithms = Data Structures = Programs* (Prentice-Hall 1976)
663202 Topic U — Operations Research — W. D. Wallis

Prerequisites
Topic D

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper

Content
Topics covered will be chosen from games theory; linear programming; integer programming; dynamic programming; networks and flows; activity analysis; inventory theory.

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.

663203 Topic V — Measure Theory and Integration — V. Ficker

Prerequisite
Topic L — Analysis of Metric Spaces

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper

Content

References
Banach, S.
Brown, A. L. & Page, A.
Giles, J. R.
Giles, J. R.
Kolmogorov, A. N. & Fomin, S. V.
Liusternik, L. A. & Sobolev, U. J.

663204 Topic W — Analysis of Normed Linear Spaces — T. K. Sheng

Prerequisite
Topic L — Analysis of Metric Spaces

Hours
1 lecture hour per week and 1 tutorial hour per fortnight

Examination
One 2-hour paper

Content

References
Banach, S.
Brown, A. L. & Page, A.
Giles, J. R.
Giles, J. R.
Kolmogorov, A. N. & Fomin, S. V.
Liusternik, L. A. & Sobolev, U. J.
Simmons, G. F. *Introduction to Topology and Modern Analysis* (McGraw-Hill 1963)
Wilansky, A. *Functional Analysis* (Blaisdell 1964)

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

**Prerequisites**
Topics D & K

**Hours**
1 lecture hour per week and 1 tutorial hour per fortnight

**Examination**
One 2-hour paper

**Content**

**Text**
Nil

**References**
Birkhoff, G. D. & MacLane, S. *A Survey of Modern Algebra* (Macmillan 1953)
Herstein, I. N. *Topics in Algebra* (Wiley 1975)
Kaplansky, I. *Fields and Rings* (Chicago U.P. 1969)
Stewart, I. *Galois Theory* (Chapman & Hall 1973)

663206 **Topic Y — Topic in Applied Probability**
e.g. *Information Theory* — W. P. Wood

**Prerequisites**
Topics C, D & H

**Hours**
1 lecture hour per week and 1 tutorial hour per fortnight

**Examination**
One 2-hour paper

**Content**
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.

**Text**
Nil

**References**
Ash, R. *Information Theory* (Wiley 1965)
Brillouin, I. *Science and Information Theory* (Academic 1962)
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* (Methuen 1966)
Reza, F. M. *An Introduction to Information Theory* (McGraw-Hill 1961)

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

**Prerequisites**
Topics C, D & E

**Hours**
1 lecture hour per week and 1 tutorial hour per fortnight

**Examination**
One 2-hour paper

**Content**
Solution of linear systems of algebraic equations by direct and linear iterative methods; particular attention will be given to the influence of various types of errors on the numerical result, to the general theory of convergence of the latter class of methods and to the concept of “condition” of a system. Solution by both one step and multi-step methods of initial value problems involving ordinary differential equations. Investigation of stability of linear marching schemes. Boundary value problems. Finite-difference and finite-element methods of solution of partial differential equations. Some analysis background and some experience in programming computers is assumed but no prerequisites of numerical analysis courses will be expected.

**Text**
Nil

**References**
PART IV SUBJECT

664100 Mathematics IV

**Prerequisites**
Mathematics IIIA & IIB, 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 8 lecture hours per week over one full-time year of 4 lecture hours per week over two part-time years.

**Examination**
At least eight 2-hour final papers.

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 Reviews*.

Content
A selection of topics, each of about 27 lectures, will be offered. Summaries of topics which may be offered in 1977 follow.

PART IV TOPICS

664137 Introduction to Category Theory — R. F. Berghout

**Prerequisite**
Topic T

**Hours**
About 27 lecture hours

**Examination**
One 2-hour paper

Content
This course is geared to an examination of the concept of "naturality" in mathematics. Categories and functors will be introduced as unifying concepts underlying much of mathematics. Adjoint functors will be discussed in some depth and illustrated by applications to various branches of mathematics, particularly group theory. The existence of adjoint functors under certain conditions and a monadic approach to universal algebra will end the course.

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

References
Arbib, M. et al. *The Categorical Imperative*  
Dickson, S. *An Introduction to Categorical Algebra* (Obtainable from Mathematics Department)

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.
References

Burrow, M.  
Coxeter, H. S. M. & Moser, W. O. J.  
Feit, W. J.  
Hall, M. Jr  
Kurosh, A. G.  
Magnus, W. et al.  
Scott, W. R.  
and other articles and books mentioned during the course.

664138 Programming Languages and Advanced Applications in Computing — J. A. Campbell

Prerequisites  
Topic O, and at least one of Topics F, U and Z

Hours  
About 27 lecture hours

Examination  
One 2-hour paper

Content

Classification of the principal types of programming languages, with detailed comparisons of the properties of representative languages of each type. Review of the mutual influences between the design of languages and the nature of the applications for which the languages have originally been intended. Presentation of the current state of mathematical and computational work in selected advanced topics, e.g., artificial intelligence, information retrieval and handling of large data bases, computation with symbolic expressions.

Text  
Nil

References

Aho, A. V. et al.  
The Design and Analysis of Computer Algorithms (Addison-Wesley 1974)

Griswald, R. E. et al.  
The SNOBOL4 Programming Language (Prentice-Hall 1968)

Hunt, E. B.  
Artificial Intelligence (Academic 1975)

Jensen, K. & Wirth, N.  

McCarthy, J.  
LISP 1.5 Programmer's Manual (MIT 1965)

664139 Mathematics for Classification and Numerical Taxonomy — J. A. Campbell

Prerequisite  
Topic I

Hours  
About 27 lecture hours

Examination  
One 2-hour paper

Content

The course will deal with the mathematical techniques presently in use for classification or ranking of objects in terms of their attributes. Topics covered will include measures of similarity and dissimilarity, correlation and weighting of attributes, cluster analysis, multidimensional scaling, and mathematical models for the process of simplification of data concerning attributes. Fields in which applications will be considered include archaeology, pattern recognition, biology and information retrieval.

Text  
Sneath, P. H. A. & Sokal, R. R.  
Principles of Numerical Taxonomy 2nd edn (Freeman 1973)

References

Jordine, N. & Sibson, R.  
Numerical Taxonomy (Wiley 1971)

Kullback, S.  
Information Theory and Statistics (Wiley 1959)

van Rijssbergen, C. J.  
Information Retrieval (Butterworth 1975)

Taylor, J. C.  
Gauge Theories of Weak Interactions (Cambridge U.P. 1975)

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)

664140 Dynamical Systems — J. G. Couper

Prerequisites  
Topics I and P

Hours  
About 27 lecture hours

Examination  
One 2-hour paper

Content
This course will be concerned with the orbit structure of differential equations and diffeomorphisms, with an orientation towards their stable and generic properties.

Text
References  
Hirsch, M. W. & Smale, S.  
*Differential Equations, Dynamical Systems and Linear Algebra* (Academic 1974)

Hurewicz, W.  
*Lectures on Ordinary Differential Equations* (M.I.T. 1958)

Nitecki, Z.  
*Differentiable Dynamics* (M.I.T. 1971)

664141 Introduction to Number Theory — R. B. Eggleton

Prerequisite  
Topic C

Hours  
About 27 lecture hours

Examination  
One 2-hour paper

Content
Several areas of elementary number theory will first be examined at an introductory level. These will include the Euclidean algorithm, Farey fractions, Diophantine equations, linear congruences and Gauss's theorem. A rather detailed study of several major theorems will follow: these will be the Prime Number Theorem, the Quadratic Reciprocity Theorem, and Dirichlet's Theorem on primes in arithmetic progressions.

Text
References  
Apostol, T. M.  
*Introduction to Number Theory* (Springer 1976)

Davenport, H.  
The Higher Arithmetic 3rd edn (Hillary 1968)

Hardy, G. & Wright, E. M.  
*Introduction to Number Theory* 4th edn (Oxford U.P. 1960)

Nagell, T.  
*Introduction to Number Theory* 2nd edn (Chelsea 1964)

Rademacher, H.  
*Lectures on Elementary Number Theory* (Blaisdell 1964)

664142 Topological Graph Theory — R. B. Eggleton

Prerequisite  
Topic C

Hours  
About 27 lecture hours

Examination  
One 2-hour paper
This topic deals with drawings of graphs on various surfaces. It will begin with a brief introduction to the theory of graphs, to be followed by a fairly detailed introduction to the topology of surfaces, with particular attention to the classification of surfaces. The main areas to be treated are: Kuratowski's Theorem characterising graphs which can be embedded in the plane; genus, thickness, coarseness and crossing numbers of graphs; chromatic number of a surface and the recent proof of the Four Colour Theorem by Appel and Haken.

