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UNIVERSITY OF TECHNOLOGY SYDNEY

FACULTY OF MATHEMATICAL AND COMPUTING SCIENCES

HANDBOOK ◆ 1992

UTS
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OF TECHNOLOGY
SYDNEY

FACULTY OF MATHEMATICAL AND COMPUTING SCIENCES

HANDBOOK
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UNIVERSITY OF TECHNOLOGY, SYDNEY

UTS has nine Faculties and each one has a separate Handbook which provides a detailed introduction to the Faculty's Undergraduate Courses.

Each Faculty also has a separate Postgraduate Studies Guide.

Reading these publications will show you how all courses at UTS aim to equip graduates for their professional career. Most courses can be undertaken with part-time attendance. Some are also offered with full-time and sandwich attendance. You do not have to be employed at the time you enrol in a sandwich pattern. And you can usually transfer from one attendance pattern to another at the end of a stage, provided the Head of School approves and there is space available in the class.

UTS does not offer external or correspondence courses.

Further information

The UTS Information Service is open all year in the Tower building at 15-73 Broadway (near Central Railway) and on the entrance level of Kuring-gai campus. If you can't visit them, write to PO Box 123 Broadway 2007 Australia or telephone (02) 330 1222 or (02) 413 8200.

Representatives of UTS attend Careers Days held in the Sydney region through the year.

Open Days are your chance to visit the campus and discuss your career plans and course preferences with members of the Academic staff.

Applications for admission

If you want to be admitted or readmitted to a UTS Undergraduate course, apply to the Universities Admissions Centre by 27 September.

(There are some courses for which you can apply direct to UTS - the deadlines for these are advertised separately.)

If you want to enrol in a Doctoral programme or a Masters by Thesis, UTS will generally accept your application at any time.

For a Master of Arts, Master of Business or other higher degree by coursework, you should lodge your application with the University by 31 October.

EQUAL OPPORTUNITY

It is the policy of the University of Technology, Sydney to provide equal opportunity for all persons regardless of sex, race, marital status, physical ability, sexual preference, political conviction or religious belief.

MISSION

The mission of the University of Technology, Sydney is to provide higher education for professional practice which anticipates and responds to community needs and the effects of social and technological change. The University offers access to its human, physical and technological resources for the advancement of society. It is committed to freedom of enquiry and the pursuit of excellence in teaching, scholarship and research, and to interaction with the practising professions.

The University seeks to accomplish its mission in the following ways:

- by teaching an appropriate range of undergraduate, postgraduate and other educational programmes in a variety of attendance patterns for students wishing to enter the workforce at a professional level, those already employed at that level and those in employment who wish to attain that level.
- by ensuring that its courses are designed to enable graduates to carry out full professional practice in their chosen field. The courses aim to develop students' ability to learn, to solve problems, to adapt to change, and to communicate. Students should gain a broad understanding of social as well as technological issues, and acquire a greater perception of the nature and needs of modern society and of their responsibility to play a leading part in shaping it.
- by recognising that it has been established to serve the community as a major resource in vocational higher education. It therefore makes its technological expertise and facilities available to industry, commerce, government, and professional and community organisations. The means by which this is achieved include co-operative education, continuing education, pure and applied research and development, consulting, technology transfer and management, and contribution to national and regional policy development in education and technology.
- by promoting effective teaching and scholarship, professional activity and research by members of the University community to ensure the maintenance of high educational standards and their recognition at national and international levels.
- by continuing to develop and promote policies that ensure equality of opportunity in all its aspects.
- by seeking effective support for its educational activities
- by conducting regular consultative reviews of its mission and objectives.

STUDENT SERVICES

Student Services staff are employed by the University to cater for your health, counselling and welfare needs. Staff also assist in the development of study skills and provision for students with disabilities.

WELFARE

Welfare Officers offer assistance with your personal financial security. Central to their work is administration of the Student Loan Fund, and advising on Austudy claims and appeals.

HEALTH

The Health Service has two locations: Level 3A of the Broadway Tower on City campus and Level 5 of Kuring-gai campus. The practice offers a free service with an emphasis on Health Education and Promotion.

COUNSELLING

Counsellors are available on all campuses at least one day per week. They are experienced in dealing with personal difficulties and can advise on administrative matters in relation to the University, such as appeals against exclusion. If you suffer from exam nerves or loss of concentration, you're welcome to see one of the counsellors for assistance. They can also help you to clarify personal and career goals.

STUDY SKILLS

The Study Skills Counsellor, John Piechocki, helps students to understand how best they can learn. Advice is given on time management, writing assignments and how to read and comprehend more in less time. You don't need to have problems to see John - Study Skills counselling is about improving your performance.

ASSISTANCE FOR STUDENTS WITH DISABILITIES

The Special Needs Co-ordinator works with academic, administrative and Student Services staff to ensure appropriate support is available for students with disabilities. Students who have disabilities or chronic illness are encouraged to contact Marie Flood at Level 3A of City campus, Broadway. Telephone (02) 330 1177 or TTY (02) 330 1164 or Fax: (02) 330 1172

WHERE & WHEN TO FIND STUDENT SERVICES

Kuring-gai
Level 5
Monday to Friday 9-5

Broadway
Level 3A, Broadway Tower
Monday to Thursday 9-6
Friday 9-5

Haymarket
Room D105
Monday to Thursday 9-5

Balmain
Student Centre, White Bay
Tuesday & Wednesday 9-5

Gore Hill
Clinical Studies Building, Level 1
Tuesday to Thursday 9-5

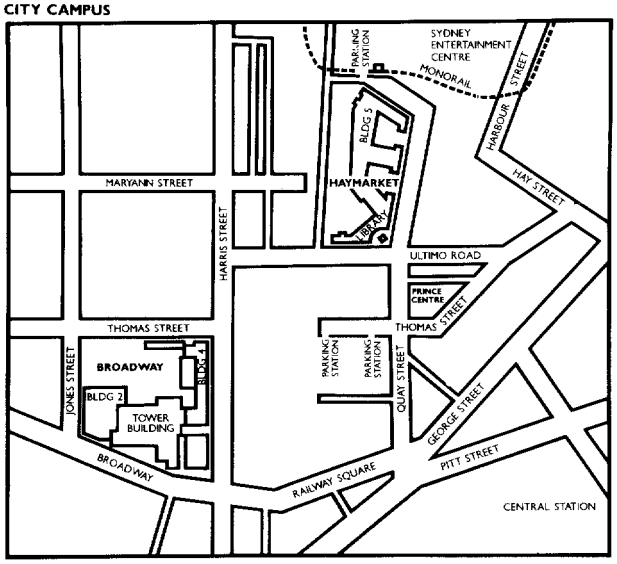
FACULTY LOCATION

Faculty of Mathematical and Computing Sciences

Faculty Office:
Room G29, Building 4,
Broadway, City Campus

Postal Address:
PO Box 123,
Broadway NSW 2007

CITY CAMPUS



School of Mathematical Sciences
Room 1523, Level 15, Building 1,
Broadway, City Campus,
Telephone: (02) 330 2246

School of Computing Sciences
Room G30, Building 4,
Broadway, City Campus,
Telephone: (02) 330 1802

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Information correct at September 1991
Produced by the Publications & Public Affairs Branch

FACULTY OF MATHEMATICAL AND COMPUTING SCIENCES

The Faculty consists of the School of Mathematical Sciences and the School of Computing Sciences. These Schools offer courses leading to the awards of Bachelor of Applied Science (at pass and honours levels), Bachelor of Mathematics and Finance (at pass and honours levels), Bachelor of Information Technology, Graduate Certificate in Mathematical Sciences, Graduate Diploma in Data Processing, Graduate Diploma in Operations Research, Master of Applied Science by Thesis, Master of Applied Science (Operations Research) and Master of Applied Science (Information Science) (both by course work), and Doctor of Philosophy.

Admission Requirements

Admission to the courses offered by the Faculty will be in accordance with the general requirements for admission to the University as set out in the University Calendar. There are no formal subject requirements for students with the NSW Higher School Certificate, although a level of 2 Unit Mathematics will be assumed, and 3 Unit Mathematics is recommended. It is recommended that intending students have a combined minimum of 5 units of Mathematics and Science as well as satisfactory results in 2 Unit Contemporary English or its equivalent for courses offered by the School of Mathematical Sciences. The School of Computing Sciences requires a high level of communication skills.

Students may enter the courses with advanced standing. Admission with advanced standing is determined in individual cases on the basis of merit. However, a minimum of two-thirds of the prescribed course must be completed in order to qualify for an award unless prior approval is granted by Academic Board.

Requirements to Graduate

In order to become eligible for any award, students are required to complete satisfactorily the course programme for the course in which they are enrolled by:

(a) obtaining at least pass level grades for all subjects, or

(b) being granted an exemption from subjects on the basis of equivalent study, or

(c) completing approved alternative subjects.

STAFF

Associate Professor and Dean of Mathematical and Computing Sciences
J M Hughes, BSc (Syd), MIEEE, FACS, MBCS

Secretary to the Dean
A Brooks

Faculty Administrator
F Ma, BA (Hons), DipEd (HKU)

Graduate Assistant
B Irvine, BA (Hons) (Macq)

School of Mathematical Sciences

Associate Professor and Head of School
L C Botten, BSc (Hons), PhD (Tas), MAIP, MACS, MOSA

Professor of Applied Mathematics and Deputy Head of School
A G Shannon, AM, BSc, DipEd (Syd), MA, PhD, MLitt (UNE), FCP, FIMA, FACE

Professor of Applied Mathematics and Computing
B S Thornton, PhD (NSW), DSc (Syd), FInstP, FBCS, FACS, CPhys,, CEng,, FRAeS, FIREE

Director of Undergraduate Studies
G J McLelland, BSc, PhD (Syd)

Administrative Officer
J C Smith

School Clerk
M L Murray

Part-time School Secretary
S Arthur

Senior Systems Programmer
M J Caden, BAppSc (UTS)

Computer Systems Support Officer
E B Lindsay

Department of Computational Mathematics

Professor of Applied Mathematics and Computing and Head of Department
B S Thornton, PhD (NSW), DSc (Syd), FInstP, FBCS, FACS, CPhys., CEng., FRAeS, FIREE

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Senior Lecturers
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T M Park, BSc (Manch), MSc (NSW), MIEEE, MBCS, FACS

Lecturers
T N Langtry, BA(Hons) (NSW), BAppSc, MAppSc (NSWIT), MACS
B R E Lederer, BSc (Hons), MEngSc (NSW), PhD (Syd), MACS
D R Porteus, BSc, DipEd (Tas), MACE
R M Sorli, BSc (Syd), MAppSc (NSWIT), MACS

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University Reader
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Senior Lecturers
J G Sekhon, BSc (WA), MSc (Lough), DipEd, PhD (UNE), FCollP, FIMA, MACE
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Lecturers
M Coupland, BSc, DipEd (Syd)
B W Stephenson, BAppSc (NSWIT), DipEd (STC), MA (NSW)
Y K Yap, BSc (Malaya), MSc (IIT), PhD (W'gong), AFIMA

Senior tutor
E Pejovic, BSc (Hons), DipEd

Department of Operations Research

Senior Lecturer and Head of Department
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Lecturers
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Department of Statistics

Senior Lecturer and Head of Department
S H Huxham, BSc, PhD (NSW), FSS

Senior Lecturer
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Lecturers
E Lidums, BSc (Hons), MSc (Syd)
L Wood, BSc (Hons) (NSW), DipEd (Tech) (SCAE), MA (Macq)
P A Wright, BA (Macq), MStats (UNSW), MEngSc (UNSW)

School of Computing Sciences - Academic Staff

Head of School
Professor I T Hawryszkiewycz, BE (Hons), ME (Adelaide), PhD (MIT), MACS

Deputy Head of School and Head, Department of Computer Science
Associate Professor T Hintz, BSc (EE) (UTexas), MSc (EE), DSc (EE) (New MexSU)

Director, Key Centre for Advanced Computing Sciences
Director, Centre for Graduate and External Studies
Professor J Debenham, MA, MSc (Dub), PhD (Syd)

