Brendan

ANNUAL SUBSCRIPTIONS

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(adding $2 to foreign cheques
to cover bank charges).

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Please be sure to fill in and return
the form enclosed in this newsletter.

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Dept. of Mathematics	Dept. of Mathematics	Dept. of Computer Science

University of Queensland, St.Lucia, Queensland 4067, Australia.

COMBINATORIAL MATHEMATICS AND COMPUTING
FIFTEENTH AUSTRALASIAN CONFERENCE

The Fifteenth Australasian Conference on Combinatorial Mathematics and Computing will be held at the University of Queensland, Brisbane, Queensland, during the week 10–14 July 1989. All interested persons are cordially invited to attend. Contributed papers are welcome in all areas of combinatorics and combinatorial computing, pure and applied. Several speakers are being invited. Accommodation will be available in Cromwell College, on the University of Queensland campus.

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The **Combinatorial Mathematics Society of Australasia** was formed in 1978 to promote combinatorial mathematics. It disseminates information about combinatorics and combinatoricists through its newsletter *Combinatorics*, and it conducts an annual conference with refereed published proceedings. There are currently about 120 members from all over the world.

Any interested person is invited to join the C.M.S.A. Annual subscription for 1988 is Australian $5, payable to C.M.S.A. Members receive the newsletter and a reduction in the conference registration fee. Please address all enquiries, giving your full name and address, to Anne Street or Elizabeth Billington at the address given overleaf.

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The 1990 Australasian Conference on Combinatorics, Graph Theory and Computing will be held at Massey University, 3–7 December, 1990. For further information on this conference, please write to

Dr.C.H.C.Little,
Department of Mathematics and Statistics,
Massey University,
Palmerston North,
New Zealand.

Ars Combinatoria – Change of Address

Professor W.L.Kocay has taken over from Professor S.A.Vanstone as Managing Editor of Ars Combinatoria. Consequently, effective at once, any correspondence regarding new manuscripts submitted to Ars Combinatoria should be sent to

Professor W.L.Kocay,
Managing Editor, Ars Combinatoria,
Department of Computer Science,
University of Manitoba,
Winnipeg, Manitoba,
CANADA, R3T 2N2.

All new submissions will be processed by Professor Kocay. Papers that are currently in the refereeing process under Professor Vanstone will be completed at the University of Waterloo, and the final version forwarded to Professor Kocay. But no new processing will be initiated from Professor Vanstone's office. This transition is expected to be finished by midyear at the very latest.

CMSA Publications

The suggestion has been made that CMSA should produce some small booklets, of interest to students of discrete mathematics, as a service to lecturers in the area. Any profits would be used by CMSA to establish a fund for the purpose of encouraging visitors to Australasia.

A survey of the contents of discrete mathematics courses in Australasia has been carried out, and appears later in this newsletter. From information obtained in this survey, we propose that initially the following topics should be considered:

(1) a collection of examples of graphs with interesting properties;

(2) logic and set theory (including recursion);

(3) a collection of graph theory algorithms (including those for flows in networks);

(4) generating functions and recurrence relations, pigeonhole principle, principle of inclusion-exclusion;

(5) planar graphs;

(6) permutations and combinations;

(7) trees;

(8) graph colouring.

We would be grateful for opinions as to whether such booklets should be produced and, if so, for comments on the choice of topics. For example, we would like to know what graphs might be of interest, should we decide to go ahead with (1). We are considering booklets of approximately 30 pages each. We would also like to hear from aspiring authors, and if the plan goes ahead, we shall need a series editor.

<div align="right">

Derek Holton
Charles Little
Anne Street

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Other Combinatorial Conferences

The Twelfth British Combinatorial Conference will be held at the University of East Anglia, Norwich, 3–7 July, 1989.

The Thirteenth British Combinatorial Conference will be held at the University of Surrey, Guildford, 8–12 July, 1991.

Further information on these conferences is available from

<div align="center">

Mrs.C.A.Whitehead,
Hon.Secretary, British Combinatorial Committee,
Department of Mathematical Sciences,
University of London Goldsmiths' College,
London SE14 6NW.