Text
Nil

References
Harary, F. Graph Theory (Addison-Wesley 1969)
Ore, O. The Four Colour Problem (Academic 1967)
Ringel, G. Map Colour Theorem (Springer 1974)
Wilson, R. J. Introduction to Graph Theory (Oliver & Boyd 1972)

664143 Families of Sets — V. Ficker

Prerequisite
Topic V

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content

Text
Nil

References
Dinculeanu, N. Vector Measures (Pergamon 1967)
Halmos, P. R. Measure Theory (Van Nostrand 1950)

664119 Population Dynamics — R. W. Gibberd

Prerequisites
Topics B and H

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
This topic will cover the models and techniques used by demographers and biologists for predicting and studying population growth and mobility. The initial emphasis will be on human populations and various '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 different countries and cities; then models dealing with the problem of several interacting species will be discussed.

Text
Nil

References
Keyfitz, N. Introduction to the Mathematics of Population (Addison-Wesley 1968)
Keyfitz, N. & Flieger, W. Population, Facts and Methods of Demography (Freeman 1972)
Rogers, A. Matrix Methods in Urban and Regional Analysis (Holden-Day 1971)

664144 High Level Software Development — A. J. Guttmann

Prerequisite
Programming experience in a high-level language is assumed

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
This course covers the writing of medium to large scale software projects by developing realistic programs that actually work and solve realistic problems. Emphasis is placed on top-down design, structured
programs, program portability and other aspects of software engineering. The writing of successful programs will be an integral part of the course.

**Text**


**References**

To be advised

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**664116 Mathematical Models of Phase Transitions — A. J. Guttmann**

**Prerequisite**

Topic P

**Hours**

About 27 lecture hours

**Examination**

One 2-hour paper

**Content**


**Text**

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

**References**

Brout, R. H.

*Phase Transitions* (Academic 1972)

Chretien, M. et al.

*Statistical Physics, Phase Transitions and Superfluidity* (Brandeis Summer Institute 1966)

Domb, C.


Domb, C. & Green, M. S. (eds)


Fisher, M. I.


Huang, K.

*Statistical Mechanics* (Wiley 1963)

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**664127 Topology — M. J. Hayes**

**Prerequisite**

Topic L

**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**

References

Cairns, S. S.

*Introductory Topology* (Ronald 1961)

Lefschetz, S.

*Introduction to Topology* (Princeton 1949)

Patterson, E. M.

*Topology 2nd edn* (Oliver & Boyd 1966)

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**

**Prerequisite**

Topic H

**Hours**

About 27 lecture hours

**Examination**

One 2-hour paper

**Content**

This topic will include 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**

Stanley, H. E.

*Introduction to Phase Transitions and Critical Phenomena* (Oxford U.P. 1971)

Uhlenbeck, G. E. & Ford, G. W.

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, Ito integral. Applications to prediction, filtering or signal detection, will also be studied.

Text

References

Bartlett, M. S.
Cramér, H.
Doob, J. L.
Feller, W.
Gikhman, I. I.
Grenander, U.
Hannan, E. J.
Hannan, E. J. & Battin, R. H.
Parzen, E.
Phabbu, N. U.
Solodovnikov, V. V.
Wong, E.
Yaglom, A. M.

664125 Stochastic Processes — R. G. Keats

Prerequisite

Topic H

Hours

About 27 lecture hours

Examination

One 2-hour paper

664145 Viscous Flow Theory — W. T. F. Lau

Prerequisite

Topic Q

Hours

About 27 lecture hours

Examination

One 2-hour paper

Content

Basic equations. Some exact solutions of the Navier-Stokes equations. Approximate solutions: theory of very slow motion, boundary layer theory, etc.
**664118 Perturbation Theory — D. L. S. McElwain**

**Prerequisites**
Topics C and E

**Hours**
About 27 lecture hours

**Examination**
One 2-hour paper

**Content**

**Text**
Nil

**References**
Batchelor, G. K. *An Introduction to Fluid Dynamics* (Cambridge 1967)


Langlois, W. E. *Slow Viscous Flow* (Macmillan 1964)


Schlichting, H. *Boundary Layer Theory* (McGraw-Hill 1968)

**664106 Combinatorics — R. W. Robinson**

**Prerequisite**
Topic K

**Hours**
About 27 lecture hours

**Examination**
One 2-hour paper

**Content**
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.

**Text**
Nil

**References**

Hall, M. *Combinatorial Theory* (Blaisdell 1967)


Liu, C. L. *Introduction to Combinatorial Mathematics* (McGraw-Hill 1968)

Riordan, J. *Combinatorial Analysis* (Wiley 1958)

**664134 Recursion Theory — R. W. Robinson**

**Prerequisite**
Topic O

**Hours**
About 27 lecture hours

**Examination**
One 2-hour paper

**Content**
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.

**Text**
Nil

**References**
Kleene, S. C. *Introduction to Metamathematics* (Van Nostrand 1952)

Rogers, H. *Theory of Recursive Functions and Effective Computability* (McGraw-Hill 1967)

Sacks, G. E. *Degrees of Unsolvability* (Princeton 1963)

Shoenfield, J. R. *Degrees of Unsolvability* (North-Holland 1971)

**664146 Rational Number Theory — T. K. Sheng**

**Prerequisites**
Topic C

**Hours**
About 27 lecture hours

**Examination**
One 2-hour paper

**Content**
Properties and distributions of rational numbers. Approximation by rationals. Rational polygons. Linear operators over rationals. Dispersive and explosive mappings, super catastrophe. Lines determined by lattice points in $\mathbb{R}^n$. 

64
664103 Elliptic Functions and Integrals — E. R. Smith

Prerequisite

Hours

Examination

Content

Doubly periodic functions, Weierstrass's elliptic function and its integrals. Physical problems which give rise to elliptic functions and integrals. Elliptic integrals, Jacobian elliptic functions and their inverses, the connection between Weierstrass's elliptic function and the Jacobian elliptic functions. The theta functions and their connections with other elliptic functions which are useful in their numerical evaluation, and on the application of elliptic functions to the study of physical phenomena.

References

Byrd, P. F. & Friedman, M. D.

Handbook of Elliptic Integrals for Engineers and Scientists 2nd edn (Springer 1958)

Erdelyi, A.

Higher Transcendental Functions Vol. 1

The Bateman Manuscript Project (McGraw-Hill 1953)

664109 Ergodic Theory — E. R. Smith

Corequisite

Rigorous Statistical Mechanics

Hours

About 27 lecture hours

Examination

One 2-hour paper

Content

This course will be an introduction to the classical theorems of ergodic theory, and the ideas of Bernoulli systems, K-systems, mixing systems and ergodic systems. It is hoped to include a discussion of the recent work of Sinai on the ergodicity of hard-sphere gas systems.

References

Arnold, V. I. & Avez, A.

Ergodic Problems of Statistical Mechanics (Benjamin 1967)

Halmos, P. R. & Lebowitz, J. L. & Penrose, O.

Lectures on Ergodic Theory (Chelsea 1955)

Modern Ergodic Theory (Physics Today Feb. 1973 p.23)

664123 Rigorous Statistical Mechanics — E. R. Smith

Prerequisites

Hours

Examination

Content


References

Arnold, V. I. & Avez, A.

Ergodic Problems of Statistical Mechanics (Benjamin 1967)

Ruelle, D.

Statistical Mechanics: Rigorous Results (Benjamin 1969)

Thompson, C. J.

Mathematical Statistical Mechanics (Macmillan 1971)

Uhlenbeck, G. E. & Ford, G. W.

Lectures in Statistical Mechanics (Amer. Math. Soc. 1963)

Wannier, G. H.

Statistical Physics (Wiley 1966)

664147 Numerical Analysis — W. Summerfield

Prerequisite

Either Topic F or Topic Z

Hours

About 27 lecture hours

Examination

One 2-hour paper

Content

Often, one has to resort to a numerical method to "solve" a mathematical problem; before the resultant numbers can be interpreted in terms of the latter problem, one must analyse how their generation has been biased by the numerical method. The three major problem areas of numerical analysis involve rounding error, discretisation error and convergence (in iterative methods) error. The effect of each of these types of error is often masked by "ill-conditioning" (instability) either in the numerical method or in the mathematical problem itself.

References

Huang, K.

Statistical Mechanics (Wiley 1963)

Ruelle, D.

Statistical Mechanics: Rigorous Results (Benjamin 1969)

Thompson, C. J.

Mathematical Statistical Mechanics (Macmillan 1971)

Uhlenbeck, G. E. & Ford, G. W.

Lectures in Statistical Mechanics (Amer. Math. Soc. 1963)

Wannier, G. H.

Statistical Physics (Wiley 1966)
This course concentrates on the basic theoretical results pertaining to these areas, especially as they apply to linear systems of equations, eigenvalue problems and to differential equations.

References
Daniel, J. W. & Moore, R. E.
Forsythe, G. & Moler, C. B.
Gear, C. W.
Isaacson, E. & Keller, H. M.
Lambert, J. D.
Ortega, J. M.
Strang, G. & Fix, G. J.
Wilkinson, J.

664148 Urban Spatial Traffic Patterns — R. J. Vaughan
Prerequisites
Topics C and H

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content

References
Kendall, M. G. & Moran, P. A. P.
Mardia, K. V.