Associate Professor and Director, External Development
M Fry, MA (Cantab), MSc (Imperial College), DIC

University Reader
J Potter, BSc (Adel), ME, PhD (N'cle), MIEEE

Honorary Associates
J Goddard, DipTech (Public Admin) (NSWIT), MSCS, FACS
W Holmes, BEE (Melb)

Department of Computer Science

Head of Department
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Senior Lecturers
J Cady, BE, MEngSc (NSW), MACS
J Edwards, MSc (Syd), MASOR, MACS
B Howarth, BSc (NSW), MEng (N'cle), PhD (Calif), SMIEEE, MACS
T Osborn, BMath, MMath, PhD (N'cle), INNS, ACM
R Rist, BSc (Hons) (NSW), BSc (CommSc) (NSW), GradDipComputer Studies (CCAE), PhD (Yale)
K Suffern, BSc (Hons), MSc (Monash), MSc (Com), PhD (Syd), MACS

Lecturers
J Colville, BSc, MSc (Melb), MBCS, MACS, CEng
C W Johnson, MAppSc (NSWIT), MComp (Macq), MRACI, CChem, MACS
S Prabhakar, BE, PhD (IISc, Bangalore)
U Szewcow, BSc, DipNAAC (Syd), MEngSc (NSW), MIEEE, MACS
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V Tu, BSc, BE (Mont), ME (Hons), MCSEE, MACS

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Department of Information Systems

Head of Department of Information Syst4ms
Vacant

Senior Lecturers
J Feuerlicht, BSc (Lond), DIC, PhD (Imperial College), MACS
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D Wilson, BSc (Hons), MBCS, MACS, MACM

Lecturers
P Bebbington, BSc (Tech), MEngSc, MCom (NSW), MACS
J Clark, BEcon (JCU), MEcon (New Mex), IASTED, ACM, BIM
J El-Den, BSc CompEng (METU, Ankara), MSc CompEng (METU, Ankara)
J Hammond, BA, DipTchg (NZ), MScSoc (NSW), FACS, MBCS, MACE
D Jinks, BSc (ANU), MACS
C S Johnson, BAppSc (HonsCompSc) (NSWIT), MPhil (Brunel)
E Lawrence, BA (Qld), GradDipComComp (QUT)
R Raban, MEng (Warsaw)
C Richardson, BCommHons (InfoSys) (Wits)
L Smith, BA (Syd), MA (Macq)
J Underwood, BSc (NSW), GradDipRecPlan, GradDipAdmin (CCAE)
B Wong, BSc (Syd), MCom (NSW), MACS, AIMM, JP

Tutors
P Corliss, BAppSc (CompSc), AACS
A Dokli, BSc (UST, Ghana)
J Smith, BSc (HonsComp/Maths) (Bristol, UK)

Administrative and Technical Staff

School Administrator
S Jenner, BA (Syd)

Co-operative Education Officer
D Saunders

Office Manager
M Thill

Secretaries
L Chamas
I Chu

Computing Systems Manager
D Cheesman, BSc (Melb), BSc (Wollongong), PhD (Wollongong), DipEd (Wollongong), MRACI, MACS

Engineer
G Redwood, BE (Hons)

Senior Technical Officer
B Power, E&C Cert (TAFE)

Technical Officers
M Trivedi, BE (Electronics) (Baroda, India), IE Australia
C Wanichwetin, CST (TAFE)

Programmers
S Gowing
S Cosic, BAppSc (CompSc) (NSWIT)
W Wong, BChem (Minnesota), MCompSc (Minnesota)

Industrial Training Student
C Panisset

Key Centre for Advanced Computing Sciences
Projects Co-ordinator
H Roberts

Industrial Training Student
I Sinclair

SCHOOL
OF
MATHEMATICAL SCIENCES

SCHOOL OF MATHEMATICAL SCIENCES

The School of Mathematical Sciences offers two undergraduate courses leading to Bachelor's degrees, three postgraduate courses leading to qualifications at the Graduate Certificate, Graduate Diploma and Master's levels and two research degree programmes leading to Master's and Doctoral level qualifications. They are:

* the Bachelor of Applied Science (Mathematics), which is offered as a three year pass degree and a four year honours degree;
* the Bachelor of Mathematics and Finance, offered in conjunction with the School of Finance and Economics as a three year pass degree or a four year honours degree;
* the Graduate Certificate in Mathematical Sciences,
* the Graduate Diploma in Operations Research;
* the Master of Applied Science (Operations Research) by Coursework;
* the Master of Applied Science, which is awarded on the basis of approved research work and presentation of a thesis;
* the Doctor of Philosophy, which is awarded on the basis of research and presentation of a thesis.

POSTGRADUATE RESEARCH DEGREES

The Master of Applied Science (by thesis) and Doctor of Philosophy degrees provide the opportunity for graduates to extend and deepen their knowledge in specialised areas of mathematics by undertaking research under the supervision of a member of the academic staff.

The main interests within the School of Mathematical Sciences are in Applied and Computational Mathematics, Operations Research and Statistics. Although a wide range of topics can be covered by the staff, particular interests and specialisations exist in the following areas:

* Biomedical applications (erythrocyte sedimentation, application of control theory to cancer and diabetes therapy);
* Computing (computer aided instruction, biomedical applications, performance modelling, language theory and implementation, mathematical foundations, neural networks, functional programming);
* Differential geometry (differential manifolds, topology and Ricci curvature);
* Geophysical applications (seismic ray and seismic wave theory, inverse problems);
* Mathematics education (education of industrial mathematicians, impact of technology on mathematics education, language problems in mathematics education);
* Number theory (recurring sequences, odd perfect numbers, computational number theory);
* Numerical analysis (numerical quadrature);
* Operations research (manpower planning, delivery of health services, economic modelling);
* Statistics (medical applications, measurement and test design, permissible statistics, Markov sequences);
* Theoretical physics (optics, electromagnetic diffraction theory, quantum mechanics).

MASTER OF APPLIED SCIENCE (BY THESIS)

Applicants should hold a first degree with a major in mathematics (or a related field) or should have previously undertaken postgraduate studies in mathematics (or a related field).

Master's degree programmes are normally of two years duration on a full-time basis or three years duration on a part-time basis. In some cases a student with appropriate advanced study and/or relevant experience may be permitted to complete the programme in a reduced period. Applicants who believe that they may be eligible to complete the degree in a shorter time are advised to discuss the matter with the Director of Postgraduate Studies.

Prospective applicants should have considered a possible area of research within the interests of the School before making enquiries about the Master's programme.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy (PhD) requires students to undertake a prescribed programme of research, in one of the areas listed above, under the supervision of a member of academic staff. The research required for the PhD is more extensive in nature than that required for the Master's degree and a higher level of originality in the work is required. The degree programme is available on either a full-time or a part-time basis. The minimum period of enrolment is of three years duration for either pattern and the maximum period of enrolment is five years for full-time students and six years for part-time students.

Applicants should hold a degree with either First Class or Second Class (Division One) Honours in Mathematics (or a related field) or a Master's degree in an appropriate area. Prospective applicants with other qualifications are advised to consult with the Director of Postgraduate Studies. Prospective applicants should initially approach a member of the academic staff of the School of Mathematical Sciences to discuss the proposed research, or send a detailed summary (approximately 500-1000 words) to the Director of Postgraduate Studies.

POSTGRADUATE COURSEWORK PROGRAMMES

GRADUATE CERTIFICATE IN MATHEMATICAL SCIENCES

The Graduate Certificate in Mathematical Sciences has been developed in response to a demand for short courses in statistics, operations research, computational and applied mathematics. It will commence operation in 1992 and will provide those employed in industry with access to additional training or retraining in quantitative disciplines.

The course has a flexible structure and the wide range of subjects offered in the other postgraduate and undergraduate courses of the School of Mathematical Sciences would be available to intending students. Students may undertake any sequence of subjects with a total weight of nine semester hours offered by the School, provided that individual subject prerequisites are satisfied. Approved elective subjects from other Schools of the University may also be taken with the consent of the Head of School (or his or her nominee).

Applicants will normally be expected to hold a Bachelor's degree, or higher qualification, from a recognised tertiary institution. Applicants who do not possess such qualifications will be considered on an individual basis. Prior to their admission, all applicants will be required to discuss their preferred programme of study with an academic adviser in order to ensure that they have the requisite background knowledge for their chosen subject sequences.

A number of coherent subject sequences in the areas of Computational Mathematics, Applied Mathematics, Operations Research and Statistics are envisaged and samples of these are listed below.

Computational Mathematics

Sequence A
Theme: Numerical Analysis

Presumed Knowledge:
Equivalent to tertiary level courses in scientific computing, calculus, linear algebra and differential equations.

Programme of Study:
34790 Numerical Computing
34891 Numerical Methods A
34992 Numerical Methods B

Sequence B
Theme: Mathematical Computer Science (1)

Presumed Knowledge:
Equivalent to an introductory tertiary level course in discrete mathematics.

Programme of Study:
34770 Computing 1A
34771 Computing 1B
34781 Mathematical Foundations of Computing 1

Sequence C
Theme: Mathematical Computer Science (2)

Presumed Knowledge:
This sequence provides for an extension of the material prescribed in *Sequence B*. It is, therefore, presumed that students will have a working knowledge of Pascal or Modula-2 and abstract data structures, as well as some experience with abstract algebraic structures (such as groups and monoids) and a functional programming language such as Miranda..

Programme of Study:
34872 Computing 2
34873 Computing 3
34982 Mathematical Foundations of Computing 2

Sequence D
Theme: Mathematical Cryptology

Presumed Knowledge:
Equivalent to introductory level courses in calculus, linear algebra and scientific computing.

Programme of Study:
34790 Numerical Computing
34803 Algebra 3
34987 Cryptology

Sequence E
Theme: Neural Networks

Presumed Knowledge: Equivalent to tertiary level courses in programming (eg Pascal) and matrix algebra.

Programme of Study:
34790 Numerical Computing
34802 Algebra 2
34976 Neural Networks

Mathematics

Sequence A
Theme: Differential Equations

Presumed Knowledge:
Equivalent to tertiary level courses in the calculus of one and several variables, real and complex analysis and linear algebra.

Programme of Study:
34815 Ordinary Differential Equations
34821 Partial Differential Equations 1
34922 Partial Differential Equations 2

Sequence B
Theme: Modern and Linear Algebra

Presumed Knowledge:
Equivalent to an introductory tertiary level course in matrix algebra.

Programme of Study:
34700 Discrete Mathematics
34802 Algebra 2
34803 Algebra 3

Sequence C
Theme: Analysis with applications to Probability Theory

Presumed Knowledge:
Equivalent to tertiary level courses in analysis, (ordinary) differential equations, and linear algebra.

Programme of Study:
34812 Analysis 2
34913 Modern Analysis
34914 Measure Theory

Sequence D
Theme: Mathematical Control Theory

Presumed Knowledge:
Equivalent to introductory tertiary level courses in calculus and linear algebra.

Programme of Study:
34815 Ordinary Differential Equations
34817 Vector Calculus
34927 Deterministic Optimal Control

Operations Research

Sequence A
Theme: Financial Modelling

Presumed Knowledge:
Equivalent to introductory tertiary courses in statistics and calculus.

Programme of Study:
34740 Introduction to Operations Research Models
34936 Decision Theory
34938 Financial Modelling Techniques

Sequence B
Theme: Techniques of Mathematical Programming

Presumed Knowledge:
Equivalent to introductory tertiary courses in statistics, calculus and matrix algebra.

Programme of Study:
34740 Introduction to Operations Research Models
34931 Linear Programming
34932 Optimisation Techniques

Sequence C
Theme: Simulation and Decision Support

Presumed Knowledge: Equivalent to introductory tertiary level courses in statistics and elementary scientific computing.

Programme of Study:
34740 Introduction to Operations Research Models
34930 Simulation Techniques
34936 Decision Theory

Sequence D
Theme: Optimisation and Applications

Presumed Knowledge:
Equivalent to introductory tertiary level courses in statistics, matrix algebra and operations research models, together with knowledge of computerised simulation (as in 34930 Simulation Techniques)

Programme of Study:
34931 Linear Programming
34934 Network Optimisation
34935 Inventory Control

Statistics

Sequence A
Theme: Analysis of Experimental Data

Presumed Knowledge:
Equivalent to introductory tertiary level courses in statistics and calculus.