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The Combinatorics group at Auburn University is hosting a year of design theory, sponsored by the N.S.A.Mathematical Sciences Program, and including a mini-conference to be held at Auburn, 21-25 March, 1988. For further information about the conference or the year-long program of special talks, write to

<div align="center">

Professor C.A.Rodger,
Department of Algebra, Combinatorics and Analysis,
120 Mathematics Annex,
Auburn University,
Auburn, Alabama 36849–5307, USA.

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THE AUSTRALIAN MATHEMATICAL SOCIETY'S
SUMMER RESEARCH INSTITUTE 1988

I am taking this opportunity to give a brief informal report on the Summer Research Institute 1988, which was held recently (20 January – 5 February) at the University of Newcastle. A detailed formal report will be presented to the Australian Mathematical Society for its annual meeting in May, so I shall concentrate here on details of particular interest to members of CMSA.

Among the invited speakers, there was a strong contingent representing combinatorics and discrete mathematics:

Claude Berge:	*Graph Theory* (5 lectures)
Paul Erdös:	*Combinatorial problems in graph theory, number theory and geometry* (4 lectures)
Ron Graham:	*Topics in combinatorial and discrete mathematics* (5 lectures)
Rudolf Lidl:	*Short course in finite fields and ciphers* (5 lectures)
Victor Miller:	*Aspects of computer algebra* (5 lectures)
Henry Pollak:	*The application of discrete mathematics* (3 lectures).

A total of 98 participants attended SRI 1988. While this was considerably better than average numbers recorded in recent years, there were still some deficiencies to be noted. The main one is that very few people were able to attend for the full length of the Meeting. In spite of a coherent programme in combinatorial and discrete mathematics for the full duration of SRI 1988, most participants came for about a week, so the pattern of a weekly turnover in attendance, which has become familiar in recent years, was not reversed this time. The probable reason is the shortage of funds (departmental and personal) for such extensive conference participation. This is regrettable but is a fact we must recognize. The other disappointment which I would like to report to CMSA is that the number of combinatorists who attended was quite low. At the most generous count this number was 40, including the relevant invited speakers! When one takes into account the fact that few participants were in attendance throughout the meeting it is no surprise that many of the lectures had fewer than 30 in their audience. This is regrettable because the annual meeting of CMSA at the University of Sydney in August 1985 agreed to waive a 1988 CMSA conference in favour of supporting SRI 1988 in view of its strong offering of combinatorial mathematics.

In spite of these deficiencies, I am pleased to report that the general assessment of SRI 1988 was very favourable. Those attending were very appreciative of the professional and social programmes and the standard of the lecture series was very high. In closing remarks Bernhard Neumann lamented the probable passing of "Polymath meetings" of the

type represented by the Summer Research Institutes, and said that "there had been good SRIs and better SRIs but this one had been one of the best".

In closing I would like to acknowledge the considerable support which this Meeting enjoyed from a number of sources in addition to the Australian Mathematical Society, notably QANTAS, Australian Airlines, Eastern Australia Airlines, IBM Australia, BHP Central Research Laboratories, Australian-American Research Foundation, Australian Institute of Health, Newcastle City Tourist Association, Tomago Aluminium, Hunter District Water Board, University of Newcastle Senate Research Committee.

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ROGER EGGLETON
Director, SRI 1988

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Other News Items

The **National Mathematical Sciences Congress** will be held at the Australian National University, Canberra, 16–20 May, 1988. Information is available from

<div align="center">

N.M.S.C. Secretariat,
Capital Conferences Pty Ltd,
P.O.Box E345,
Queen Victoria Terrace, Canberra, A.C.T. 2600.

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The abstracts of the contributed talks given at the **Eleventh British Combinatorial Conference** will be on display at the National Mathematical Sciences Congress in May.

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The **Charles Babbage Research Centre**, which publishes the journal *Ars Combinatoria* and the proceedings of the CMSA conferences, also publishes a **Selected Papers** series, a set of volumes of selected papers of eminent mathematicians; the papers are selected by the mathematicians themselves, and they provide additional commentaries concerning the papers. In April, 1988, the **Selected Papers of Bernhard and Hanna Neumann**, with commentaries by Professor Bernhard Neumann, will be published, in six volumes. The price will be US$24 per volume, plus shipping, for an effective total of US$156 for the set. However forty sets, an over–run arranged prior to printing, will be available to individual members of the Australian Mathematical Society at US$78 for the six-volume set. Once these special forty sets are exhausted, the offer will terminate. To take advantage of this special offer, please send US$78 to

<div align="center">

Charles Babbage Research Centre,
P.O.Box 272, St.Norbert Postal Station,
Winnipeg, Manitoba,
Canada R3V 1L6.