664149 Coding Theory — W. D. Wallis
Prerequisites
Topics D and K

Hours
About 27 lecture hours

Examination
One 2-hour paper

Content
Introduction to codes; Hamming distance; linear codes; the Slepian-Moore-Prange algorithm; Hamming codes; perfect codes; polynomial codes; BCH codes.

Text
Street, A. P. & Wallis, W. D.

References
Anderson, I.
Berlekamp, E. R.
van Lint, J. H.

664105 Combinatorial Designs — W. D. Wallis
Prerequisites
Topics D and K

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 designs; 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
Street, A. P. & Wallis, W. D.
References
Denes, J. & Keedwell, A. D.
Latin Squares and their Applications (English
U.P. and Akadémiai Kiadó 1974)
Hall, M. Jr.
Combinatorial Theory (Blaisdell 1967)
Mann, H. B.
Addition Theorems. The Addition Theorems of
Group Theory and Number Theory
(Interscience 1965)
Raghavarao, D.
Constructions and Combinatorial Problems in
Design of Experiments (Wiley 1971)
Ryser, H. J.
Combinatorial Mathematics (Wiley 1963)
Vajda, S.
The Mathematics of Experimental Design,
Incomplete Block Designs and Latin
Squares (Griffin 1967)
Wallis, W. D. et al.
Combinatorics: Room Squares, Sum-Free Sets,
Hadamard Matrices (Springer 1972)

664102 Asymptotic Methods in Analysis — W. P. Wood

Prerequisites
Topics B, C, E and P

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,
direct 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, insta-
tility of shear flows, spiral structure of disc galaxies.

Text
Nil

References
Copson, E. T.
Asymptotic Expansions (Cambridge U.P.,
1965)
DeBruijn, N. G.
Asymptotic Methods in Analysis 3rd edn
(North Holland 1970)
Erdelyi, A.
Asymptotic Expansions (Dover 1956)
Corequisite
Hours
Examination
Content
(i) CE111 Statics
(ii) ME131 Dynamics
(iii) CE231 Fluid Mechanics 1 or ME251 Fluid Mechanics
(iv) CE212 Mechanics of Solids 1

(i) 51101 CE111 Statics — B. Karihaloo

Hours
Examination
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.

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

References
Beer, F. P. &
Johnston, E. R. Mechanics for Engineers: Statics 2nd edn
(McGraw-Hill 1962)
Meriam, J. L. Statics (Wiley 1966)

(ii) 541103 ME131 Dynamics — K. L. Hitz

Hours
Examination
Content
Basic concepts required for study of motion: length, time, force and mass; Newton’s laws of motion; systems of units; friction. Motion of point masses, rigid bodies and connected bodies in straight or curved paths, or in simple rotation. Relative motion using translating reference frames. General plane motion of rigid bodies.

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 and friction “losses”, for particles and rigid bodies.

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

Reference
Beer, F. P. &
(McGraw-Hill 1962)

(iii) 522202 CE231 Fluid Mechanics 1—W. G. Field

Hours
Examination
Content

Text
Streeter, V. L. &

References
Daugherty, R. L. &
Franzini, J. B. Fluid Mechanics with Engineering Applications (McGraw-Hill)
Vennard, J. K. &
Street, R. L. Elementary Fluid Mechanics 5th edn (Wiley)

Or

(iii) 542202 ME251 Fluid Mechanics — R. A. Antonia

Hours
Examination
Progressive assessment & examination

72
Content
Fluid properties and definitions. Fluid statics:— statics of moving systems, forces on surfaces, buoyant forces, stability of floating and submerged bodies. Fluid flow concepts:—
Types of flow, continuity equation. Euler's equation of motion along a streamline, Bernoullï equation, energy equation. Linear momentum equation. The moment of momentum equation. Linear and angular momentum applications. Introduction to dimensional analysis. Viscous effects:— fluid resistance, laminar and turbulent flow, flow in pipes and conduits. Fluid measurement.

Text

References
Streeter, V. L. *Fluid Mechanics* 5th edn (McGraw-Hill)

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

Hours
3 lecture hours & 3 tutorial/laboratory hours per week

Examination
Four 1½-hour papers plus assignments

Content
(i) Mechanical Properties of Materials
(ii) Microstructure of Materials
(iii) Atomic Structure of Materials
(iv) EITHER Chemical Metallurgy OR Electronic Structure of Materials

(i) M11141 Mechanical Properties of Materials

Prerequisites
Nil

Hours
About 21 hours of lectures & 21 hours of tutorial, demonstration & practical classes

Examination
1½ hour paper

Content
Macroplasticity. The tension test, engineering stress and strain, true stress and strain, theories of strength, complex stresses, yielding, flow and fracture, effect of metallurgical variables. Visco-elastic behaviour of materials, classical models. Heating a cold worked metal, recrystallization, hot working.
Microplasticity. Slip in single crystals, work hardening, multiple slip, deformation bands in polycrystals. Theoretical strength anomaly and dislocations, edge and screw types, their interaction, multiplication and pile ups.
Fracture. Types of fracture under static loading, ductile, brittle, Creep dynamic loading fatigue. Ductile-Brittle transition in mild steel, the effects of variables, Mn/C ratio. Creep Test, shape of curve, microstructural aspects, creep rupture. Fatigue Test, S-N curve, effect of variables.

Text

References
Dieter, G. *Mechanical Metallurgy* (McGraw-Hill)
(ii) 111151 Microstructure of Materials

**Prerequisites**
Nil

**Hours**
About 21 hours of lectures & 21 hours of tutorial, demonstration & practical classes

**Examination**
1½ hour paper

**Content**
The generation of microstructure and its relationship with material properties. States of matter, bonding in solids, crystal structure, phases, surfaces, grain boundaries and interfaces, atom development. Phase rule and microstructures in binary systems for equilibrium conditions and for near equilibrium transformations including: isomorphous, eutectic, peritectic and eutectoid types, the lever rule. Microstructures of ceramics and polymers. Technically important systems including iron-carbon, copper-zinc, aluminium-silicon, aluminium-copper. Modification of eutectics, normalizing and annealing. Non-equilibrium microstructures, quenching. Martensite and bainite, TTT diagrams, age hardening tempering.

**Text**

**References**
Cracknell, A. P. *Crystals and their Structure* (Pergamon)
Van Vlack, L. H. *Elements of Materials Science* (Addison-Wesley)

(iii) 111181 Atomic Structure of Materials

**Prerequisites**
Nil

**Hours**
About 21 hours of lectures & 21 hours of tutorial, demonstration & practical classes

**Examination**
1½ hour paper

**Content**
Introductory crystallography; crystal systems, lattices and unit cells. Miller indices and stereographic projection. The periodic table and atomic bonding.

Text

References
Rhines, F. N. *Phase Diagrams in Metallurgy* (McGraw-Hill)
Rollason, E. C. *Metallurgy for Engineers* (Arnold)
Van Vlack, L. H. *Elements of Materials Science* (Addison-Wesley)

(iii) 111122 Chemical Metallurgy

**Prerequisites**
Nil

**Hours**
About 21 hours of lectures & 21 hours of tutorial, demonstration & practical classes

**Examination**
1½ hour paper

**Content**
Introduction to chemical thermodynamics and the rates of homogeneous and heterogeneous chemical reactions. Extension to electrochemical and photochemical reactions, thermodynamics and kinetics of chemical change illustrated by reference to the environmental degradation of materials. Wet and dry corrosion of metals. Chemical attack on refractories, ceramics and cement. Photochemical breakdown of polymers, stress corrosion of metals and plastics. Internal chemical breakdown of materials.

Texts
Ives, D. J. G. *Principles of Extraction of Metals* (Chem. Soc.)
Chilton, J. P. *Principles of Metallic Corrosion* (Chem. Soc.)
Guggenheim, E. A. *Elements of Thermodynamics* (Chem. Soc.)
Reference
Guy, A. G. *Introduction to Materials Science*
**Electronic Structure of Materials**

**Prerequisites**
Nil

**Hours**
About 21 hours of lectures & 21 hours of tutorial, demonstration & practical classes

**Examination**
1½ hour paper

**Content**
Atomic bonding and electron mobility. Electrons in a potential box, free electron model of a metal, effects of the lattice, alkali, noble and transition metals, insulators and semi conductors.
Specific heat and thermal conductivity of electrons and lattices.
Thermal and Electronic properties of metals, insulators and semi conductors.
Magnetic properties of metals and insulators. Optical properties of metals, insulators and semi conductors.