Programme of Study:
34852 Statistics 2
34955 Regression Analysis
34956 Design of Experiments

Sequence B
Theme: Industrial Applications of Statistics

Presumed Knowledge:
Equivalent to introductory tertiary level courses in statistics and calculus.

Programme of Study:
34852 Statistics 2
34955 Regression Analysis
34957 Industrial Statistics

Sequence C
Theme: Stochastic Modelling

Presumed Knowledge:
Equivalent to introductory tertiary level courses in statistics and calculus.

Programme of Study:
34852 Statistics 2
34960 Theory of Probability
34961 Stochastic Processes 1

Sequence D
Theme: Mathematical Statistics

Presumed Knowledge:
Equivalent to introductory tertiary level courses in statistics and calculus.
Programme of Study:
34852 Statistics 2
34953 Statistics 3
34960 Theory of Probability

GRADUATE DIPLOMA IN OPERATIONS RESEARCH

This course is designed to train practising professional people in the application of operations research principles and methods. The entry requirement to the course is graduate standing (or equivalent) in any discipline, and a sound working knowledge of introductory calculus, statistics and computing. Because of the possible diversity of backgrounds, each applicant will be assessed by interview prior to enrolment. As a result of this interview and assessment the applicant will be directed to either:

(i) undertake any preliminary subjects considered necessary,
(ii) enter the normal course, or
(iii) enter the course with advanced standing.

The course is structured for study on a part-time basis over a period of four semesters, each requiring approximately ten hours of attendance per week. In the normal course, students undertake a basic core of consolidation subjects followed in the second semester by a study of the mathematical methods required for operations research and model building.

In the third and fourth semesters specific mathematical techniques used commonly in operations research are treated and students undertake a project designed to integrate their knowledge and provide wider experience than is possible on an individual subject basis.

The course programme is flexible in that students may enter the course with advanced standing. Applicants who enter the course at a later stage or who have some formal qualification in one or more of the specified operations research topics may be counselled to select alternative topics from additional electives. Exemptions are permitted up to a maximum of 13 semester hours. Thus a minimum attendance of 27 semester hours is required

The academic award for satisfactory completion of the course is a graduate diploma with the nomenclature: Graduate Diploma in Operations Research, abbreviated as GradDipOR(UTS). The award will be made in one of three grades - Distinction, Credit or Pass - based on the overall level of performance throughout the course. The award with Distinction requires a demonstration of outstanding comprehension and ability in the theory and application of operations research.

The standard programme follows:

Semester 1		*Hours/Week*
33702	Statistical Methods	3
33730	Simulation Techniques	3
33760	Financial Modelling Techniques	3
33780	Introduction to OR Models	3
Semester 2		
33732	Linear Programming	3
33734	Network Optimisation	3
33736	Decision Theory	3
Semester 3		
33733	Dynamic Optimisation	3
33735	Inventory Control	3
33747	Stochastic Processes	3
Semester 4		
33731	Optimisation Techniques	3
	Elective (*)	3
33799	Project	4

(*) Subject to demand, additional elective subjects may be offered each year. Students will be required to indicate in Semester 3 their preference from the following subjects:

		Hours/Week
33745	Design of Experiments	3
33748	Industrial Statistics	3
33844	Queuing Systems: Theory and Application	3
34955	Regression Analysis	3

MASTER OF APPLIED SCIENCE (OPERATIONS RESEARCH)

The objective of this course is to prepare students for high level professional work in the application of operations research techniques to the problems of modern society. Graduates from this course will have gained a sound qualification in a variety of basic disciplines and some of the techniques of operations research and its methodology. The special emphasis of the course is in the application of operations research to the optimal delivery of health services and to manpower planning.

The entry requirement is graduate standing, or equivalent, in an appropriate discipline and the consent of the Director of Postgraduate Studies or his/her nominee. Special entrance is permitted to applicants who have satisfactorily completed the Graduate Diploma in Operations Research (UTS).

The course comprises of a total of 54 semester hours on a part-time basis extending over six semesters. Each semester requires nine hours of attendance per week. The academic award for satisfactory completion of the course is a Master of Applied Science; abbreviated MAppSc (UTS).

Students entering the Master's course should note that some of the subjects listed in the programme below have prerequisites in both statistics and operations research at an undergraduate level. Accordingly, these should be regarded as entry requirements for the course and students should closely examine subject prerequisites and also discuss their eligibility for entry with the Head of the Department of Operations Research (or his/her nominee) prior to their enrolment.

The course programme follows:

Semester 1		*Hours/Week*
33830	Simulation Techniques	3
33833	Dynamic Optimisation	3
33847	Stochastic Processes	3
Semester 2		
33832	Linear Programming	3
33834	Network Optimisation	3
33836	Decision Theory	3
Semester 3		
33835	Inventory Control	3
33855	Manpower Planning	3
33880	OR Models and Methodology	3

Semester 4		*Hours/Week*
33831	Optimisation Techniques	3
33860	Corporate and Financial Decisions and Investment Analysis	3
34823	Seminar	3
Semester 5		
33806	Report	6
33850	Operations Research in Health Services 1	3
Semester 6		
34806	Report	6
33857	Large-Scale Mathematical Programming	3

In lieu of subjects for which students have been granted exemptions, the following elective subjects may be selected, depending on their availability:

Electives		*Hours/Week*
33844	Queuing Systems: Theory and Applications	3
33845	Design of Experiments	3
33848	Industrial Statistics	3
33851	OR in Health Services 2	3
33853	Energy and Environmental Modelling	3
33858	Stochastic Models in OR	3
33859	Engineering Applications in OR	3
33861	OR in Public Sector Services	3

UNDERGRADUATE DEGREE PROGRAMMES

BACHELOR OF APPLIED SCIENCE (MATHEMATICS)

This degree aims to prepare students for employment in industry, commerce and government and to provide the foundation for higher studies in mathematics. It provides great flexibility by allowing students to follow a course of study which best suits their interests and aspirations. It aims to help the student acquire sufficient experience and understanding in a broad range of mathematical disciplines to enable him or her to apply mathematical and computing techniques to industrial and commercial problems.

The course operates as either a three year pass degree or a four year honours degree. The basic structure of the pass degree is:

* *the core* - providing a thorough grounding in the elements of mathematics, statistics, operations research, computing, and their applications. This component, occupying half of the pass degree, is taught during the first two years of the full-time programme.

* *a mathematics major* - which occupies half of the third year of the full-time course (or years 5 and 6 of the part-time course) and may be taken in one of the areas of applied mathematics, statistics or operations research. This framework provides for specialised study of a particular area of application. A major in Operations Research involves topics such as linear programming, simulation and optimisation. The Statistics major aims to expose students to realistic statistical problems, preparing them to cope with data and its associated uncertainty and variability. Applied Mathematics, particularly since the advent of computers, has developed a large collection of tools for the solution of practical problems. In many cases, these can be unified by a few basic geometric, analytic and algebraic ideas. The Applied Mathematics majors aim to develop these ideas and apply them in a variety of complex and practical situations.

* *electives* - which occupy one third of the course and are subjects from any School of the University chosen by students to strengthen their understanding in an area of their choice. Common choices are the major in Computing offered by the School of Mathematical Sciences, an additional major in Mathematics, a sub-major in Financial Management and various sub-majors in the sciences.

  The Computing major provides students with both practical and theoretical training in computer science (and its mathematical foundations), information systems and commercial computing, and a wide variety of applications. Because this major occupies the entire elective sequence, students who wish to pursue it are advised to commence it in their first year of studies. However, because it is an elective major, students are not obliged to follow it to completion. The major is accredited at Level 1 by the Australian Computer Society and, accordingly, those who do complete it are eligible to apply for Associate Membership of the Australian Computer Society.

The course may be attempted on either a full-time or a part-time basis. Part-time students will be accommodated by the provision of special evening classes and it is *expected that all part-time students will be able to attend classes for one afternoon and two evenings per week.*

For the pass degree, a total of 108 semester hours of attendance at lectures and tutorials is required.

Note: The BAppSc (Math) degree was substantially revised in 1990 and the programme listed below reflects the pattern of attendance in 1992 and beyond. There have been a number of minor changes in the scheduling of subjects for 1992 and hence students who enrolled in 1991 (or earlier) are advised to consult the School of Mathematical Sciences' BAppSc (Maths) Course Handbook (1992 Edition) for a more detailed discussion. Subjects of the former degree programme which have direct equivalences in the new programme are not listed in the Synopsis. Subject descriptions which do not appear may be found in previous editions of the Faculty and School Handbooks and include:

33320 Partial Differential Equations
34100 Algebra 1
34101 Calculus 1
34102 Calculus 2
34107 Computing 1
34117 Commercial Computing 1
34127 Information Systems 1
34137 Computer Systems 1
34141 Statistics 1
34203 Mechanics
34212 Vector Calculus
34213 Ordinary Differential Equations
34214 Algebra 2
34217 Commercial Computing 2
34227 Information Systems 2
34251 Macroeconomic Models
34307 Computing 2
34320 Partial Differential Equations
34342 Statistics 2
34343 Theory of Probability
34407 Computing 3
34417 Numerical Methods 1
34418 Numerical Methods 2
34419 Complex Variables
34452 Financial Modelling Techniques
34480 Introduction to OR Models
34524 Wave Theory
34527 Real Variables
34528 Modern Analysis
34531 Optimisation Techniques
34532 Linear Programming
34544 Regression Analysis
34545 Design of Experiments
34547 Stochastic Processes
34548 Industrial Statistics
34553 Multiple Regression Models
34554 Time Series Analysis
34570 Algebra 3
34571 Algebra 4
34572 Fourier Analysis
34621 Mathematical Methods 1
34622 Mathematical Methods 2
34626 Control Theory
34630 Simulation Techniques
34633 Dynamic Optimisation
34634 Network Optimisation
34635 Inventory Control
34636 Decision Theory
34642 Statistics 3
34655 Simultaneous Equation Models
34667 Computer Graphics
34673 Advanced Numerical Methods
34675 Convexity and Optimisation
34677 Integral Equations

FULL-TIME PROGRAMME (1992 onwards)

YEAR 1

Autumn Semester		*Hours/Week*
34700	Discrete Mathematics	3
34701	Algebra 1	3
34710	Calculus	6
34770	Computing 1A	3
	Electives (+)	3

Spring Semester		
34711	Analysis 1	3
34751	Statistics 1	3
34790	Numerical Computing	3
34802	Algebra 2	3
	Electives (+)	6

YEAR 2

Autumn Semester		
34740	Introduction to OR Models	3
34803	Algebra 3	3
34815	Ordinary Differential Equations	3
34817	Vector Calculus	3
	Electives (+)	6

Spring Semester		*Hours/Week*
34812	Analysis 2	3
34818	Complex Variables	3
34821	Partial Differential Equations 1	3
34852	Statistics 2	3
34891	Numerical Methods A	3
	Electives (+)	3

YEAR 3

Autumn Semester	
Mathematics Major (++)	9
Electives (+)	9

Spring Semester	
Mathematics Major (++)	9
Electives (+)	9

(+) These electives may be chosen from subjects listed within the University Calendar and acceptable to the School of Mathematical Sciences. The most common choice of elective pattern is the Computing major. Electives are discussed in a later section.

(++) The mathematics majors in the third year of the full-time course consist of prescribed sequences of six 3 semester hour subjects taken from one of the four strands in Statistics, Operations Research and Physical and Modern Applied Mathematics.