</div>

Be sure to indicate that you are a member of the Australian Mathematical Society when ordering.

A SURVEY OF UNDERGRADUATE COURSES IN DISCRETE MATHEMATICS TAUGHT IN
AUSTRALASIAN UNIVERSITIES

C H C Little
Massey University
Palmerston North
New Zealand

This survey updates an earlier one which appeared in *Combinatorics* 2
(1980), 15-23, 33-38. In contrast to the earlier article, however, the
present survey deals only with university courses. Once again letters were
sent to all Australasian universities seeking information, and I take this
opportunity of thanking everyone who responded.

Again I have included syllabi for most of the courses. It has been
suggested that the CMSA should produce booklets on various topics in
discrete mathematics as a service to both lecturers and students.
Publication of the syllabi in this article should assist authors of such
booklets.

I   QUEENSLAND

(1) Griffith University

In the School of Computing and Information Studies, no courses
emphasising discrete mathematics are offered, but it was reported that
there is considerable discrete mathematics and combinatorial algorithm
content throughout the degree programme. It was suggested that I find
a way to communicate their dedication to promoting discrete mathematics
as an important foundation for computing science.

(2) University of Queensland

The Department of Mathematics offers a number of courses in discrete
mathematics. Each lasts for one semester.

(i)   MP104 Foundations of Mathematics I: truth tables and
           propositional calculus;   introduction to set theory;
           relations and mappings; rings and fields; ordered integral
           domains;   equivalence relations,   partitions and the
           construction of the rational numbers;   integer arithmetic:
           division and congruences;   finite fields;   elementary group
           theory;   introduction to graph theory and algorithms;
           Boolean algebras and applications to switching circuits.
           This is a first-year pass course, taught to about 200
           students. An honours course, MP173, includes this material
           as a subset.   Texts are Bavel, Stewart & Tall, or Cooke &
           Bez.

(ii)   ME205   Mathematical   Foundations: introduction   to
           propositional calculus; predicate calculus; sets; numbers;
           relations; functions; recursion. This course is a new one,
           first   offered   in   1988   to   second-year   engineers.
           Approximately 80 students are expected.   No text has been
           decided.   .

(iii)   MP205 Finite Mathematics: relations on sets, especially
           finite sets;   representation of relations by incidence
           matrices and by graphs;   graphs, both directed and
           undirected;   properties of graphs, especially those needed
           for applications;   vector spaces associated with graphs;
           Boolean algebras, as axiomatic systems (modelling electrical

networks) and as special types of lattices representable by graphs. According to the Department of Mathematics Handbook, this course "is designed both for mathematics and for computer science students, and covers topics on discrete structures relevant to the Association for Computing Machinery Curriculum 78." It is taken by approximately 50-60 second-year pass or honours students. Text: Street & Wallis.

(iv)   MP306 Combinatorial Analysis: a selection of topics chosen from those listed in the Undergraduate Degree Handbook.   On previous occasions the topics chosen have been combinatorial designs, coding theory and the interrelation between designs and codes. Though designed as a third-year pass or honours course, it is sometimes taken by second-year students. Approximately 40-50 students enrol for this course.   Text: Street & Wallis.

(v)   MP475 Combinatorics IIIH/IVH: topics chosen from: graph theory, enumeration theory, transport networks,   block designs, algebraic coding theory, theory of cyclotomy.   This course is taken by approximately 4-8 third- or fourth- year honours students. Texts: Street & Wallis, Street & Street, and others.

II   NEW SOUTH WALES AND AUSTRALIAN CAPITAL TERRITORY

(1)   Australian National University

ANU offers two relevant courses.   Both consist of two lectures per week and one tutorial per fortnight, for 13 weeks.

(i)   Mathematics 801 (Discrete Mathematics):   combinatorics: introduction;   permutations and combinations;   binomial coefficients;   recurrence relations;   generating functions; graphs;   trees;   directed graphs.   The course is taught to 80-90 second-year pass students.   No text is prescribed but notes are issued.