**Text**

**References**
To be advised

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**Civil Engineering II M**

**Prerequisites**
Mathematics I & Civil Engineering I M

**Hours**
5 lecture hours & 2½ tutorial & laboratory hours per week

**Examination**
Two 3-hour papers & progressive assessment

**Content**

(i) **523105** CE313A Structural Analysis I
(ii) **523301** CE332 Fluid Mechanics II
(iii) **543101** ME301 Engineering Computations

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(i) **523105** CE313A Structural Analysis I — A. W. Page/N. O. Betts

**Hours**
2 lecture hours & 1 tutorial hour per week

**Examination**
One 3-hour paper

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

**Text**
Nil

**References**

(ii) **523301** CE332 Fluid Mechanics II — W. G. Field

**Hours**
2 lecture hours & 1 tutorial & laboratory hour per week

**Examination**
One 3-hour paper

**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.

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

Rouse, H.
Streeter, V. L.

**Handbook of Applied Hydraulics** 3rd edn
(McGraw-Hill 1969)

**Applied Hydraulics in Engineering** (Ronald 1963)

**Engineering Hydraulics** (Wiley 1958)

**Handbook of Fluid Dynamics** (McGraw-Hill 1961)

**Applied Hydrodynamics** (Butterworths 1959)
ME301 Engineering Computations — L. W. B. Browne

**Hours**
1½ hours per week

**Examination**
Progressive assessment

**Content**

Numerical solution of ordinary differential equations, initial value, boundary value and characteristics value problems. Solutions of partial differential equations by finite difference methods.

Introduction to linear programming, with engineering applications.

**Texts**
McCracken, D. P. & Dorn, W. S.

*Numerical Methods with Fortran IV Case Studies* (Wiley 1972)

*Fortran* (Dataset 1973)

**References**
Forsythe, G. & Moler, C. B.

*Ralston, A.*

*A First Course in Numerical Analysis* (McGraw-Hill 1965)

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**752300 Psychology IIC**

**Prerequisites**
Psychology I & Mathematics I

**Hours**
3 lecture hours, one 2-hour practical session & 1 tutorial hour per week.

**Examination**
Two 3-hour papers plus an assessment of practical work

**Content**


3. Mathematical Psychology

**Texts**
To be advised

**References**

*Accounting Standards Steering Committee*

*American Accounting Assn*

Backer, M. (ed.)

*Barradell, M.*

*Baxter, W. T. & Davidson, S.*

Beck, G. W.

Bray, F. S.

Chambers, R. J.


*A Statement of Basic Accounting Theory* (Prentice-Hall 1966)

*Ethics and the Accountant* (Gee 1969)

*Studies in Accounting Theory* (Sweet & Maxwell 1966)

*Public Accountants in Australia—Their Social Role* (Aust. Accounting Research Found.)

*The Accounting Mission* (Melbourne U.P.)

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, feed-back for accounting control, behavioural considerations in management accounting and general concepts of management accounting including decision making for small and medium sized manufacturers, management accounting and statistics; production and operations management.

Texts
To be advised. Articles are selected from Abacus, The Accounting Review, Journal of Accounting Research, Journal of Business, etc.

References
Amey, L. R. & Egginton, D. A. Management Accounting: A Conceptual Approach (Longman)
Benston, G. J. Contemporary Cost Accounting and Control (Dickenson 1970)
Broom, H. N. & Longenecker, J. G. Small Business Management 4th edn (South Western)
Broster, E. J. Management Accounting and Statistics (Longman)
Chase, R. B. & Aquiland, N. J. Production and Operations Management (Irwin)
De Coster, D. T. & Schafer, E. L. Management Accounting: A Decision Emphasis (Wiley/Hamilton)
Greenwood, W. T. Decision Theory and Information Systems (South Western 1969)
Horngren, C. T. Accounting for Management Control (Prentice-Hall 1965)
National Assn 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 & IIC & either Biology IIA or IIB

Hours 4 lecture hours & 8 tutorial & laboratory hours per week & a field excursion

Examination Two 3-hour papers

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 1975)
Milthorpe, F. L. & Moorby, J. An Introduction to Crop Physiology (Cambridge U.P.)
Zar, J. H. Biostatistical Analysis (Prentice-Hall)

References
Ford, E. B. An Introduction to Crop Physiology (Cambridge U.P.)
Gordon, M. S. Kershaw, K. A. Animal Physiology: Principles and Adaptations (Macmillan)
Kiers, P. K. Evolutionary Ecology (Harper & Row)
Kiers, P. E. Ecological Genetics (Methuen 1975)
Pianka, E. R. Ecological Dynamics (Arnold)
Phillipson, J. Introduction to Quantitative Ecology (McGraw-Hill)
Poole, R. W. Schmidt-Nielsen, K. Dukes Physiology of Domestic Animals (Cambridge U.P. 1970)

513900 Chemical Engineering IIIB

Prerequisites Chemical Engineering I, (but see note on page 15), Mathematics IIA & IIC (including topics E & F)

Hours See under individual topics below

Examination To be advised

Content
Six of the following 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
(i) 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 transforms 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**

**References**

(ii) ChE312 Reaction Engineering — T. F. Wall

**Hours**
1½ hours a week for ½ 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. *Chemical Reaction Engineering* 2nd edn (Wiley 1972)

(iii) ChE313 Transport Principles

**Hours**
1½ hours per week

**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**

(iv) ChE314 Process Control — W. G. Kirchner

**Hours**
1½ hours a week

**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 rio locus, Bode diagram. Feed forward. Control, cascade control with applications to control of temperature, flow pressure and composition.

**Text**

(v) ChE322 Particulate Systems — J. Roberts/I. McC. Stewart

**Hours**
1½ 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


(vi) ChE331 Process Economics — B. D. Henry

Hours 1½ 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)

(vii) ChE412 Radiant Heat Transfer — I. McC. Stewart

Hours 1½ hours a week for half a year

Examination To be advised

Content


Text

Hottel, H. C. & Sarofim, A. C. Radiative Transfer (McGraw-Hill 1968)

523700 Civil Engineering III

Prerequisites Mathematics IIA & IIC (including Topic E) & Civil Engineering III

Hours 7 lecture hours and 4 tutorial/laboratory hours per week

Examination To be advised

Content

Topics CE324 and CE414A, and any 2 of the other topics.
(i) CE324 Soil Mechanics
(ii) CE414A Structural Analysis II
(i) 523102 CE324 Soil Mechanics — J. B. Berrill

**Corequisite**  
CE332 Fluid Mechanics II

**Hours**  
2 lecture hours & 1 laboratory hour per week

**Examination**  
One 3-hour paper

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

**Text**  

**References**  
SAA *Methods of Testing Soils for Engineering Purposes* A.S.A. 89  

(ii) 524030 CE414A Structural Analysis II — P. W. Kleeman

**Hours**  
1½ lecture hours & 1½ tutorial hours per week

**Examination**  
One 3-hour paper

**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. et al. *Design of Steel Structures* (Wiley 1968)  

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

**Corequisite**  
CE414A Structural Analysis II

**Hours**  
1½ hours per week

**Examination**  
One 2-hour final paper

**Content**  

**Text**  
Nil

**References**  

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

**Corequisite**  
CE414A Structural Analysis II

**Hours**  
1½ hours per week

**Examination**  
One 2-hour 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**  
— *Plastic Design of Multi-story Frames* (Lehigh University 1965)

90

91
(v) 524038 CE433 Theoretical Hydrodynamics — F. M. Henderson

**Prerequisite**
CE332 Fluid Mechanics II is advisory  

**Hours**
1½ hours per week  

**Examination**
To be advised

**Content**
General treatment of stresses and rates of strain in a moving fluid, derivation of the Navier-Stokes equations, the vorticity equation; Kelvin's circulation theorem, the generation and diffusion of vorticity, with engineering applications. Irrotational flow theory in two and three dimensions, with engineering applications.

**Text**
Vallentine, H. R. *Applied Hydrodynamics* (Butterworths)

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

(vi) 524039 CE434 Open Channel Flow — F. M. Henderson

**Prerequisite**
CE332 Fluid Mechanics II is advisory  

**Hours**
1½ hours per week  

**Examination**
To be advised

**Content**
Numerical methods for the solution of unsteady non-uniform flow problems in irregular channels. The equations of unsteady flow, the method of characteristics, with engineering applications, e.g., the dam break problem. Theories of flood wave movement and techniques for its prediction. Sediment transport, river channel formation and stability.