PART-TIME PROGRAMME

YEAR 1

Autumn Semester		*Hours/Week*
34700	Discrete Mathematics	3
34710	Calculus	6

Spring Semester		
34701	Algebra 1	3
34770	Computing 1A	3
	Electives (+)	3

YEAR 2

Autumn Semester		
34711	Analysis 1	3
34751	Statistics 1	3
	Electives (+)	3

Spring Semester		*Hours/Week*
34740	Introduction to OR Models	3
34817	Vector Calculus	3
	Electives (+)	3

YEAR 3

Autumn Semester		
34790	Numerical Computing	3
34802	Algebra 2	3
	Electives (+)	3

Spring Semester		
34803	Algebra 3	3
34815	Ordinary Differential Equations	3
	Electives (+)	3

YEAR 4

Autumn Semester		
34812	Analysis 2	3
34821	Partial Differential Equations 1	3
	Elective (+)	3

Spring Semester		
34818	Complex Variables	3
34852	Statistics 2	3
34891	Numerical Methods A	3

YEAR 5

Autumn Semester
Mathematics Major (++)
Electives (+)

Spring Semester
Mathematics Major (++)
Electives (+)

YEAR 6

Autumn Semester
Mathematics Major (++)
Electives (+)

Spring Semester
Mathematics Major (++)
Electives (+)

(+), (++) See the corresponding notes above.

Major Areas of Study

Students must complete at least one of the mathematics majors which are offered in the areas of Statistics, Operations Research, Modern Applied Mathematics and Physical Applied Mathematics. Students may also choose to complete the elective major in Computing.

Statistics

FULL-TIME - YEAR 3

Autumn Semester		*Hours/Week*
34953	Statistics 3	3
34955	Regression Analysis	3
34960	Theory of Probability	3
Spring Semester		
34956	Design of Experiments	3
34957	Industrial Statistics	3
34961	Stochastic Processes 1	3

PART-TIME - YEARS 5 AND 6

Autumn Semester		
34953	Statistics 3	3
34955	Regression Analysis	3
34961	Stochastic Processes 1	3
Spring Semester		
34956	Design of Experiments	3
34957	Industrial Statistics	3
34960	Theory of Probability	3

Operations Research

FULL-TIME - YEAR 3

Autumn Semester		*Hours/Week*
34930	Simulation Techniques	3
34931	Linear Programming	3
34938	Financial Modelling Techniques	3
Spring Semester		
34932	Optimisation Techniques	3
34936	Decision Theory	3
34961	Stochastic Processes 1	3

PART-TIME - YEARS 5 AND 6

Autumn Semester		
34930	Simulation Techniques	3
34938	Financial Modelling Techniques	3
34961	Stochastic Processes 1	3
Spring Semester		*Hours/Week*
34931	Linear Programming	3
34932	Optimisation Techniques	3
34936	Decision Theory	3

Physical Applied Mathematics (**)

FULL-TIME - YEAR 3
PART-TIME - YEARS 5 AND 6

Autumn Semester		*Hours/Week*
34922	Partial Differential Equations 2	3
34924	Mechanics	3
34927	Deterministic Optimal Control	3
Spring Semester		
34916	Mathematical Methods	3
34925	Wave Theory	3
34992	Numerical Methods B	3

Modern Applied Mathematics (**)

FULL-TIME - YEAR 3
PART-TIME - YEARS 5 AND 6

Autumn Semester		*Hours/Week*
34904	Algebra 4	3
34913	Modern Analysis	3
34920	Integral Equations	3
Spring Semester		
34914	Measure Theory	3
34995	Advanced Numerical Analysis	3
34996	Convexity and Optimisation	3

(**) In order to complete the requirements for either of the two Applied Mathematics majors, students must complete at least four subjects from the major of their choice and select the remainder from the alternative major.

Computing

FULL-TIME

YEAR 1

Autumn Semester		*Hours/Week*
31134	Information Systems (Math Sc)	3
Spring Semester		
34771	Computing 1B	3
34781	Mathematical Foundations of Computing 1	3

YEAR 2

Autumn Semester		*Hours/Week*
31135	Commercial Programming Development (Math Sc)	3
34872	Computing 2	3

Spring Semester

34873	Computing 3	3

YEAR 3

Autumn Semester

34982	Mathematical Foundations of Computing 2	3
	Elective 1A (#)	3
	Elective 1B (##)	3

Spring Semester

34984	Language Theory	3
	Elective 2A (#)	3
	Elective 2B (##)	3

PART-TIME

YEAR 1

Autumn Semester *Hours/Week*

No Computing Major subjects in this semester.

Spring Semester

34781	Mathematical Foundations of Computing 1	3

YEAR 2

Autumn Semester

31***	Information Systems (Math Sc)	3

Spring Semester

34771	Computing 1B	3

YEAR 3

Autumn Semester

34872	Computing 2	3

Spring Semester

34873	Computing 3	3

YEAR 4

Autumn Semester

31135	Commercial Programming Development (Math Sc)	3

Spring Semester

No Computing Major subjects in this semester.

YEARS 5 AND 6

Autumn Semester		*Hours/Week*
34982	Mathematical Foundations of Computing 2	3
	Elective 1A (#)	3
	Elective 1B (##)	3

Spring Semester

34984	Language Theory	3
	Elective 2A (#)	3
	Elective 2B (##)	3

(#) In each semester of the final year(s) of study, students will undertake one subject from a choice of two, which will be nominated by the School and drawn from Group 1 for the Autumn Semester and from Group 2 for the Spring Semester. These groups are listed below.

(##) The subjects labelled as Elective 1B and Elective 2B may be drawn from either of the Group 1 and Group 2 lists or from subjects offered by the School of Computing Sciences. Students wishing to take the latter option (ie electives from the School of Computing Sciences) must consult with the Head of the Department of Computational Mathematics (or his/her nominee) to obtain the necessary approval. Students wishing to take electives in the area of commercial information systems are advised to enrol in subjects in the areas of systems analysis and database offered by the School of Computing Sciences.

Group 1

34975 Computer Graphics
34976 Neural Networks
34987 Cryptology

Group 2

34977 Formal Specification
34983 Mathematical Foundations of Computing 3
34985 Digital Image Processing

Elective Subjects offered within the BAppSc (Mathematics) Degree

There are 36 semester hours in the BAppSc (Mathematics) programme allocated to elective subjects outside of the Mathematics majors. Students may choose to complete these hours of study in a number of ways:

* by completing one additional mathematics major, leaving 18 unspecified elective hours

to be completed in the case of most double majors, and 21 unspecified elective hours to be completed in the case of a double major in Statistics and Operations Research;

* by completing the Computing major, leaving no unspecified elective hours; or

* by completing a total of 36 hours of subjects offered by this School or by other Schools of the University. Common choices of subjects include those forming recognised sub-majors in other disciplines such as Financial Management, Physics and Electronics. Students wishing to pursue these should consult the BAppSc (Maths) Course Handbook for details. However, a student may elect to take any subject, provided that:

  (i) the student has satisfied the prequisites of the chosen subjects;
  (ii) the student's enrolment in a subject is approved by the School which offers that subject, and
  (iii) the student's choice of subjects is approved by the School of Mathematical Sciences.

In addition to subjects listed within the descriptions of the majors, the following subjects offered by the School of Mathematical Sciences may be taken as electives.

34573 History of Mathematics
34668 Computational Number Theory
34681 Special Applications in Operations Research
34682 Special Applications in Computing
34683 Special Applications in Statistics
34684 Special Applications in Physical Applied Mathematics
34685 Special Applications in Modern Applied Mathematics
34691-7 Project (1 - 7 semester hours)
34894 Mathematical and Business Modelling

BACHELOR OF APPLIED SCIENCE (MATHEMATICS) (HONOURS)

The honours year provides the opportunity for students to develop considerably their level of competence in the area of mathematics chosen as their major in the BAppSc (Maths) degree. The honours degree is offered only on a full-time basis and consists of advanced coursework (comprising 75% of the programme) and a research project (comprising the remaining 25%). This project component provides the opportunity for students to utilise the expertise developed by their coursework in an area of application. Students who complete the honours year will, accordingly, be well prepared to enter the workforce at a high level or to undertake graduate studies.

Admission to the honours year will be assessed on a case-by-case basis according to the criteria listed in either category below:

* Students who are eligible to graduate from the BAppSc (Maths) degree at UTS with a credit average (i.e. weighted average mark of at least 65) or higher in the second year of the full-time core and in their chosen third year major, together with the satisfactory completion of the third year essay, will be eligible for entry to the honours year, subject only to the approval of the Head of the School of Mathematical Sciences;

* Students who have obtained qualifications equivalent to the BAppSc (Maths) degree will be considered for entry, upon application, by the Head of the School of Mathematical Sciences, on the basis of assessed potential to complete the honours course.

The honours course will require attendance for 18 hours per week over two semesters. Honours will be offered in Mathematics, Statistics and Operations Research and will consist of coursework subjects and a project whose weight is equivalent to three coursework subjects.

Students who intend applying to enter the honours year will need to make this decision prior to entering their third year of full-time studies. This is to enable them to take appropriate honours units in the third year which are prerequisites to some of the fourth year subjects. Consequently, such students will have to defer some of their third year electives to the fourth year of study.

Students proposing to attempt the honours degree should consult with the Honours Coordinator (or his/her nominee) prior to the commencement of their third year

of full-time studies. Students who are deemed eligible for admission will then be assigned an honours supervisor who will monitor their progress and supervise their fourth year research project, which will be assessed by a report and seminar. In addition, students will, in their third year, be required to complete an essay in an appropriate area of mathematics. This essay will also be prepared under the guidance of the honours supervisor. Its satisfactory completion will be a prerequisite for the fourth year of study.

The assessment of the student's final result will be based on the two honours level subjects taken in the third year, the seven honours level subjects taken in the fourth year, the third year essay and the fourth year project. Grades of First Class, Second Class (Division 1), and Second Class (Division 2) will be awarded appropriately.

Course Programme

Listed below are the course programmes for honours in Mathematics, Statistics and Operations Research. In view of the need to take certain honours units in the third year and delay various third year electives until the fourth year, both third and fourth year attendance patterns are listed.

Mathematics Honours

YEAR 3

Autumn Semester		*Hours/Week*
34922	Partial Differential Equations 2	3
34927	Deterministic Optimal Control	3
34961	Stochastic Processes 1	3
	Third year elective	3
	Third year elective	3
34013	Modern Analysis (Hons)	3
Spring Semester		
34916	Mathematical Methods	3
34960	Theory of Probability	3
34992	Numerical Methods B	3
	Third year elective	3
	Third year elective	3
34014	Measure Theory (Hons)	3

YEAR 4

Autumn Semester		
	Third year elective	3
34023	Partial Differential Equations 3	3
34026	Fractal Geometry	3
34062	Stochastic Processes 2	3
34096	Convexity and Optimisation (Hons)	3
34098	Project	3
Spring Semester		
	Third year elective	3
34019	Functional Analysis	3
34028	Stochastic Optimal Control	3
34029	Nonlinear Dynamical Systems	3
34099	Project	6

Note: This programme is for students doing the Physical Applied Mathematics major of the BAppSc (Maths) degree. A similar programme, differing in only two subjects, would apply to the Modern Applied Mathematics major. Details of this programme may be obtained from either the Honours Coordinator or the Director of Undergraduate Studies in the School of Mathematical Sciences.

Operations Research Honours

YEAR 3

Autumn Semester		*Hours/Week*
34930	Simulation Techniques	3
34931	Linear Programming	3
34938	Financial Modelling Techniques	3
	Third year elective	3
	Third year elective	3
34013	Modern Analysis (Hons)	3
Spring Semester		
34932	Optimisation Techniques	3
34936	Decision Theory	3
34960	Theory of Probability	3
34961	Stochastic Processes 1	3
	Third year elective	3
34014	Measure Theory (Hons)	3

YEAR 4

Autumn Semester		
33880	OR Models and Methodology	3
	Third year elective	3
34033	Dynamic Optimisation	3
34062	Stochastic Processes 2	3
34096	Convexity and Optimisation (Hons)	3
34098	Project	3

Spring Semester		*HoursWeek*
	Third year elective	3
	Third year elective	3
33857	Large Scale Mathematical Programming	3
33860	Corporate and Financial Decisions and Investment Analysis	3
34099	Project	6

Statistics Honours

YEAR 3

Autumn Semester		*Hours/Week*
34953	Statistics 3	3
34955	Regression Analysis	3
34961	Stochastic Processes 1	3
	Third year elective	3
	Third year elective	3
34013	Modern Analysis (Hons)	3

Spring Semester		
34956	Design of Experiments	3
34957	Industrial Statistics	3
34960	Theory of Probability	3
	Third year elective	3
	Third year elective	3
34014	Measure Theory (Hons)	3

YEAR 4

Autumn Semester		
	Third year elective	3
34062	Stochastic Processes 2	3
34065	Time Series Analysis	3
34067	Multivariate Statistics	3
34096	Convexity and Optimisation (Hons)	3
34098	Project	3

Spring Semester		
	Third year elective	3
34066	Nonlinear Statistical Models	3
34068	Statistical Modelling 3	
34069	Linear Models and Experimental Design	3
34099	Project	6

BACHELOR OF MATHEMATICS AND FINANCE

The years since deregulation of the Australian financial system have witnessed many sweeping changes and a considerable increase in the financial and economic activity of many Australian corporations. During this same period there has been an increasing use by major financial institutions of the sophisticated quantitative techniques that have been developed since the early 1970s. As a consequence, there is a demonstrated demand for a new type of graduate trained in both mathematics and finance.