(ii)   A third-year course, Mathematics C01 (Topic in Pure Mathematics) has covered graph theory and applications in 1987 and 1988.   The lecture diary comprised: basic definitions;   standard types of graphs;   constructions; paths and connectivity;   Eulerian and semi-Eulerian graphs; Hamiltonian and semi-Hamiltonian graphs;   weighted graphs; weighted digraphs;   trees and forests;   planar graphs; interval graphs;   elementary homology of graphs.   The topic covered in this course changes from time to time.   Class size is about 50.   There is no text book.

(2)   Macquarie University

(i)   MATH237 - Introduction to discrete mathematics: algorithms; mathematical induction;   complexity;   big oh notation; numbers in other bases;   modular arithmetic;   graphs;   trees; Kruskal's algorithm;   travelling salesman problem;   minimal path tree algorithm;   critical path method;   Boolean algebra; switching theory;   prime implicants;   logic and quantifiers; generating functions;   difference equations;   counting functions;   sets;   functions;   relations;   cardinality.   This

is a second-year course, taken by about 110 students internally and 50 externally. Text: Dierker and Voxman.

(ii)   Another course (MATH234 – Geometry and Topology) has about $^1/_6$ of its content devoted to graph theory. The course is intended for students likely to become high school teachers, and touches on embeddings of graphs in surfaces, map colourings and Eulerian cycles. It attracts about 35 students.

(3) University of New South Wales

The Department of Computer Science at the Australian Defence Force Academy teaches a third-year one-semester course in cryptography and computer security, and may offer a fourth-year course on error correction codes. The Department of Mathematics offers a course on discrete mathematics.

(4) University of Sydney

The Department of Pure Mathematics offers three courses.

(i)   A second-year ordinary level discrete mathematics course covers basic concepts in the theory of graphs, trees, paths in graphs, matrices associated with a graph, planarity, colouring, and important applications of graphs. It uses finite graphs as a base for developing methods and applications of combinatorial theory. The course attracts about 180 students.

(ii)   A third-year ordinary level coding theory course is taught to approximately 120 students. It is a general introduction to the theory of error-correcting codes. The main part of the course concerns cyclic codes. Attention is focused on the problem of constructing efficient codes, and the course concludes with the construction of classes of codes that are used in modern digital communication systems, including the code used in the compact disc player. Text: Pless.

(iii)   A third-year combinatorial theory course attracts about 40 advanced level students. Its theme is enumeration. It covers binomial identities, Stirling numbers, Bell numbers, generating functions, principle of inclusion-exclusion, Möbius inversion on partially ordered sets, and Pólya's theory of counting.

(5) University of Wollongong

A second-year discrete mathematics course, MATH241, attracts about 25 students, and covers number theory, recurrence relations and graph theory.

Number Theory: approximation theory, the computer as a rational number machine, diophantine equations, division and its functions.

Recurrence relations: Fibonacci numbers and the golden section, generating functions.

Graph theory: strong components and matrices, trees, tournaments, orientability, food webs, intersection graphs, group decision making, probability chains.

III VICTORIA

(1) Deakin University

  (i)   Deakin offers a second-year operations research course
         covering linear programming and network optimisation. Number
         of lectures: 52. Number of students: 40. Text: Taha.

  (ii)   A third-year operations research course deals with integer
         programming, dynamic programming, inventory models,
         simulation and non-linear optimisation. Number of lectures:
         78. Number of students: 20. Text: Taha.

  (iii) There is also a third-year combinatorial mathematics course
         covering   recurrence   relations,   matchings,
         inclusion-exclusion, graphs, traversability, planarity,
         colourings and connectivity. Number of lectures: 26.
         Number of students: 10.

(2) La Trobe University

La Trobe offers a first-year course, Mathematics IDM, which is strongly
recommended for students intending to major in mathematics. It pays
particular attention to the interface between pure mathematics and
computer science, and covers the following topics.

Logic: relationship between ordinary language and formal statements in
propositional and predicate calculus;   concepts of truth and
counterexamples; deduction, truth tables, Boolean algebra, switching
circuits.

Algorithms: introduction to growth rates, order notation, recurrence
relations, difference equations.

Numerical concepts: discrete arithmetic in different bases; floating
point arithmetic; approximation of real numbers by rational numbers;
integer arithmetic and primes.