**Text**
Henderson, F. M. *Open Channel Flow* (Collier-Macmillan 1966)

**References**
Davis, C. V. & Sorensen  
Morris, H. M.  
Rouse, H.  
Streeter, V.  
Vallentine, H. R.  

Text
Henderson, F. M. *Open Channel Flow* (Collier-Macmillan 1966)

References
Davis, C. V. & Sorensen  
Morris, H. M.  
Rouse, H.  
Streeter, V.  
Vallentine, H. R.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Authors</th>
<th>Prerequisite</th>
<th>Hours</th>
<th>Examination</th>
<th>Content</th>
<th>Text</th>
<th>Reference</th>
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<tbody>
<tr>
<td>533210</td>
<td>EE342 Linear System Theory</td>
<td>K. L. Hitz</td>
<td>EE341</td>
<td>3 lecture, tutorial &amp; laboratory hours per week for second half year</td>
<td>Progressive assessment &amp; final examination</td>
<td>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.</td>
<td>Carlson, A. B.</td>
<td>Communication Systems (McGraw-Hill 1975)</td>
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<td>423206</td>
<td>Economics IIA</td>
<td></td>
<td>Mathematics IIA &amp; IIC</td>
<td>As indicated in the description of the components</td>
<td>To be advised</td>
<td>Two of the following so as to include Econometrics I or Mathematical Economics or both:</td>
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<td></td>
<td>(i) 423208 Econometrics I</td>
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</tr>
</tbody>
</table>
(ii) 423204 Mathematical Economics

(iii) 423104 Growth and Development

(iv) 423102 International Economics

(v) 423103 Public Economics

(i) 423308 Econometrics I — R. W. McShane

Prerequisite
Economic Statistics II or Statistical Analysis

Hours
2 lecture hours per week

Examination
One 3-hour paper

Content
A knowledge of matrix algebra and of the mathematical statistics dealt with in Statistical Analysis is recommended. The course examines the usefulness of single equation regression analysis in applied economic research and also provides an introduction to simultaneous estimation procedures.

Text

References
Fox, K. A. Intermediate Economic Statistics (Wiley)
Goldberger, A. Econometrics (Wiley)
Hadley, G. Linear Algebra (Addison-Wesley)
Huang, D. S. Regression and Econometric Methods (Wiley)
Kmenta, J. Elements of Econometrics (Macmillan)
Koutsoyiannis, A. Theory of Econometrics (Macmillan)
Wonacott, R. J. & T. H. Econometrics (Wiley)

(ii) 423204 Mathematical Economics — P. C. Ip

Hours
3 lecture hours per week

Examination
One 3-hour paper

Content
(i) The mathematical reformulation and interpretation of traditional micro- and macroeconomic theory.

(ii) Modern capital and growth theory and mathematical programming.

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

Hours
3 lecture hours per week

Examination
Two 3-hour papers (i) end of 1st half of academic year (ii) end of year

Content
The first half of this course will 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 second half of the course will study some underdeveloped countries with specific focus upon their dualistic nature. The structure of the rural and urban economies of the typical underdeveloped country will be investigated in order to understand underdevelopment and hence design development strategies. Theoretical models will be supplemented with case studies from Asia.
Preliminary Reading

Bober, S.  
*The Economics of Cycle and Growth*  
(Wiley 1968)

Clark, J. G. & Cohen, M. (eds)  
*Business Fluctuations, Growth and Economic Stabilisation: A Reader*  
(Random House 1963)

Hicks, J. R.  
*A Contribution to the Theory of the Trade Cycle*  
(Clarendon 1967)

Meade, J. E.  
*A Neoclassical Theory of Economic Growth*  
(Allen & Unwin 1962)

Neher, P. A.  
*Economic Growth and Development — A Mathematical Introduction*  
(Wiley 1971)

Text

Hamberg, D.  
*Models of Economic Growth*  
(Harper Internat. Edns 1973)

References

Bauer, P. T.  
*Dissent on Development*  
(Weidenfeld & Nicolson 1971)

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

Gill, R. T.  
*Economic Development Past and Present*  
(Prentice-Hall 1973)

Higgins, B.  
*Economic Development rev. edn*  
(Norton 1968)

Kindleberger, C.  
*Economic Development*  
(2nd edn McGraw-Hill 1965)

Meier, G. M. (ed.)  
*Leading Issues in Economic Development*  
(2nd edn Oxford U.P.)

Myrdal, G.  
*Asian Drama*  
(Twentieth Century Fund 1968)

Myint, H.  
*The Economics of Developing Countries*  
(3rd edn Hutchinson 1973)

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

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

Hours  
2 lecture hours per week & 1 seminar hour per fortnight

Examination  
One 3-hour paper

Content  
(i) The pure theory of international trade. Comparative costs, the Heckscher-Ohlin theorem. Critical assessment of these and other theories of trade. The theory of protection; tariffs and quota restrictions on imports. Australian protection policy. Customs union theory. Relationships between economic growth and trade.


Texts

Ellsworth, P. T. & Leith, J. C.  
*The International Economy*  
(5th edn Macmillan 1975)

or

Scammell, W. M.  
*International Trade and Payments*  
(Macmillan 1974)

Snape, R. H.  
*International Trade and the Australian Economy*  
(2nd edn Longman 1973)

Wells, S. J.  
*International Economics*  
(rev. edn Allen & Unwin 1973)

References

Bhagwati, J. (ed.)  
*International Trade*  
(Penguin 1972)

Caves, R. E. & Johnson, H. G. (eds)  
*Readings in International Economics*  
(Allen & Unwin 1968)

Clement, M. D. et al.  
*Theoretical Issues in International Economics*  
(Constable 1967)

Cooper, R. R. (ed.)  
*International Finance*  
(Penguin 1969)

Heller, H. R.  
*International Trade: Theory and Empirical Evidence*  
(2nd edn Prentice-Hall)

Heller, H. R.  
*International Monetary Economics*  
(Prentice-Hall 1974)

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

McColl, G. D. (ed.)  
*Overseas Trade and Investment*  
(Pelican 1972)

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

Hours  
2 lecture hours plus seminars

Examination  
One 3-hour paper

Content

The effects of government intervention in the economy through the budget and through the operation of publicly-owned business undertakings. Inter-governmental fiscal relationships are examined. At the microeconomic level, an analysis of the effects of tax and expenditure policies, in particular, community welfare and incentives.
At the macroeconomic level, aggregate models are used to analyse the relation of fiscal policy to other economic policies for stability and growth.

**Preliminary Reading**

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

**Texts**

Nil

**References**


Fromm, G. & Taubman, P. *Public Economic Theory and Policy* (Collin-Macmillan)


Johansen, L. *Public Economics* (North Holland 1971)

Keizer, N. F. *Reading in Macroeconomics* (Prentice-Hall)


**733300 Geology IIIA**

**Prerequisites** Physics IA, Mathematics IIA & IIC & Geology IIA

**Hours** 3 lecture hours & 6 laboratory hours per week and 12 days field work

**Examination** Two 3-hour papers plus assessment

**Content**

Sedimentology — the petrogenesis of sedimentary rocks. Economic geology — principles of formation of economic mineral deposits; major Australian ore deposits; ore mineralogy. Structural geology — structural aspects of geosynclinal concept; orogenies; continental drift; global tectonics. Photogrammetry and Photogeology — basic principles of interpretation; aerial photographs and their use in stratigraphic and structural studies. Exploration Geophysics: geophysical techniques — their interpretation and application in petroleum and mining exploration, and hydrogeological and engineering investigations as well as sedimentary basin and tectonic studies.

**Texts** Consult lecturers concerned

543500 Industrial Engineering II

**Prerequisites** Mathematics IIA & IIC

**Hours** 6 lecture hours per week

**Examination** Progressive assessment

**Content**

(i) 543501 ME381 Methods Engineering

(ii) 543502 ME383 Quality Engineering

(iii) 543503 ME384 Design for Production

(iv) 544104 ME483 Production Engineering

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

**Hours** 1½ hours per week

**Examination** Progressive assessment

Content


**Text**

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

**References**


Barnes, R. M. *Motion and Time Study* (Wiley)

Krick, E. V. *Methods Engineering* (Wiley)


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

**Hours** 1½ hours per week

**Examination** Progressive assessment & examination

**Content**

The application of economics, methods engineering, ergonomics, and mechanical engineering to the development and design of a product. Production, distribution, and marketing of engineering products. Principles of metrology and tool, jig, and fixture design.

References
Kempster, M. H. A. Principles of Jig and Tool Design (English U.P.)
McCormick, E. J. Human Factors Engineering (McGraw-Hill 1964)

(iv) 544104 ME483 Production Engineering — J. W. Hayes

Hours 1½ hours per week
Examination Progressive assessment

Content
Production planning and control, Forecasting, inventory, scheduling. Dynamics of production-inventory systems. Simulation of production systems.

References
Baker, K. R. Introduction to Sequencing and Scheduling (Wiley 1974)
Box, G.E. & Jenkins, G. M. Time Series Analysis, Forecasting and Control (Holden-Day)
Forrester, J. Industrial Dynamics (M.I.T. Press 1961)

553900 Mechanical Engineering IIIC

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

Hours 6 hours per week
Examination Progressive assessment

Content
Students may choose one of the following alternatives (a), (b), (c), or (d) but all 4 alternatives may not be available each year.
(a) (i) ME361 Automatic Control
(ii) ME401 Systems Analysis
(iii) ME402 Systems Planning, Organisation & Control
(vii) ME482 Operations Research—Deterministic Models
(b) (iii) ME402 Systems Planning, Organisation & Control
(vii) ME487 Operations Research—Deterministic Models
(x) ME489 Operations Research—Applications in Industry
(c) (iii) ME402 Systems Planning, Organisation & Control
(iv) ME404 Mathematical Programming
(ix) ME488 Operations Research—Probabilistic Models
(d) (i) ME361 Automatic Control
(v) ME434 Advanced Kinematics & Dynamics of Machines
(vi) ME448 Introduction to Photomechanics
(vii) ME449 Reliability Analysis for Mechanical Systems

(i) S43204 ME361 Automatic Control—K. L. Hitz

Hours 1½ hours per week
Examination Progressive assessment

Content
An introductory course in linear control systems. Mathematical models of systems and components; differential equations and transfer functions. Discussion of analog computers and their use in the solution of equations and simulations of systems. Simple systems of first and
second order. Analysis of steady state performance. System stability
and transient response by algebraic, root-locus and frequency response
methods. Introduction to compensation techniques. Description of
components of servo-mechanisms and process control systems.