To meet this need, the Bachelor of Mathematics and Finance has been jointly developed by the School of Mathematical Sciences and the School of Finance and Economics and commenced operation in the 1991 academic year.

Students graduating from the BMathFin will have undertaken an integrated sequence of study in mathematics, statistics, finance, economics, accounting, business law and computing and will thus have sound training in both the traditional theory of finance and the mathematical aspects of modern portfolio management techniques.

As a result, graduates should find interesting and rewarding employment in major financial institutions such as merchant banks, insurance companies and government instrumentalities.

The Bachelor of Mathematics and Finance operates as both a three year pass degree and a four year honours degree (described later). The pass degree is operated only on a full-time basis and requires 18 hours per week attendance at lectures and tutorials for a period of six semesters (three years).

The course programme is listed below:

YEAR 1

Autumn Semester		*Hours/Week*
22105	Accounting A	3
25110	Microeconomics	3
34700	Discrete Mathematics	3
34701	Algebra 1	3
34710	Calculus	6

Spring Semester		
22205	Accounting B	3
25209	Macroeconomics	3
34711	Analysis 1	3
34751	Statistics 1 3	
34790	Numerical Computing	3
34802	Algebra 2	3

YEAR 2

Autumn Semester		*Hours/Week*
25210	Microeconomic Policy	3
25308	Financial Institutions and Markets	3
25314	Business Finance 1	3
34815	Ordinary Differential Equations	3
34817	Vector Calculus	3
34894	Mathematical and Business Modelling	3

Spring Semester		
25905	Asset Pricing and Capital Market Studies (Hons)	3
34812	Analysis 2	3
34821	Partial Differential Equations 1	3
34852	Statistics 2	3
34936	Decision Theory	3
79101	Law for Business	3

YEAR 3

Autumn Semester		
25515	International Finance	3
25906	Investment Analysis and Portfolio Management (Hons)	3
34913	Modern Analysis (+)	3
34955	Regression Analysis	3
34960	Theory of Probability	3
79267	Commercial Law	3

Spring Semester		
25502	Current Issues in Finance	3
25606	Financial Time Series Analysis	3
34914	Measure Theory (+)	3
34961	Stochastic Processes 1	3
34992	Numerical Methods B	3
79365	Company Law	3

(+) Note that students proceeding to the honours year will be required to substitute 34013 Modern Analysis (Hons) and 34014 Measure Theory (Hons) in place of the two pass level subjects.

Note: There have been a few minor changes to the course structure which take effect in 1992. Students who enrolled in the course in 1991 should consult the BMathFin Course Handbook (1992 Edition) for the programme that should be taken in 1992. They should also discuss their programme of study with the Director of Undergraduate Studies (or his or her nominee) prior to their enrolment in 1992.

BACHELOR OF MATHEMATICS AND FINANCE (HONOURS)

The provision exists for able students to undertake an additional year of advanced study leading to the award of an honours degree. Graduates from this honours degree would be particularly sought after and the additional skills gained would enable them to compete for the top jobs in the banking sector. Consequently, it is expected that most students will opt to undertake this additional year comprising nine coursework units in advanced mathematics, statistics and finance and a research project (equivalent to three coursework units).

Admission to the honours year will be assessed on a case-by-case basis according to the criteria listed in either category below:

* students who are eligible to graduate from the BMathFin (pass) degree at UTS with a credit average or higher in the second and third years of the course will be eligible for entry to the BMathFin (Hons), subject only to the approval of the Heads of the Schools of Mathematical Sciences and Finance and Economics;

* students who have obtained qualifications equivalent to the BMathFin (pass) degree will be considered for entry, upon application, by the Heads of the two participating Schools on the basis of their assessed potential to complete the honours course.

The honours year will require attendance for 18 hours per week over two semesters of full-time study. The year comprises nine coursework units of an advanced nature in mathematics, statistics and finance together with a substantial project. The project will involve a major investigation in some area of finance and will provide students with the opportunity to apply the skills developed in their coursework to a research oriented problem. The project will be assessed on the basis of a thesis and a seminar presented to the staff of both Schools.

The assessment of students' results will take into account the fourth year coursework subjects, the thesis and the seminar, and Honours at the grades of First Class, Second Class (Division 1), Second Class (Division 2) and Third Class will be awarded.

Listed below is the course programme for the BMathFin(Hons) degree.

YEAR 4

Autumn Semester	*Hours/Week*
25906 Thesis	6
25903 Advanced Microeconomics	3
34062 Stochastic Processes 2	3
34065 Time Series Analysis	3
34927 Deterministic Optimal Control	3

Spring Semester	
25906 Thesis	3
25901 Futures and Options	3
25902 Advanced Corporate Finance	3
34028 Stochastic Optimal Control	3
34029 Nonlinear Dynamical Systems	3
34066 Nonlinear Statistical Models	3

SYNOPSES

33100 DISCRETE MATHEMATICS
Three semester hours

Formal systems and proof methods. Propositional logic. Quantifiers and predicate logic. Method of induction. Sets and set operations. Indexing, mappings, relations and functions. Equivalence relations. Recursive definition of functions. Partially ordered sets. Semigroups, lattices and Boolean algebras and state machines. Basic combinatorial techniques and applications. Isomorphisms. Graphs, trees, sequences.

33101 MATHEMATICS 1 (Life Sciences)
Three semester hours

Graphical procedures, linear, logarithmic, power, exponential and trigonometric functions and their use in developing models of biological systems from data or basic assumptions. The use of differential and integral calculus in investigating such systems.

33103 STATISTICS 1 (Life Sciences)
Three semester hours

Populations and samples; measures of central tendency and dispersion; probability; binomial, Poisson and normal distributions; standard tests of significance and estimation for means and variances; goodness-of-fit tests.

33105 INTRODUCTORY BIOMETRICS (Life Sciences)
Three semester hours

Design and analysis of biological experiments; completely randomised design; regression analysis and correlation; multiple regression; polynomial regression; randomised block and latin square designs; two factor experiments; distribution-free tests.

33110 ENGINEERING MATHEMETICS 1 (Electrical)
Six semester hours

Matrices and determinants. Solution of linear equations. Gaussian reduction. Vectors. Products of vectors. Equations of lines and planes. Complex numbers. Polar form. De Moivre's theorem. Limits, continuity and differentiation. Mean value theorem. Curve sketching. Related rates. Maxima and minima. Integration. Riemann sums. Fundamental theorem of calculus. Application to areas and volumes and to lengths of curves. Logarithm and exponential functions. Trigonometric and hyperbolic functions. L'Hopital's rule. Considerable time will be spent developing proofs of the basic concepts to aid in deep understanding.

33121 ENGINEERING MATHEMATICS 1A
Three semester hours

Matrices and determinants. Vectors. Limits, continuity and differentiation. Applications of differentiation.

33122 ENGINEERING MATHEMATICS 1B
Three semester hours
Prerequisite: 33121 Engineering Mathematics 1A

This subject is a continuation of 33121. The two subjects cannot be taken concurrently. The following topics will be covered: integration and applications, elementary functions, methods of integration, sequences and series, complex numbers.

33170 BASIC SCIENCE MATHEMATICS
Three semester hours

Basic mathematics for scientists. Quadratic and linear equations. Functions; limits; continuity; derivatives. Trigonometric functions, introduction to integral calculus.

33171 SCIENCE MATHEMATICS 1 F/T
Four semester hours
Prerequisite: 33170 Basic Science Mathematics

A subject which develops the essential mathematical tools used in the physical sciences. Determinants and matrices. Differentiation; trigonometric functions; implicit differentiation. Integration. The natural logarithm and exponential functions. Inverse trigonometric functions. Sequences and series. Complex numbers.

33172 SCIENCE MATHEMATICS 2
Three semester hours
Prerequisite: 33171 Science Mathematics 1

An introduction to areas of application of differential and integral calculus in the physical sciences. Applications of differentiation; maximising functions; Newton's method for finding roots. Applications of integration; areas, volumes, mass centres, arc lengths. Techniques for integrating; integration by parts; use of trigonometric identities; partial fractions. Functions of many variables; partial differentiation; chain rule. Variable separable differential equations; applications.

33173 SCIENCE MATHEMATICS 3
Three semester hours
Prerequisite: 33171 Science Mathematics 1 F/T or 33175 Science Mathematics 1 P/T
Corequisite: 33172 Science Mathematics 2

Mathematical techniques for the physical sciences. Matrices; inverses; eigenvalues and eigenvectors. Three dimensional coordinate geometry; vectors. Hyperbolic and inverse hyperbolic functions. Linear and exact first order differential equations. Infinite sequences and series.

33175 SCIENCE MATHEMATICS 1 P/T (2 semesters)
Four semester hours (Two semester hours in each semester)
Prerequisite: 33170 Basic Science Mathematics

A subject which develops the essential mathematical tools used in the physical sciences. Determinants and matrices. Differentiation; trigonometric functions; implicit differentiation. Integration. The natural logarithm and exponential functions. Inverse trigonometric functions. Sequences and series. Complex numbers.

33210 ENGINEERING MATHEMATICS 2 (Electrical)
Six semester hours
Prerequisites: 33110 Engineering Mathematics 1 (Electrical), 33100 Discrete Mathematics (recommended)

Methods of integration. Sequences and their convergence. Series and their convergence. Tests for convergence. Power series. Radius of convergence. Taylor series. Vector spaces. Linear independence. Bases. Inner products. Linear transformations. Rank of matrix. Ordinary differential equations. First-order linear and variable separate equations. Solution of linear equations by auxiliary equation and undetermined coefficients. Systems of linear equations. Application of matrix exponentials. Partial derivatives. Gradient. Lagrange multipliers. Laplace transforms. Application to ordinary differential equations. Convolution theorem. There will be emphasis on formally proving the fundamental concepts.

33221 ENGINEERING MATHEMATICS 2A
Three semester hours
Prerequisite: 33122 Engineering Mathematics 1B

Partial derivatives. Double and triple integrals. Applications of multiple integrals. Ordinary differential equations.

33222 ENGINEERING MATHEMATICS 2B
Three semester hours
Prerequisite: 33221 Engineering Mathematics 2A

This subject is a continuation of 33221. The two subjects cannot be taken concurrently. Topics include: Laplace transforms, series solutions of differential equations, boundary value problems, vector calculus.

33310 ENGINEERING MATHEMATICS 3 (Electrical)
Six semester hours
Prerequisite: 33210 Engineering Mathematics 2 (Electrical)

Series solution of linear differential equations. Ordinary and regular singular points. Bessel functions. Boundary value problems for one dimensional heat and wave equations. Laplace equation in a circle. Circular drum. Double and triple integrals. Polar, cylindrical and spherical coordinates. Line and surface integrals. Green's theorem. Divergence theorem and Stokes' theorem. Analytic functions. Cauchy-Riemann equations. Conformal mapping. Cauchy's integral theorem. Taylor and Laurent series. The residue theorem. Inverse Laplace transforms. There will be emphasis on deriving proofs of the fundamental concepts.