Graphs: introduction to directed and undirected graphs, including
simple applications; traversal algorithms; trees as an introduction
to recursion; binary balanced search trees.

Counting: use of induction; introduction to recursion; combinatorial
algorithms and formulae.

Class requirements are two lecture hours per week throughout the year
plus one tutorial a fortnight. The text is Dierker & Voxman.

(3) Monash University

  (i)   A first-year course, 711 Graph Theory and Linear Algebra,
         includes 13 lectures on graph theory, covering an
         introduction to graph theory, isomorphisms, routes and trees.
         Enrolment: 254. Text: Ore.

  (ii)   A second-year course, 723 Discrete Mathematics, is also
         offered. Syllabus: permutations and combinations; Pascal's
         triangle;   recurrence relations, induction, generating
         functions;   derangements, Catalan numbers, Euler numbers,
         sequences of brackets; pushdown stacks, flows in networks,
         Menger's theorem, marriage theorem; coding theory, Hamming

distance; linear codes, de Bruijn sequences, triplet and
n-tuple graphs; cryptography, pairs of primes, computation
of codes, complexity; Boolean algebra, examples and sets of
connectives; falsification, satisfaction, deductive systems;
finite Boolean algebras. Number of lectures: 24.
Enrolment: 108.

(iii)   There is also a third-year course, 7351 Graph Theory and
Surface Topology. Syllabus: graphs, paths and trees;
embedding and colouring graphs in the plane and other
surfaces; topological classification of surfaces;
introduction to the fundamental group and homology groups;
application of topology to group theory and vice versa.
Number of lectures: 24. Enrolment: 12.

IV TASMANIA

The University of Tasmania offers several courses in discrete modelling.

(i)   SMA115 Discrete Modelling 1: an introduction to probability,
linear programming and difference equations, with applications
chiefly to the biological, physical and social sciences. About
100 students enrol in this first-year course, and attend two
lectures and one tutorial per week for 14 weeks.

(ii)   SMA215 Discrete Modelling 2B: selected topics from elementary
combinatorics including networks, probability, random walks,
counting techniques, optimisation and game theory, with
applications chiefly to management techniques, engineering and the
sciences. This second-year course requires two lectures and one
tutorial per week for 14 weeks, and attracts about 50 students.

(iii)   SMA315 Discrete Modelling 3: a selection of the following topics
and their applications: coding and cryptography; Boolean
algebras; graphs; block designs. This is a third-year course
of two lectures and one tutorial per week. Approximately 40
students enrol.

(iv)   A new second-year course in discrete modelling is being offered in
1988 for the first time. It covers a selection of the following
topics and their applications: linear programming, including
duality; dynamic, integer and convex programming; simple
stochastic processes; sampling theory; difference equations.
This course will require two lectures and one tutorial per week
for 14 weeks.

V SOUTH AUSTRALIA

Flinders University offers the following three second-year courses, each of
which requires three lectures and one tutorial per week for one term.

(i)   61241 Combinatorics: additive and multiplicative counting;
binomial coefficients and combinatorial identities, including
those of Pascal and Vandermonde; the multinomial theorem;
placing n indistinguishable objects into n different cells,
n-selections, placing flags on flagpoles, the number of terms in
the multinomial theorem; recurrence relations as an approach to
linear and circular permutations; Euler's problem of dissection

of a convex polygon into triangles, Segner's recurrence, the relationship with Catalan's associativity problem; derangements via recurrence relations; the Fibonacci sequence and related recurrence relations; the principle of inclusion-exclusion, derangements; permutations with forbidden positions, rook polynomials, the direct sum, expansion and forbidden board theorems; generating functions and exponential generating functions.

(ii)   61201 Discrete Mathematics 1:   sets, Cartesian products, relations, functions; graphs, trees; logic, truth tables, rules of inference; induction, recursive definitions; combinations, permutations, inclusion-exclusion; a brief introduction to the concepts of semigroups, groups, rings, fields and vector spaces, with application to computer science.

(iii)   61202 Discrete Mathematics II: resolution method, unification; spanning trees, labelled graphs, connectivity of graphs, Euler walks; models of computability, finite state automata; grammar, the Chomsky hierarchy, context-free grammars; Boolean algebras, conjunctive and disjunctive normal forms, Boolean minimisation; Huffman codes, secret codes, error detecting codes; information theory, entropy of a set of messages, noise and errors in information.