Text
Fortmann, T. E. & Hitz, K. L. Introduction to Linear Control Systems
Theory (Dekker 1976)

References
Desoer, C. A. Notes for a Second Course in Linear Systems
(Van Nostrand-Reinhold 1970)
Gupta, S. C. & Hasdorff, L. Fundamentals of Automatic Control (Wiley
1970)

(iii) 544452 ME403 Systems Planning, Organization and Control — A. Roberts/G. D. Butler

Hours 1\textfrac{1}{2} hours per week
Examination Progressive assessment & examination
Content
Goals and structure of systems, Mathematical modelling and system
simulation. Hierarchical control systems. System performance criteria,
concepts of optimization.
Formal organisation and decision theory. Application of systems
techniques to organisational analysis and design. Examples of industrial
and business systems.

Text Nil

References
Ackoff, R. L. A Concept of Corporate Planning (Wiley
1970)
Battersby, A. Network Analysis for Planning Scheduling
(Macmillan 1970)
Carzo, R. & Yanouzas, J. V. Formal Organisation, A Systems Approach
(Irwin-Dorsey 1965)
Citron, S. J. Elements of Optimal Control (Holt, Rinehart
& Winston 1969)
Kuester, J. L. & Mize, J. H. Optimization Techniques with Fortran
(McGraw-Hill 1973)
Machol, R. Systems Engineering Handbook (McGraw-
Hill 1965)
Decision Models (Irwin-Dorsey 1968)
(Wiley 1968)
Raven, F. H. Mathematics of Engineering Systems
(McGraw-Hill 1966)

(iv) 544417 ME404 Mathematical Programming — K. L. Hitz

Hours 1\textfrac{1}{2} 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
Gass, S. I.  
Nemhauser, G. L.  
Introduction to Dynamic Programming (Wiley 1966)

References
Bellman, R. E. & Dreyfus, S. E.  
Kunzi, H. P. et al.  
Non-Linear Programming (Blaisdell 1966)
Macmillan, C.  
Mathematical Programming (Wiley 1970)
Taha, H. A.  
Operations Research (Macmillan 1971)

Note
This subject is identical with the first part of ME581G.

(v) 544419 ME434 Advanced Kinematics and Dynamics of Machines — E. Betz
Hours  1½ hours per week
Examination  To be advised

Content
Dynamic Motion Analysis: energy distribution method, equivalent mass-and-force method, the rate-of-change-of-energy method.
Advanced Kinematics of the Plane Motion: the inflection circle, Euler-Savary equation, Bobillier's construction, Hartmann's construction. Introduction to synthesis: graphical and analytical methods.

Text
Hirschhorn, J.  
Mechanics of Plane Motion (McGraw-Hill 1962)

References
Hall, A. S.  
Kinematics and Linkage Design (Prentice-Hall 1960)
Holowenko, A. R.  
Dynamics of Machines (Wiley 1955)

(vi) 544416 ME448 Introduction to Photomechanics — D. R. A. Budney
Hours  1½ hours per week
Examination  Progressive assessment

Content
Model analysis for two and three dimension problems which may involve static, dynamic or thermal loading conditions.
Calibration of material and solution of disc problem.

Text
References
Dally, J. W. & Riley, W. F.  
Experimental Stress Analysis (McGraw-Hill 1965)
Durelli, A. J. & Riley, W. F.  
Introduction to Photo-Mechanics (Prentice-Hall 1965)
Frocht, M. M.  

(vii) 544418 ME449 Reliability Analysis for Mechanical Systems — A. J. Chambers/A. W. Roberts
Hours  1½ hours per week
Examination  To be advised

Content

Text
Shooman, M. L.  
References
Haviland, R. P.  Engineering Reliability and Long Life Design (Van Nostrand 1964)
Polovko, A. M.  Fundamentals for Reliability Theory (Academic 1968)

(vii) 544841 ME487 Operations Research — Deterministic Models  — G. D. Butler

Hours  1½ 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.

Texts
Hillier, I. S. & Lieberman, G. J.  Introduction to Operations Research (Holden-Day)
Taha, H. A.  Operations Research (Macmillan)

References
McMillan, C.  Mathematical Programming (Wiley)
Wagner, H. W.  Principles of Operations Research (Prentice-Hall)

(x) 544843 ME489 Operations Research — Applications in Industry  — G. D. Butler

Hours  1½ hours per week
Examination  To be advised

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. et al.  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 IIA, or IIC (Topics C, E, G & H or B or D desirable)

Hours  4 lecture hours & 8 laboratory hours per week
Examination  Assessment to the equivalent of three 3-hour papers
Content

The areas of classical and quantum physics essential to the understanding of both advanced pure physics and also the many applications of physics. Some electronics is also included.

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

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

C. Laboratory
Parallels the lecture course in overall content with at least one experiment available in each topic, although students are not expected to carry out all the experiments available.

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

753300 Psychology IIIC

Prerequisites
Mathematics IIA, IIC & Psychology IIA or IIB

Hours
4 lecture hours & 3 laboratory hours per week

Examination
To be advised

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 IIA or IIB. Students will also be required to complete an independent investigation in mathematical psychology under supervision.

Text
Nil

References
Coombs, C. H. et al.
Flavell, J. H.
Harman, H. H.
Jackson, D. N. & Messick, S.
Laming, D.
Mandler, J. M. & Mandler, G.

Mathematical Psychology (Prentice-Hall 1974)
The Developmental Psychology of Jean Piaget (Van Nostrand 1963)
Modern Factor Analysis (Chicago U.P. 1960)
Problems in Human Assessment (McGraw-Hill 1967)
Mathematical Psychology (Academic 1973)
Thinking: From Association to Gestalt (Wiley 1964)

SCHEDULE C

664300 Mathematics/Physics IV

Prerequisites
Mathematics IIIA & 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
To be prescribed by the Heads of the Departments of Mathematics and Physics. Project work will normally begin in the first week of February.

Examination
Examinations will be held in the Mathematics and Physics topics selected by the student.

Content
The student shall complete four topics from Mathematics IV, chosen for their application to Physics; he must also attend selected topics in Physics IV. A project of mathematical and physical significance supervised jointly by the Department of Mathematics and the Department of Physics is also required.

664200 Mathematics/Psychology IV

Prerequisites
Mathematics IIIA & Psychology IIIC.
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
To be advised

Examination

Content
4 Mathematics topics chosen from the Part IV Mathematics topics (see page 53 et seq.)
Psychological Measurement (see below).
Mathematical Models in Perception and Learning (see below).
Prerequisites

Hours

Examination

Content

Text

References

Atkinson, R. C. (ed.) *Studies in Mathematical Psychology* (Stanford U.P. 1964)

Campbell, N. R. *Foundations of Science: The Philosophy of Theory and Experiment* (Dover 1957)


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 1964)

Torgerson, W. S. *Theory and Methods of Scaling* (Wiley 1958)

Prerequisites

Part II Mathematics Topic H recommended

Hours

1½ hours per week

Examination

To be advised

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.

Text

Nil

References

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 subject 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.