33330 PHYSICAL MATHEMATICS
Three semester hours
Prerequisite: 33221 Engineering Mathematics 2A

Vector calculus; vector fields. Line and surface integrals. Conservative fields. Green's theorem. Divergence and curl. Gauss's theorem and the equation of continuity. Stokes' theorem and circulation. ODEs: series solutions of linear equations with non-constant coefficients. Legendre's and Bessel's equations and functions. Boundary value problems: one-dimensional heat and wave equations. Separation of variables. Fourier sine and cosine series. Vibrating circular membrane.

33702 STATISTICAL METHODS
Three semester hours

Review of basic probability theory, hypothesis testing, standard tests of significance and expectation. Quality control and reliability. Regression analysis. Analysis of variance, Markov chains.

33730 Simulation Techniques
Three semester hours
Prerequisite: 34751 Statistics 1 (or equivalent)
Corequisite: 34790 Numerical Computing (or equivalent)

Survey of types of problems amenable to study by simulation. Use of activity cycle diagrams to describe systems of interacting entities. Statistical models. Input data analysis. Verification and validation. Output analysis. Comparison of system designs. Random number generation. Tests for random numbers. Random variate generation. Investigation of variance reduction techniques. Application of simulation techniques to specific operations research problems such as inventory control. Simulation with SEESIM and SIMSCRIPT 11.5.

33731 OPTIMISATION TECHNIQUES
Three semester hours
Prerequisite: 33732 Linear Programming, 34711 Analysis 1 (or equivalent)

Review of classical optimisation, theoretical foundations of nonlinear programming, Kuhn-Tucker theorem, useful properties of convexity, line search by the Fibonacci method and by curve-fitting methods, steepest ascent, Newton's method, conjugate direction methods, feasible descent algorithms for constrained optimisation, quadratic programming, survey of available computer codes, geometric programming.

33732 LINEAR PROGRAMMING
Three semester hours
Prerequisite: 33780 Introduction to OR Models, 34701 Algebra 1 (or equivalent)

Formulation of linear programming problems. The simplex method and its variants. Duality theory. Degeneracy and post-optimal analysis. Applications to deterministic systems arising in industry and management. Sensitivity analysis and parametric programming. Integer and quadratic programming. Multiple objective decision making.

33733 DYNAMIC OPTIMISATION
Three semester hours
Prerequisite: 34747 Stochastic Processes, 34790 Numerical Computing (or equivalent)

Bellman's principle of optimality. Recursive relations. Production scheduling. Resource allocation. Equipment replacement. Two or more state variables. Continuous state variables. Application to linear and nonlinear programming. Computational feasibility. Stochastic state space. PDP formulations. Markov decision processes. Approximation in policy space with discounting.

33734 NETWORK OPTIMISATION
Three semester hours
Prerequisite: 33780 Introduction to OR Models
Corequisite: 33732 Linear Programming

Transportation problems. Assignment problems. Transshipment problem. Shortest path problems. Maximum flow problems. Project planning and scheduling. CPM cost models. Minimum cost network flow problems. The network simplex method.

33735 INVENTORY CONTROL
Three semester hours
Corequisite: 33730 Simulation Techniques

Forecasting techniques. Economic order quantity. Production lot size. Quantity discounts. Shortage models. Stochastic inventory models. Single period model. Safety stock approach. Service level approach. ABC classification. Dynamic EOQ. Silver-Meal heuristic. Use of dynamic optimisation and linear programming. Simulation models. Classical optimisation methods. Materials requirements planning.

33736 DECISION THEORY
Three semester hours
Prerequisite: 34751 Statistics 1 (or equivalent)

Prior analysis. Decision trees. Decision criteria. Certainty equivalents. Value of information. posterior analysis. Using experimental information. Using sample information. Preposterior analysis. Normal prior distributions. Beta prior distributions. Risk analysis. Risk premiums. Preferences. Multiattribute utility. Game theory. Classical vs Bayesian methods.

33745 DESIGN OF EXPERIMENTS
Three semester hours
Prerequisite: 34955 Regression Analysis (or equivalent)

Design and analysis of experiments. Completely randomised blocks and latin square designs. Factorial experiments. Hierarchical experiments. Introduction to confounding, split plots, fractional replication, incomplete blocks, analysis of covariance, use of computer packages.

33747 STOCHASTIC PROCESSES
Three semester hours
Prerequisite: 34852 Statistics 2 (or equivalent)

Random walks. Markov chains; classification of states; limit results for irreducible recurrent chains; absorption probabilities. Discrete state Markov processes; Poisson processes; pure birth processes; birth-death processes; application to queuing problems. Stationary processes; moving average and autoregressive models. Introduction to Wiener processes and renewal processes.

33748 INDUSTRIAL STATISTICS
Three semester hours
Prerequisite: 34852 Statistics 2 (or equivalent)

Reliability and life testing. Repeatability and reproducibility of test results. Deterministic forecasting of time series, including EWMA models. Quality Control including: Total Quality Control methods, lot acceptance sampling plans, continuous sampling plans, process control charts, and Taguchi methods of quality evaluation.

33760 FINANCIAL MODELLING TECHNIQUES
Three semester hours
Prerequisites: 34711 Analysis 1 (or equivalent), 34751 Statistics 1 (or equivalent)

Introduction of some stylised models of the standard problems of financial management and the mathematical techniques for their solution. Models covered include asset and liability management, planning day-to-day operations and the firm's financing and investment decisions. Topics include the concept of net-present value, the present value of income streams; the capital budgeting problem - investment under certainty, investment decisions under uncertainty; the debt-capacity decision; debt maturity and timing decisions; dividend policy, internal financing and growth.

33780 INTRODUCTION TO OPERATIONS RESEARCH MODELS
Three semester hours
Corequisite: 34751 Statistics 1 (or equivalent)

This subject introduces the basic methodology of Operations Research emphasising the application of the scientific method to problem solving and decision making, and considers the general purpose models and computational methods of Operations Research (linear network, network, financial, dynamic and stochastic models).

33799 PROJECT
Four semester hours
Prerequisite: by consent

An investigation of an approved topic selected by the student and carried out under supervision. The aim is to develop the student's ability in the formulation and solution of an operations research problem from a real-life situation. A formal report of the investigation will be required for satisfactory completion of the project.

33801-33812 REPORT
One to twelve semester hours
Prerequisite: by consent

33814 APPLIED LINEAR ALGEBRA
Three semester hours
Prerequisite: by consent

This is a course in linear algebra motivated by relevant applications from areas such as operations research and modelling in the physical and biological sciences. Topics considered are: concepts of rank, kernel and uniqueness introduced via systems of linear equations and the LU decomposition. Inner products and norms. Condition of linear systems. Perturbed systems of equations. The eigenvalue problem (motivated by examples from discrete and continuous systems modelling). Similarity transformations, unitary matrices. Eigensystems of normal matrices and the least squares problem. Singular value decompositions. The generalised inverse. The Jordan canonical form, matrix exponentials and applications.

33817 .NUMERICAL ANALYSIS
Three semester hours
Prerequisite: 33814 Applied Linear Algebra

Computational linear algebra (relying on the foundation supplied by 33814 Applied Linear Algebra): direct and iterative methods (including analysis of convergence); the eigenvalue problem; Jacobi's method; QR methods.

Interpolation: use of splines. Solution of non-linear equations: fixed point method, Newton's method, analysis of convergence, algorithms for complex roots. Quadrature: the Newton-Cotes methods, extrapolation methods, error analysis. Solution of ordinary differential equations: series methods, Runge-Kutta methods, predictor-corrector methods, error analysis.

33823 SEMINAR
Three semester hours
Prerequisite: by consent

Application of operations research techniques to a particular field. Depending on staff availability and student demand, applications will be from the following: computing system performance, public sector applications, marketing and health planning.

33830 SIMULATION TECHNIQUES
(See 33730)

33831 OPTIMISATION TECHNIQUES
(See 33731)

33832 LINEAR PROGRAMMING
(See 33732)

33833 DYNAMIC OPTIMISATION
(See 33733)

33834 NETWORK OPTIMISATION
(See 33734)

33835 INVENTORY CONTROL
(See 33753)

33836 DECISION THEORY
(See 33736)

33844 QUEUING SYSTEMS: THEORY AND APPLICATION
Three semester hours
Prerequisite: 34960 Theory of Probability (or equivalent)

Fundamental results of queuing theory and their application to important systems of delay, analysis of various queuing (waiting line) systems, discrete and continuous time Markov processes, birth-and-death processes, equilibrium results for single and multiple server queues, method of stages, priority queuing, applications to communication systems, data-processing systems, queues in networks.

33845 DESIGN OF EXPERIMENTS
(See 33745)

33847 STOCHASTIC PROCESSES
(See 33747)

33848 INDUSTRIAL STATISTICS
(See 33748)

33850 OPERATIONS RESEARCH IN HEALTH SERVICES 1
Three semester hours
Prerequisite: by consent
Corequisite: 33855 Manpower Planning

Recognition of problem areas and specific problems in the health field which can be solved or alleviated by operations research techniques, selection and application (with appropriate adaption) of the appropriate techniques. Methods discussed include queuing theory, decision analysis, mathematical programming, Markov chains, simulation, inventory control. Areas of application include appointment systems, blood banking, manpower planning and scheduling, centralisation versus decentralisation. An important consideration is the quality of health care in terms of efficiency of provision of services.

33851 OPERATIONS RESEARCH IN HEALTH SERVICES 2
Three semester hours
Prerequisite: 33850 OR in Health Services 1

Continuation of OR in Health Services 1 with additional techniques and survey of current literature on recent applications of OR to health services.

33853 ENERGY AND ENVIRONMENTAL MODELLING
Three semester hours
Prerequisite: by consent

Modelling of energy systems on a global and a national (or regional) basis, large system simulation and industrial dynamics, risk-benefit analysis of alternative technologies, problems of pollution and resource exhaustion, demand projections, conservation proposals, environmental trade-offs, interdependence between the energy sector and the economy as a whole, relationship with international trade.

33855 MANPOWER PLANNING
Three semester hours
Prerequisite: by consent

Manpower planning and scheduling in companies and in public facilities such as health systems. Cohort analysis, measures of wastage, continuous methods (renewal equations), discontinuous methods, Markov-based examples, political, economic, social and technological changes, effects of computerisation, Grosch's Law, manpower equivalent of a computer, job displacement, penetration of computers into industries. Gompertz curve, effect of new computer-based technology on public facilities, e.g. a hospital radiology department.

33857 LARGE SCALE MATHEMATICAL PROGRAMMING
Three semester hours
Prerequisite: 33831 Optimisation Techniques

The subject introduces students to the solution of large scale problems using mathematical programming techniques and considers the use of these techniques in a number of case studies and research areas. Topics to be covered include: theory and computational methods for optimising large scale linear and nonlinear programs, exploitation of special structure, data handling, Dantzig-Wolfe decomposition. Bender's decomposition, surrogate programming; multidivisional problems, combinatorial problems, stochastic problems and dynamic problems.

33858 STOCHASTIC MODELS IN OPERATIONS RESEARCH
Three semester hours
Prerequisite: by consent

Survey of models, methods for operational problems characterised by uncertainty, including formulation of models, useful special structures, applicable solution approaches, insight gained from analysis of models, and selection between deterministic and stochastic models. Specific topics include stochastic linear programming, two-stage LP formulations and chance-constrained programming, finite horizon probabilistic dynamic programming, Markov chains and Markovian decision processes, and probabilistic inventory models (infinite horizon continuous review).

33859 ENGINEERING APPLICATIONS IN OPERATIONS RESEARH
Three semester hours
Prerequisite: consent based on relevant engineering background

Depending on demand, selected applications of operations research in specific areas of engineering (electrical, mechanical, etc), to be formulated in consultation with senior members of staff of the Faculty of Engineering.

33860 CORPORATE AND FINANCIAL DECISIONS AND INVESTMENT ANALYSIS
Three semester hours
Prerequisite: 34938 Financial Modelling Techniques (or equivalent)

This subject introduces students to areas of current research in the field of finance theory. Topics to be covered include: Options - concepts and valuation models; current issues and developments. Capital structure and theory of the firm; the effects of personal and corporate tax; current issues. Dividend policy.