VI   WESTERN AUSTRALIA

(1) Curtin University

Two undergraduate courses in discrete mathematics are offered, each requiring two lectures and one tutorial per week.

(i)   Discrete Mathematics 101:

Logic:, operations on statements, truth tables, mathematical theorems, proof by contradiction, quantifiers; mathematical induction.

Combinatorics: elementary principles of counting, permutations, combinations; principle of inclusion and exclusion, derangements; number of integer solutions of an equation with unit coefficients; introduction to the generating function method.

Graph theory: basic definitions; graphs as models; concepts of algorithm, Dijkstra's algorithm; introduction to computational complexity.

The text is an internal publication.

(ii)   Discrete Mathematics 201:

Graph theory: basic definitions; cycles, connectivity, matchings, graph colourings; Fleury's algorithm for finding a minimum weight Euler tour; applications of graph theory to the design of communication networks, assignment problems and allocation problems; data structures and algorithm analysis.

Coding theory: basic definitions and concepts such as block

codes, Hamming distance, Hamming weight, information rate, error detection and correction.

Combinatorial designs: block designs, Latin squares, balanced and partially balanced incomplete block designs; applications to scheduling.

In addition, two operations research courses include some discrete mathematics. Operations Research 202 contains some network analysis and applied graph theory, and Operations Research 302 includes network flows: basic concepts, max-flow min-cut theorem, the Ford-Fulkerson algorithm, feasible flows, applications.

There are also post-graduate courses in both discrete mathematics and operations research, but they lie outside the scope of this survey.

(2) Underline University of Western Australia

(a) Underline Department of Computer Science

The second- and third-year courses CS200 and CS300 consist of four equally weighted components, each of two lectures for 13 weeks. CS200 has a discrete structures component covering sets, logic, relations, functions, Boolean algebra, lattices, graph theory and automata. The graph theory is supplemented in a data structures component where data structures and classical algorithms over them are studied. About 90 students select this course. CS300 attracts about 20 students. It has a component on algorithms that includes combinations and complexity and draws upon discrete mathematics. A functional and logic programming component also includes some discrete mathematics.

(b) Underline Department of Mathematics

Although no course is devoted entirely to discrete mathematics, Mathematics 100 contains a 10 lecture component on group codes as an application of linear algebra. Graph theoretic algorithms are taught in Applied Mathematics 105. Propositional logic and finite algebras are covered in a second-year option, Mathematics 221. Many discrete topics such as enumeration and generating functions are taught in various statistics courses. Finite geometry is taught as part of a third-year geometry course. Altogether almost 1500 students are exposed to some discrete mathematics.

A new semester length third-term course, Geometry and Combinatorics, is planned for 1989.

VII NEW ZEALAND

(1) Underline Massey University

(i)   60.208 Discrete Mathematics: relations; functions; monoids; groups; graph theory with applications; Boolean algebras; posets; error correcting codes; cryptography; analysis of algorithms; recursion; induction. Text: Laufer. This second-year course attracts about 50 students, about half of whom study the subject extramurally (externally).

(ii)   A fourth-year course, 60.405, offers an introduction to applied graph theory. Applications emphasise the

computational and algorithmic aspects of graphs and include
such topics as the travelling salesman problem, shortest
paths, network flows, transportation and scheduling problems,
location theory, distribution problems and facilities layout.
Text: Minieka.

(iii)   An introduction to graph theory is offered in another
fourth-year course, 60.421. Topics include connectivity,
matchings, colourings, planarity, duality and digraphs.
Although the emphasis is on the theoretical aspects of the
subject, applications are included as well.

Each of the above courses requires two lectures per week.

(2) Victoria University

One course, MATH214, is devoted to discrete mathematics. It
covers sets and logic in discrete mathematics, applied algebraic
structures, elementary combinations, and an introduction to graph
theory.

(3) University of Auckland

The Department of Mathematics and Statistics offers four relevant
courses.

   (i)   26.122 Finite Mathematics: geometric linear
programming; vectors and matrices; linear equations;
linear programming; sets; counting; probability;
Markov chains; theory of games; digraphs; logic.
Text: Mizrahi & Sullivan. Number of lectures: 44.