<table>
<thead>
<tr>
<th>GROUP 1</th>
<th>DECADENT OFFERING</th>
<th>ASSUMED STANDARD OF ATTAINMENT</th>
<th>NO. OF UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Subjects</td>
<td>Department</td>
<td>Subject</td>
<td>Alasatm</td>
</tr>
<tr>
<td>CS—Commercial Programming</td>
<td>Commerce</td>
<td>Electronic Data Processing</td>
<td>NM, OR Commercial</td>
</tr>
</tbody>
</table>
### Subjects which have some application to computer science

<table>
<thead>
<tr>
<th>Department Offering Subject</th>
<th>Assumed Standard of Attainment</th>
<th>No. of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE361—Computer Structure: Mechanical &amp; Assembly Languages</td>
<td>Mathematics I</td>
<td>1</td>
</tr>
<tr>
<td>EE362—Logical Design &amp; Switching Theory</td>
<td>Mathematics I</td>
<td>1</td>
</tr>
<tr>
<td>CS—Programming &amp; Algorithms</td>
<td>Mathematics I</td>
<td>1</td>
</tr>
<tr>
<td>CS—Data Structures &amp; Programming</td>
<td>Mathematics</td>
<td>1</td>
</tr>
<tr>
<td>CS—Numerical Analysis</td>
<td>Part II Mathematics, Topics C, D, E</td>
<td>1</td>
</tr>
</tbody>
</table>

### GROUP II

Subjects in the main-stream of computer science

<table>
<thead>
<tr>
<th>Subject</th>
<th>Department Offering Subject</th>
<th>Assumed Standard of Attainment</th>
<th>No. of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE421—Electronics</td>
<td>EE421—Electronics</td>
<td>EE421—Electronics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EE422—Modern Control Theory</td>
<td>EE422—Modern Control</td>
<td>EE422—Modern Control Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EE423—Computer Aided Analysis of Power Systems</td>
<td>EE423—Computer Aided Analysis of Power Systems</td>
<td>EE423—Computer Aided Analysis of Power Systems Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CS—Probability &amp; Statistics</td>
<td>CS—Probability &amp; Statistics</td>
<td>CS—Probability &amp; Statistics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CS—Asymptotic Methods in Analysis</td>
<td>CS—Asymptotic Methods in Analysis</td>
<td>CS—Asymptotic Methods in Analysis Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EE362—Logic Design &amp; Switching Theory</td>
<td>EE362—Logic Design &amp; Switching Theory</td>
<td>EE362—Logic Design &amp; Switching Theory Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EE365—Pattern Recognition</td>
<td>EE365—Pattern Recognition</td>
<td>EE365—Pattern Recognition Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EE366—Formal Languages &amp; Automata</td>
<td>EE366—Formal Languages &amp; Automata</td>
<td>EE366—Formal Languages &amp; Automata Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CS—Mathematical Principles of Numerical Analysis</td>
<td>CS—Mathematical Principles of Numerical Analysis</td>
<td>CS—Mathematical Principles of Numerical Analysis Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ME403—Systems Planning, Organization &amp; Control</td>
<td>ME403—Systems Planning, Organization &amp; Control</td>
<td>ME403—Systems Planning, Organization &amp; Control Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ME404—Mathematical Programming</td>
<td>ME404—Mathematical Programming</td>
<td>ME404—Mathematical Programming Laboratory</td>
<td>1</td>
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<tr>
<td>ME551G—Mathematical Programming</td>
<td>ME551G—Mathematical Programming</td>
<td>ME551G—Mathematical Programming Laboratory</td>
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</tbody>
</table>

### GROUP III

Subjects which have some application to computer science

<table>
<thead>
<tr>
<th>Subject</th>
<th>Department Offering Subject</th>
<th>Assumed Standard of Attainment</th>
<th>No. of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE315—Elastic Continua</td>
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### The Board may approve the inclusion in a student's program 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 any of the mutually exclusive subjects 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.

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<td>2. ME404—Mathematical Programming</td>
<td>ME581G—Mathematical Programming</td>
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<tr>
<td>3. CS—Theory of Computing</td>
<td>EE569—Formal Languages and Automata</td>
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DESCRIPTION OF SUBJECTS

GROUP 1—CORE SUBJECTS

410136 CS—Commercial Programming—I. R. Beaman

Assumed Standard of Attainment

Mathematics I Topic NM or Commercial E.D.P.

Hours

2 lecture hours per week for 1st half year

Examination

Two 3-hour papers (i) Theory—at mid year (ii) Cobol at end of year

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

I.C.L.

Feingold, C.

1900 Series COBOL Manual

Fundamentals of COBOL Programming (W. C. Brown)

References

Clifton, H. D.

Systems Analysis for Business Data Processing (Business Books)

Davis, G. B. & Litecky, C. R.

Elementary Cobol Programming (McGraw-Hill)

DeRossi, C. J.

Learning COBOL Fast (Reston)

Kapur, G. K.

Programming in Standard COBOL (S.R.A.)

Laden, H. N. & Gildersleeve, T. R.

System Design for Computer Applications (Wiley)

McCracken, D. D. et al.

Programming Business Computers (Wiley)

Murach, M.

Standard COBOL (S.R.A.)

Sanders, D. H.

Computers in Business (McGraw-Hill)

Sprowls, R. C.

Computing with COBOL (Harper & Row)

Stern, N. B. & R. A.

Cobol Programming (Wiley)

Watters, J. L.

Cobol Programming (Heinemann)

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

Assumed Standard of Attainment

Mathematics I

Hours

1½ hours of lectures and practical work per week for the whole 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.

**Text**


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**References**


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**Assumed Standard of Attainment**  Mathematics I

**Hours**  2 lecture hours and 1 tutorial hour per week for the 1st half year

**Examination**  One 3-hour paper and a possible paper on programming techniques

**Content**  Structured Programming, program design. Flow charts. Decision Tables, Natural Language formulations of algorithms. 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. Simulation, Random number generators.

**Text**

Guttmann, A. J.  *Programming and Algorithms* (Heinemann 1977)

**References**

Knuth, D.  *The Art of Computer Programming*  
Vol. III — Sorting and Searching (1973)  
(Addison-Wesley)

Blatt, J. M.  *Introduction to Fortran IV Programming*  
(Goodyear 1967)

Day, A. C.  *Fortran Techniques: with Special Reference to Non-numerical Applications* (Cambridge U.P. 1972)

Kernighan, B. W. & Plauger, P. J.  *The Elements of Programming Style*  
(McGraw-Hill 1974)


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**Assumed Standard of Attainment**  CS—Programming & Algorithms

**Hours**  3 hours of lectures, tutorials and practical work per week for the 1st half 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 1975)

**References**

Hill, F. J. & Peterson, G. R.  *Switching and Finite Automata Theory*  
(McGraw-Hill 1970)

Kohavi, Z.  *Introduction to Switching Theory and Logical Design* (Wiley 1968)


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**Assumed Standard of Attainment**  CS—Data Structures and Programming

**Hours**  2 lecture hours and 1 tutorial hour per week for the 1st half 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**

Prather, R. E.  *Introduction to Switching Theory: A Mathematical Approach* (Allyn & Bacon)
Hours
2 lecture hours and 1 tutorial hour per week for the 2nd half year

Examination
One 2-hour paper

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
Berziss, A. T.
Data Structures: Theory and Practice
(Academic 1971)

Day, A. C.
Fortran Techniques: with Special Reference to Non-numerical Applications (Cambridge U.P. 1972)

Galler, B. A. & Perlis, A. J.
A View of Programming Languages (Addison-Wesley 1970)

Gear, W.

Knuth, D. E.
The Art of Computer Programming
Vol. III—Sorting and Searching (1973)
(Addison-Wesley)

Page, E. S. & Wilson, L. B.
Information Representation and Manipulation in a Computer (Cambridge U.P. 1973)

Sammet, J. E.
Programming Languages: History and Fundamentals (Prentice-Hall 1969)

GROUP II
Subjects in the main-stream of Computer Science

OFFERED BY THE DEPARTMENTS OF COMMERCE

413611 Information Systems

Note
Candidates who passed the subject Accounting Systems and Computer Applications or Management Studies prior to 1974 will not be permitted to enrol in this subject.

Assumed Standard of Attainment
Commercial Electronic Data Processing
(or Management Studies if passed in 1974)

Hours
2 lecture hours per week

Examination
Progressive assessment

Content
The application of the theory of information systems to the analysis and design of computer systems. Topics include, the study and analysis of existing manual and computer systems; the design of batch sequential and direct access processing systems; an introduction to the COBOL programming language; a detailed treatment of computer security management; considerations when implementing a computer system.
Content
Quantitative methodology; BASIC programming; mathematics review; decision theory; demography and its applications; CPM/PERT; inventory modelling; linear programming in practice; game theory; Markov analysis; queueing theory; dynamic programming; business forecasting; elements of simulation; management of quantitative analysis projects in real life.

Texts
Anderson, J. et al. Thesis and Assignment Writing (Wiley)
Levin, R. I. & Kirkpatrick, C. A. Quantitative Approaches to Management 3rd edn (McGraw-Hill)
Pollard, A. H. et al. Demographic Techniques (Pergamon)
Starr, M. K. & Stein, I. The Practice of Management Science (Prentice-Hall)

References
Baumol, W. J. Economic Theory and Operations Analysis (Prentice-Hall)
Hillier, F. S. & Lieberman, G. J. Introduction to Operations Research (Holden Day)
Taha, H. A. Operations Research: An Introduction (Macmillan)

410135 Social Implications of Computers — E. J. Burke

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

Hours 2 hours per week for 2nd half year

Examination One 2-hour paper

Content
The spectrum of political, legal, managerial, philosophical, ethical and social issues; human variables associated with strategies of change; impact upon organisation structures; socio-technical systems; effects upon communication, privacy, public justification.

Texts
References To be advised
Assumed Standard of Attainment

Nil

Hours

2 lecture hours per week for the 1st half year and associated practical work

Examination

One 3-hour paper

Content

The lectures and case studies are 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 the systems analyst; fact finding, recording, and analysis; documentation and standards; data capture and conversion; communication with users.