33861 OPERATIONS RESEARCH IN PUBLIC SECTOR SERVICES
Three semester hours
Prerequisite: 33855 Manpower Planning (Desirable: 33850 Operations Research in Health Services 1 and 33853 Energy and Environment Modelling)

Applications of operations research to selected service areas of the public sector. Development of economic and quantitative concepts applicable to investment planning for facility systems, problems of location, decisions and capacity planning over time, service level decisions (benefit versus cost), complexities in facilities decisions (benefit versus cost, multiple criteria, multiple interests and uncertainty). Topics are selected from local, state and national government levels, including urban service systems, location of emergency services, water resources, transportation systems, environmental considerations.

33870 MATHEMATICAL MODELLING IN THE BIOMEDICAL SCIENCES
Three semester hours
Prerequisite: by consent

Compartment models of diabetes and tumour growth, models of interacting populations, models of protein synthesis. The identification and simulation of such models. The use of control theory ideas.

33871 IMPACT OF COMPUTERS ON TRADITIONAL MATHEMATICS
Three semester hours
Prerequisite: by consent

This course is intended to demonstrate how a number of traditional mathematics courses may be approached by making integrated use of the numerical and symbol

manipulation capabilities of modern computers, e.g. traditional calculus is approached through the mechanical paradigms that give rise to the fundamental ideas. By relegating numerical and symbol manipulations to the computer, the student is encouraged to develop an intuitive feel for underlying scientific and technological problems. The need for an approach to mathematics which answers questions that are not answerable on the computer is stressed. Other topics similarly treated include classical control problems and partial differential equations.

33872 DATA ANALYSIS

Three semester hours
Prerequisite: by consent

General ideas of time-series analysis: test of randomness. Trends and moving averages. Spectral analysis. Forecasting by autoprojective methods. Exploratory data analysis: displays, plots, smoothing data and coded tables. Meta-analysis: tests of statistical significance of combined results, coding, estimation of effect sizes; meta-analysis in the biological and social sciences.

33873 MODELLING WITH DIFFERENTIAL EQUATIONS

Three semester hours
Prerequisite: by consent

A look at differential equations from a modern viewpoint which presents a balance between qualitative-geometric solutions on the one hand and numerical solutions on the other. Modelling applications are the threads holding together the various concepts; applications include biological, mechanical and economic models.

33880 OPERATIONS RESEARCH MODELS AND METHODOLOGY

Three semester hours
Prerequisites: All subjects (or their equivalents) from third year major in Operations Research in the Bachelor of Applied Science (Mathematics) degree.

Recent case studies from the literature will be critically examined from the point of view of OR methodology used rather than the OR techniques. Students will be encouraged to adopt an innovative approach to problem solving, and to develop alternative formulations of the problems and their solutions. Cases will be selected to cover the basic model archetypes (linear, network, dynamic and stochastic). At least one case study will involve the use of continuous and/or discrete event simulation using a high level language such as SIMSCRIPT II.5.

34507 COMPUTING 4

Three semester hours
Prerequiste: 34407 Computing 3

Data structures; implementation of stacks, queues, linked lists, trees etc. in FORTRAN. Sparse matrices: storage and manipulation. Simulation; design and implementation of a discrete event simulator. Recursion: implementation and elimination of recursion. Graphics: 2D function plots, histograms, pie charts, 3D function plots, wire frame shapes. Programming packages: design and implementation of user-friendly interfaces. Particular applications include rational, multiprecision and interval arithmetic and a symbolic polynomial manipulation package.

34517 COMMERCIAL COMPUTING 3

Three semester hours
Prerequisites: 34217 Commercial Computing 2, 34627 Information Systems 3

Programming techniques for the implementation of on-line systems: screen data entry, menu driven programmes, system integrity. Experience in design, testing and maintenance.

34573 HISTORY OF MATHEMATCS

Three semester hours
Prerequisite: by consent

The great mathematicians and the history of mathematics from a problem-solving point of view.

34607 COMPUTING 5

Three semester hours
Prerequisites: 34137 Computer Systems 1, 34507 Computing 4

Topics include: operating systems - structure, resource management and performance, case studies of IBM VM and Unix - user/system interface and JCL. Language structures and compilers - grammars, lexical analysis, parsing and code generation. Design and implementation of a small practical language.

34627 INFORMATION SYSTEMS 3

Three semester hours
Prerequisite: 34227 Information Systems 2

The systems development life cycle. Tools for system and process representation. Analysis of existing information systems. Proposal formulation and feasibility analysis. Logical and physical design, structural design, system implementation, project management.

34628 INFORMATION SYSTEMS 4
Three semester hours
Prerequisite: 34627 Information Systems 3

Principles of database management and organisation. CODASYL and relational models. Experience in the use and evaluation of DDL and DML for a database system.

34668 COMPUTATIONAL NUMBER THEORY
Three semester hours
Prerequisite: 34790 Numerical Computing

Prime numbers, arithmetical functions, congruences. Factorisation and primality testing, applications to cryptography. Quadratic residues. Continued fractions.

34681 SPECIAL APPLICATIONS IN OPERATIONS RESEARCH
Three semester hours
Prerequisite: by consent

34682 SPECIAL APPLICATIONS IN COMPUTING
Three semester hours
Prerequisite: by consent

34683 SPECIAL APPLICATIONS IN STATISTICS
Three semester hours
Prerequisite: by consent

34684 SPECIAL APPLICATIONS IN PHYSICAL APPLIED MATHEMATICS
Three semester hours
Prerequisite: by consent

34685 SPECIAL APPLICATIONS IN MODERN APPLIED MATHEMATICS
Three semester hours
Prerequisite: by consent

34691-34697 PROJECT
One to seven semester hours
Prerequisite: by consent

An investigation of a topic selected by the student with the approval of the Director of Undergraduate Studies or his or her designated representative. A formal report must be submitted and a seminar presented. Although this is a final year subject, consideration should be given to the selection of a topic in the preceding year.

34698 SEMINAR
Two semester hours
Prerequisite: by consent

Group studies of selected topics which may vary from year to year.

34700 DISCRETE MATHEMATICS
Three semester hours

Graphs, paths, trees. Set operations. Indexing and recurrence relations. Propositional and predicate calculus. Semigroups, lattices and Boolean algebras. Permutations, combinations, partitions, counting and allocation problems.

34701 ALGEBRA 1
Three semester hours

Complex numbers: polar form; de Moivre's theorem; exponential form; regions in the complex plane. Polynomials: remainder and factor theorems; synthetic division; Descartes' Rule of Signs; relations between roots and coefficients. Systems of linear equations: Gaussian elimination; homogeneous systems. Matrices: matrix algebra; elementary matrices; inverse matrix; application to systems of linear equations; LU decompostion. Determinants: definition and properties; methods of evaluation; Cramer's Rule; adjoint form for inverse matrix; characteristic equation. Vectors: algebra of vectors; dot and cross products; triple products; applications to trigonometry and three-dimensional coordinate geometry.

34710 CALCULUS
Six semester hours

Graphical introduction to limits, continuity and differentiation. Graphical introduction to the Mean Value Theorem. Applications of differentiation. Riemann integration and the Fundamental Theorem of Calculus. Applications of integration to areas, volumes, length of curves and surface areas. Logarithmic and exponential functions. Trigonometric and inverse trigonometric functions. Hyperbolic and inverse hyperbolic functions. Methods of integration. Improper integrals.

34711 ANALYSIS 1
Three semester hours
Prerequisite: 34710 Calculu

Convergence of sequences, limit theorems. Points sets; the least upper bound axiom, nested interval property and Bolzano-Weierstrass theorem; application to sequences. Limit of a function; limit theorems; continu-

ity; discussion in terms of sequences. Properties of continuous functions on a closed interval. Differentiation; the Mean Value Theorem. Taylor's Theorem with remainder; L'Hopital's rule. Infinite series; convergence tests for series of positive terms; absolute and conditional convergence; alternating series. Improper integrals; convergence tests. Power series and radius of convergence. Taylor and Maclaurin series; associated numerical problems.

34740 INTRODUCTION TO OPERATIONS RESEARCH MODELS
Three semester hours
Corequisite: 34751 Statistics 1

Formulation of OR problems, construction of models, linear programming, network models, dynamic optimisation, stochastic processes, Bayesian decision analysis, inventory control, waiting line models, simulation, multiple objective decision making, heuristic problem solving.

34751 STATISTICS 1
Three semester hours
Corequisite: 34711 Analysis 1

Descriptive statistics. Probability. Random variables; expectation; standard distributions. Inference on means and variances. Distribution-free tests. Goodness-of-fit tests. Linear regression.

34770 COMPUTING 1A
Three semester hours
Corequisite: 34700 Discrete Mathematics

An introduction to a disciplined approach to problem-solving and algorithm development using modern functional (Miranda) and imperative (Modula-2) programming languages. Informal introduction to algebraic methods of specification, development and proof of programmes. Use of Miranda to implement equational specifications: guarded equations, block structure, lists and list comprehensions, types, polymorphism, abstract data types, currying and higher order functions (map, filter fold), lazy evaluation and infinite lists. Introduction to functional programming in an imperative language. Elementary syntactic features of Modula-2: control structures, external modules, procedures, scope of identifiers, scalar and elementary structured data types.

34771 COMPUTING 1B
Three semester hours
Prerequisites: 34700 Discrete Mathematics, 34770 Computing 1A
Corequisite: 34781 Mathematical Foundations of Computing 1

This subject is a continuation of the subject Computing 1A. Content includes the further investigation and use of the syntactic and semantic features of Miranda and Modula-2 and the continued development of formal specification and refinement techniques appropriate to these languages. Emphasis will be placed on modular design and the investigation of a range of algorithms and recursively defined data types.

34781 MATHEMATICAL FOUNDATIONS OF COMPUTING 1
Three semester hours
Prerequisites: 34700 Discrete Mathematics, 34770 Computing 1A

The aim of this subject is to introduce the logical and mathematical principles of automatic computation. Topics include: historical overview of computing machinery; introduction to deterministic finite automata; design of combinatorial circuits and clocked sequential circuits; the von Neumann architecture; elementary data types, representation of values and realisation of operators; registers, arithmetic and logic units, data path; the fetch-execute cycle. Introduction to the theory of computation: algorithms as function definitions; the halting problem, Church's thesis; introduction to the lambda calculus.

34790 NUMERICAL COMPUTING
Three semester hours
Prerequisites: 34710 Calculus
Corequisite: 34711 Analysis 1

Coverage of the elements of the C language including control structures, functions, arrays and I/O. Basic programme design techniques and their implementation in C. Preprocessor facilities, standard libraries, function prototyping and restricted identifier scope. An introduction to numerical computing includes treatment of errors, simple algorithms for solving nonlinear equations in one variable (bisection and Newton's methods), linear equations in several variables (Gaussian elimination, iteration), and algorithms for performing numerical integration (trapezoidal and Simpson's rules, extrapolation). Non-numerical applications include sorting, searching, and text processing.

34802 ALGEBRA 2
Three semester hours
Prerequisite: 34701 Algebra 1

Vector spaces: Euclidean and general vector spaces; subspaces; linear independence; basis and dimension; row and column space; inner product spaces; the Gram-Schmidt process; change of basis. Linear transformations. Eigenvalues and eigenvectors: diagonalisation; similarity; symmetric matrices; applications to quadratic forms, conic sections, powers of a matrix and difference equations. Complex vector spaces: complex inner product spaces; unitary, normal and Hermitian matrices.

34803 ALGEBRA 3
Three semester hours
Prerequisite: 34802 Algebra 2

Sets, relations and functions. Order relations. Posets and lattices. Semigroups. Generators. Quotient semigroups. Finite state machines. Languages. Monoids. Groups. Normal subgroups. Quotient groups. Lagrange's theorem. Homomorphisms. Permutation groups, orbits and symmetries. Rings and ideals. Quotient rings. Fields. Introduction to finite fields and coding theory.