   (ii)   26.325 Topics in Discrete Mathematics: codes; finite
geometries; Latin squares; balanced incomplete block
designs; pigeonhole principle; trees; Boolean
algebras; graph theory; enumeration; algorithms.

   (iii) 26.416   Combinatorics: generating   functions;
inclusion-exclusion; Polya's theorem; properties of
almost all graphs; connections between random graph
models.   This course is a broad introduction to
combinatorial enumeration techniques and random graphs.

   (iv)   26.427 Coding Theory: generating and parity check
matrices; dual codes; Hamming distance; weight of a
code; encoding; decoding; Hamming, perfect, Golay,
BCH(n,t), general BCH and cyclic codes; error
detection.   The course is an introduction to linear
block codes.

(4) University of Canterbury

The University of Canterbury uses the term "discrete algebra" to
cover algebraic structures, graphs and other combinatorial
structures. As a result of a rearrangement of courses, a series
of three courses in this area is offered in 1988. They are
expected to appeal to the more theoretical computer science
students as well as mathematics students. Each uses Biggs as a
text.

(i)   MATH115 Discrete Algebra 1: natural numbers, induction,
        integers, congruence; logic, set algebra, relations and
        functions; digraphs, networks, critical path analysis,
        rooted trees, with applications.   Expected enrolment:
        about 150. Number of lectures: 45.

(ii)   MATH215 Discrete Algebra 2:   enumeration, algorithms;
        digraphs, graphs, rooted trees, searching, shortest path
        problems; permutations, groups, symmetry of graphs and
        patterns, cryptography;   recurrence equations;   rings,
        fields and polynomials, construction of finite fields.
        Expected enrolment: about 60.

(iii)   MATH315 Discrete Algebra 3:   enumeration techniques;
        finite fields;   coding theory;   block designs;   Latin
        squares;   partially ordered sets;   permutation groups;
        finite geometries;   cryptography, Boolean algebras,
        switching circuits. Expected enrolment: about 10.

A third-year combinatorics course for honours students is also
planned.

(5) **University of Otago**

(i)   MATH301 Algebra: abstract mathematical structures;
        logic;   sets and paradoxes;   relations and partitions;
        cardinal numbers and their arithmetic;   formalism and
        intuitionism;   lattices,   Boolean   algebras   and
        applications;   groupoids, semigroups, monoids, groups;
        rings, integral domains, fields. Number of lectures:
        50.
(ii)   MATH454 Combinatorics: preliminaries;   theory of
        partitions;   binomial functions;   multichain and chain
        functions;   the   b-transform;   principle   of
        inclusion-exclusion;   recurrences. Number of lectures:
        46.   Twelve of the lectures are allotted to seminars
        presented by students who volunteer.

(iii)   A fourth-year honours course in graph theory is also
        given if there is sufficient demand. It comprises 20 or
        more lectures covering the reconstruction conjecture,
        Hamiltonian and other cycles, and the four colour
        theorem.

(6) **University of Waikato**

Two courses include a semester (about 22 lectures) of discrete
mathematics, using Dierker & Voxman as the text.

(i)   05.103 Introduction to Algebra: logical notation and
        sets;   relations (including functions and binary
        operations);   undirected graphs;   trees, rooted trees,
        minimal   spanning   trees;   directed   graphs   and
        applications.   The remainder of the semester (up to 4
        lectures) is sometimes devoted to basic combinatorics
        and sometimes to posets, lattices and Boolean algebras.
        The text is supplemented by prepared notes.   The
        enrolment has been about 170-220.

(ii)   05.203 Algebra 1: A semester of discrete mathematics is
        included in this course in 1988 for the first time. It

the major topic will be combinatorics including basic enumeration, recurrence relations, generating functions, difference equations and Pólya enumeration. The expected enrolment is about 20.

VIII PAPUA NEW GUINEA

The University of Papua New Guinea intends to introduce a combinatorics course in the near future for third- and fourth-year students.

APPENDIX

The following books are used as texts for some of the courses we have described. They have been referred to above by the author's surname only.

1. Bavel, Math Companion for Computer Science, Prentice Hall, 1982.

2. Biggs, Discrete Mathematics, Clarendon, 1985.

3. Cooke & Bez, Computer Mathematics, Cambridge, 1984.

4. Dierker & Voxman, Discrete Mathematics, Harcourt Brace Jovanovich, 1986.

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