Texts

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

References


Chandor, A. et al. Practical Systems Analysis (Rupert, Hart & Davis)

Clifton, H. D. Systems Analysis for Business Data Processing (Wiley)

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

Glans, T. B. et al. Management Systems (Holt, Rinehart & Winston)

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

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


Weiss, E. A. Computer Usage/Applications (McGraw-Hill)

Assumed Standard of Attainment

CS — Commercial Programming, Systems Analysis & Design A

Hours

2 lecture hours per week for the 2nd half year and associated practical work

Examination

One 3-hour paper

Content

This subject is a development of the Systems Analysis and Design A, with the inclusion of the following topics: data transmission; real time systems; information retrieval; file processing; form design; management and the computer; file design; systems design and determination; operating systems, multi-programming.

Texts

As for Systems Analysis and Design A

References

ELECTRICAL ENGINEERING

533213 EE341 Automatic Control — see page 93.

533112 EE345 Sample Data and Digital Control

Assumed Standard of Attainment

EE341 Automatic Control

Hours

3 hours of lectures, tutorials and laboratory work per week for the second half 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

Nil

References


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

534113 EE425 Digital Electronics — A. Cantoni

Assumed Standard of Attainment

EE421 Electronics

Hours

3 hours of lectures, tutorials and laboratory work per week for the 2nd half year

Examination

Progressive assessment and final examination
Content

Texts
Nil

References
Kohonen, T.  
Peatman, T. B.  

Nil

534134 EE447 Digital Communications — J. B. Moore

Prerequisite
Nil

Hours
3 hours of lectures and tutorials per week for 2nd half year.

Examination
Progressive assessment and final examination

Content
1. Noisy Memoryless M-ary channels
   Orthogonal signalling on noisy memoryless channels. Optimum receivers, the matched filters, the correlation receiver, Shannons channel capacity theorem. Introduction to coding techniques; block, algebraic and convolution codes.

2. Noisy channels with memory

Text
Nil

References
Lucky, R. W. et al.  
Wozencraft, J. M.  

Nil

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

Assumed Standard of Attainment
EE361 Computer Structure: Machine & Assembly Languages

Hours
3 hours per week for the 2nd half 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)

References
Aho, A. V. & Ullman, J. D.  
Donovan, J. J.  

The Theory of Parsing, Translation and Compiling 2nd Vol. (Prentice-Hall)
Systems Programming (McGraw-Hill)

530114 EE462 Topics in Switching Theory
530108 EE565 Pattern Recognition
530119 EE566 Automata and Computing Machines
530125 EE567 Computer Process Control
530121 EE568 Advanced Computer Architecture
530122 EE569 Formal Languages and Automata

- not offered in 1977
References
Hadley, G. Linear Programming (Addison-Wesley, World Student Series 1969)
Künzi, H. P. et al. Nonlinear Programming (Blaisdell 1966)
Luenberger, D. G. Introduction to Linear and Nonlinear Programming (Addison-Wesley 1973)
Salkin, H. M. Integer Programming (Addison-Wesley 1975)

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
CIVIL ENGINEERING

520115 CES15 Elastic Continual
1 For details consult the Engineering Faculty Handbook.

COMMERCIAL

COMMERCE

413612 Theories of Organisation
Assumed Standard of Organisation Behaviour
Attainment
Hours 2 lecture hours per week
Examination Two 3-hour papers
Content
The influence of politics, power and conflict: topics include organisations and the rationalisation of work; organisational structures; bureaucracies as working communities; the scientific management movement; Mayo and the Hawthorne experiments; Kurt Lewin and field theory; group membership and intergroup conflict; search for principles of management; worker participation models; organisational development; and propositions of organisational behaviour.
Texts
Lupton, T.
Poole, M.
Sofer, C.
Mouzelis, N. P.

References
Argyle, M.
Brown, W.
Kast, F. & Rosenzweig, J. E.
Katz, D. & Kahn, R. L.
Kerr, C. D. et al.
Klein, L.
March, J. G. & Simon, H. A.
Margulies, N. & Raid, A. P.
Silverman, D.
Woodward, J.

Management and the Social Sciences (Penguin)
Worker Participation in Industry (Routledge Kegan & Paul)
Organisations in Theory and Practice (Heinemann)
Organisation and Bureaucracy—An Analysis of Modern Theories (Routledge Kegan & Paul)
The Psychology of Interpersonal Behaviour (Penguin)
Organisations (Heinemann)
Organisation and Management: A Systems Approach (McGraw-Hill)
The Social Psychology of Organisations (Wiley)
Industrialism and Industrial Man (Pelican)
New Forms of Work Organisation (Tavistock)
Organisations (Wiley)
Organisation Development: Values, Process and Technology (McGraw-Hill)
The Theory of Organisations (Heinemann)
Industrial Organisation: Theory and Practice (Oxford U.P.)

ELECTRICAL ENGINEERING

MATHEMATICS

660114 CS---Mathematical Logic --- See Mathematics III, Topic 0 page 42
660115 CS---Operations Research --- See Mathematics III, Topic U page 48
660117 CS---Probability and Statistics --- See Mathematics III, Topic R page 45
660118 CS---Asymptotic Methods in Analysis --- See Mathematics IV page 70
660119 CS---Random and Restricted Walks --- See Mathematics IV page 71
660120 CS---Signal Detection --- See Mathematics IV page 61
660121 CS---Stochastic Processes --- See Mathematics IV page 62
660122 CS---Combinatorial Designs --- See Mathematics IV page 69
660123 CS---Combinatorics --- See Mathematics IV page 64
660124 CS---Population Dynamics --- See Mathematics IV page 59
660125 CS---Graph Theory --- May not be offered in 1977

MECHANICAL ENGINEERING

544813 ME439 Reliability Analysis for Mechanical Systems see pages 107-109
544814 ME437 Operations Research --- Deterministic Models see pages 107-109
544815 ME438 Operations Research---Probabilistic Models see pages 107-109
544816 ME439 Operations Research---Applications in Industry, see pages 107-109
540101 ME503G Design of Experiments for Engineering Research 1

1 For details consult the Engineering Faculty Handbook.

METALLURGY

113312 Met 312 Optimization and Control 1

1 For details consult the Engineering Faculty Handbook.

PHYSICS

660126 CS---Instrumentation Techniques

Assumed Standard of Attainment

Physics IA or IB

Hours
One hour per week and a 12-hour project

Examination
Project assessment and one 2-hour paper

Content
From the subject Electronics and Instrumentation II:
  Specialist Instrumentation  ---  8 lectures
  Instrumentation Systems  ---  8 lectures
  Measurement Devices  ---  14 lectures
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:
   (i) the eighth Monday in First Term, in the case of a unit lasting only the first half-year;
   (ii) the eighth Monday in Second Term, in the case of a unit lasting the whole year;
   (iii) 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 University. 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.

A separate sheet on the preparation and binding of higher degree theses 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 candidature, 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. (a) The course shall be carried out in a Department of the University.
(b) Notwithstanding the provisions of subsection (a) of this clause, 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.
(c) The course shall be carried out under the direction of a supervisor or supervisors appointed 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.

24. In exceptional circumstances the Senate may relax any of these requirements.

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.

RESEARCH IN THE DEPARTMENT OF MATHEMATICS

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, and the subsequent lattice of sub-varieties of given varieties.

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.

Combinatorial Theory and Operations Research
Dr R. B. Eggleton is interested in all aspects of combinatorial mathematics, particularly graph theory.

Professor R. W. Robinson is applying combinatorics to the counting of various structures, such as graphs and search trees.

Dr R. J. Vaughan is interested in the application of optimisation methods to industrial production problems.

Associate Professor W. D. Wallis is carrying out research on block designs and graph theory. He is also working on rostering and scheduling problems.

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.

Dynamical Systems
Dr J. G. Couper is working on stable and generic properties of flows and diffeomorphisms.

Environmental and Urban Studies
Dr R. J. Vaughan is investigating mathematical models in urban geography.

Associate Professor W. D. Wallis is working on mathematical models in urban geography and urban sociology.

Dr R. W. Gibberd is studying the art of population projections and various models of urban structure and urban development. He is also interested in urban sociology, voting patterns and urban demographic models.

Fluid Mechanics
Associate Professor A. J. Guttmann is studying the problem of extrapolating regular perturbation series in fluid mechanics. Powder Mixing—the problem of powder mixing is being investigated.

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

Functional Analysis
Associate Professor 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.

**Geophysical Fluid Dynamics**
Dr W. Summerfield is currently studying the dynamics of estuarine systems. He is also interested in all ocean wave phenomena.

**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 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 $0'$. 

**Mathematical Models of Tumour Growth**
Dr D. L. S. McElwain is investigating models for the growth of solid isolated tumours.

**Number Theory**
Dr R. B. Eggleton is interested in number theory, particularly in combinatorial aspects of the subject.
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**
Associate Professor 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.
Dr W. Summerfield is working on ways of determining the “condition” of linear systems of equations. Further, he is interested in the solution by linear marching schema of ordinary differential equations, in particular “stiff” systems. He is also investigating the finite element method of solution for partial differential equations.