34812 ANALYSIS 2
Three semester hours
Prerequisite: 34711 Analysis 1
Corequisite: 34821 Partial Differential Equations 1

The aim of this subject is to present the analytic theory required to handle boundary value problems by Fourier series methods. Topics include: Cauchy sequences; cluster points of sequences; convergence of Cauchy sequences; sequential compactness of the real line; continuous and uniformly continuous functions; further properties of continuous functions on a closed interval; Mean Value Theorem and Fundamental Theorem of Calculus; sequences and series of functions; uniform convergence; continuity, integrability and differentiability of series of functions; Weierstrass M-test; power series; Fourier series; applications to ordinary differential equations and boundary value problems.

34815 ORDINARY DIFFERENTIAL EQUATIONS
Three semester hours
Prerequisite: 34710 Calculus
Corequisite: 34802 Algebra 2

First-order equations. Theory of linear equations. Auxiliary equations and undetermined coefficients. Variation of parameters. Laplace transforms, step functions, convolution. Eigenvalues and matrix exponentials. Qualitative properties of solutions. Phase plane. Stability. Linear and nonlinear systems. Predator-prey problems.

34817 VECTOR CALCULUS
Three semester hours
Prerequisite: 34710 Calculus

Partial derivatives. Multiple integrals. Vector fields. Line and surface integrals. Green's, Gauss' and Stokes' theorems.

34818 COMPLEX VARIABLES
Three semester hours
Prerequisites: 34711 Analysis 1, 34817 Vector Calculus

Analytic functions of a complex variable. Cauchy's integral theorem. Laurent series. Singularities of analytic functions. The residue theorem. Contour integration. Conformal mapping.

34821 PARTIAL DIFFERENTIAL EQUATIONS 1
Three semester hours
Prerequisite: 34815 Ordinary Differential Equations
Corequisite: 34817 Vector Calculus

Solution of boundary value problems by separation of variables. Sturm-Liouville theory. Fourier series. Two dimensional problems. Infinite domain problems. Fourier integrals and Fourier transforms. Green's function methods. Laplace transform methods for elementary boundary value problems.

34852 STATISTICS 2
Three semester hours
Prerequisite: 34751 Statistics 1

Random variables. Moments. Moment generating functions. Bivariate distribution. Transformations of random variables. Order statistics. Sampling distributions. Central Limit Theorem. Applications to estimation. Multivariate Normal distribution.

34872 COMPUTING 2
Three semester hours
Prerequisites: 34771 Computing 1B

The aim of this subject is to develop further a disciplined approach to the specification, design, implementation and testing of software using imperative and functional languages. Topics include: abstract data types (ADTs) (list, stack, queue, dequeue, tree, graph, etc); formal specification of ADTs; static and dynamic implementa-

tion in an imperative language; requisite features of Modula-2; introduction to order notation and efficiency considerations; algorithm analysis (examples include searching and sorting algorithms). Functional programming: functional implementation of ADTs; recursion and induction on lists.

34873 COMPUTING 3
Three semester hours
Prerequisites: 34711 Analysis 1, 34872 Computing 2
Corequisite: 34803 Algebra 3

The course will consolidate and extend the work on specification of abstract data types, together with advanced implementation issues. Systematic techniques of algorithm design and analysis, together with associated mathematical methods, will deal with issues of complexity, efficiency and programme verification. A wide range of advanced applications will be examined via case studies, both in formal lectures and practical assignments. In addition to existing imperative and functional languages, an object-oriented language will be introduced and employed extensively in practical assignments and in the implementation of flexible and reliable software.

34891 NUMERICAL METHODS A
Three semester hours
Prerequisites: 34711 Analysis 1, 34790 Numerical Computing, 34802 Algebra 2

Solution of nonlinear equations, including some revision from 34790 Numerical Computing. Analysis of convergence. Error analysis. Lagrange interpolation, cubic splines, Bezier curves. Numerical differentiation and integration: Newton-Cotes adaptive methods, Gaussian quadrature, methods involving Richardsonian extrapolation. Approximation theory: least squares and orthogonal polynomials, economisation of power series using Chebychev polynomials, rational approximations. Vector and matrix norms. Numerical linear algebra: LU factorisation, iterative methods - Jacobi method. Householder reduction, QR algorithm. Initial value problems for ordinary differential equations: introductory material including Taylor series methods, open Runge-Kutta methods and multistep methods. This course is heavily oriented towards practical applications.

34894 MATHEMATICAL AND BUSINESS MODELLING
Three semester hours
Prerequisites: 34751 Statistics 1, 34790 Numerical Computing

Modelling topics will be drawn from linear programming, simulation, project management, decision trees, input-output tables and elementary financial modelling, together with their application to decision making in business and other areas. Numerical work will be conducted in the environment of a commonly available spreadsheet such as Lotus 1-2-3. The subject will also provide a coverage of elementary spreadsheet facilities, the use of high level features such as graphics, optimisation and regression functions, database facilities and programming in the macro language.

34904 ALGEBRA4
Three semester hours
Prerequisite: 34803 Algebra 3

Polynomials in splitting fields; Euclidean constructions; finite fields: normal extensions, Galois fields, primitive and cyclotomic polynomials; latin squares; modular arithmetic; elements of graph and coding theories.

34913 MODERN ANALYSIS
Three semester hours
Prerequisites: 34802 Algebra 2, 34812 Analysis 2

Metric space axioms. Open and closed sets. Interior and closure. Sequences in a metric space. Sequential compactness. Contraction mapping theorem. Application to existence theorems for differential equations. Continuous mappings between metric spaces. Normed linear spaces. Banach spaces. Bounded linear maps. Operators and functionals. Dual spaces. Hilbert spaces.

34914 MEASURE THEORY
Three semester hours
Prerequisite: 34913 Modern Analysis or 34013 Modern Analysis (Honours)

Measures and outer measures. Measure spaces. Lebesgue measure on the real line. Measurable functions. Step functions. Definition of the abstract Lebesgue integral. Monotone convergence theorem. Dominated convergence theorem. Probability spaces. Independence. Borel-Cantelli lemmas. Laws of large numbers.

34916 MATHEMATICAL METHODS
Three semester hours
Prerequisites: 34922 Partial Differential Equations 2, 34924 Mechanics

Theory of distributions. The Fourier transform and applications to partial differential equations. Introduction to the calculus of variations. Euler-Lagrange equations. The brachistochrone problem. Eigenvalue problems. Lagrangian and Hamiltonian mechanics. Lagrange's equations of motion. Hamilton's principle. The principle of least action.

34920 INTEGRAL EQUATIONS
Three semester hours
Prerequisite: 34913 Modern Analysis or 34013 Modern Analysis (Honours)

Existence theory for Fredholm and Volterra integral equations using contraction mappings. Compact integral operators. Green's functions.

34922 PARTIAL DIFFERENTIAL EQUATIONS 2
Three semester hours
Prerequisites: 34818 Complex Variables, 34821 Partial Differential Equations 1

Bessel's equation and Bessel functions. Boundary value problems in partial differential equations involving Bessel's equation. Legendre's equation and Legendre's associated equation. Legendre functions and associated Legendre functions. A thorough treatment of Laplace transforms. Inverse Laplace transforms using complex variable methods.

34924 MECHANICS
Three semester hours
Prerequisites: 34815 Ordinary Differential Equations, 34817 Vector Calculus

Kinematics and dynamics of a particle. Projectile motion. Oscillations. Conservative forces and central forces. Theory of planetary motion.

34925 WAVE THEORY
Three semester hours
Prerequisite: 34922 Partial Differential Equations 2

Acoustic waves in fluids. Waves on a liquid surface. Elastic waves in solids. Electromagnetic waves.

34927 DETERMINISTIC OPTIMAL CONTROL
Three semester hours
Prerequisites: 34815 Ordinary Differential Equations, 34817 Vector Calculus, 34913 Modern Analysis or 34013 Modern Analysis (Honours)

Introduction to optimal control problems for ordinary differential equations. Linear problems and bang-bang controls. Nonlinear problems and Pontryagin's maximum principle. Necessary conditions. Sufficient conditions. Various endpoint conditions. Calculus of variations. Dynamic programming. Infinite horizon problems. Applications to optimal economic growth and to optimal investment and consumption decisions.

34930 SIMULATION TECHNIQUES
Three semester hours
Prerequisite: 34751 Statistics 1
Corequisite: 34790 Numerical Computing

Survey of types of problems amenable to study by simulation. Use of activity cycle diagrams to describe systems of interacting entities. Statistical models. Input data analysis. Verification and validation. Output analysis. Comparison of system designs. Random number generation. Tests for random numbers. Random variate generation. Investigation of variance reduction techniques. Application of simulation techniques to specific operations research problems such as inventory control. Simulation with SEESIM and SIMSCRIPT 11.5.

34931 LINEAR PROGRAMMING
Three semester hours
Prerequisite: 34740 Introduction to OR Models
Corequisite: 34802 Algebra 2

Formulation of linear programming problems. The simplex method and its variants. Duality theory, degeneracy and post optimal analysis. Applications to industrial systems, including transportation problems, production scheduling, management games and optimisation problems.

34932 OPTIMISATION TECHNIQUES
Three semester hours
Prerequisites: 34711 Analysis 1, 34931 Linear Programming

A unified treatment of the solution of models derived from real-life situations. Derivation and application of Kuhn-Tucker theorem. Special treatment will include selected algorithms of nonlinear programming.

34934 NETWORK OPTIMISATION
Three semester hours
Corequisite: 34931 Linear Programming

Transportation problems. Assignment problems. Transshipment problem. Shortest path problems. Maximum flow problems. Project planning and scheduling. CPM cost models. Minimum cost network flow problems. The network simplex method.

34935 INVENTORY CONTROL
Three semester hours
Corequisite: 34930 Simulation Techniques

Forecasting techniques. Economic order quantity. Production lot size. Quantity discounts. Shortage models. Stochastic inventory models. Single period

model. Safety stock approach. Service level approach. ABC classification. Dynamic EOQ. Silver-Meal heuristic. Use of dynamic optimisation and linear programming. Simulation models. Classical optimisation methods. Materials requirements planning.

34936 DECISION THEORY
Three semester hours
Prerequisite: 34740 Introduction to OR Models

Prior analysis. Decision trees. Decision criteria. Certainty equivalents. Value of information. posterior analysis. Using experimental information. Using sample information. Preposterior analysis. Normal prior distributions. Beta prior distributions. Risk analysis. Risk premiums. Preferences. Multiattribute utility. Game theory. Classical vs Bayesian methods.

34938 FINANCIAL MODELLING TECHNIQUES
Three semester hours
Prerequisites: 34711 Analysis 1, 34751 Statistics 1

Introduction of some stylised models of the standard problems of financial management and the mathematical techniques for their solution. Models covered include asset and liability management, planning day-to-day operations and the firm's financing and investment decisions. Topics include the concept of net-present value, the present value of income streams; the capital budgeting problem - investment under certainty, investment decisions under uncertainty; the debt-capacity decision; debt maturity and timing decisions; dividend policy, internal financing and growth.

34953 STATISTICS 3
Three semester hours
Prerequisite: 34852 Statistics 2

Estimation: point estimation; maximum likelihood; method of moments; sufficiency; completeness; exponential class of distributions. Hypothesis testing: decision problems; Neyman-Pearson lemma; best tests; uniformly most powerful tests; sequential probability ratio test; minimax and Bayesian tests. Distribution free methods: estimation and hypothesis testing; further theory of inference.

34955 REGRESSION ANALYSIS
Three semester hours
Prerequisite: 34852 Statistics 2

Simple linear regression. Multiple regression. Polynomial regression. Diagnostics and model building. Introduction to generalised linear models. Use of computer packages such as SAS, SPSS, MINITAB and GLIM, and the use of APL.

34956 DESIGN EXPERIMENTS
Three semester hours
Prerequisite: 34955 Regression Analysis

Design and analysis of experiments. Completely randomised, randomised blocks and latin square designs. Factorial experiments. Hierarchical experiments. Introduction to confounding, split plots, fractional replication, incomplete blocks, analysis of covariance. Use of computer packages MINITAB, SPSS, SAS and GLIM.

34957 INDUSTRIAL STATISTICS
Three semester hours
Prerequisite: 34852 Statistics 2

Reliability and life testing. Repeatability and reproducibility of test results. Deterministic forecasting of time series, including EWMA models. Quality Control including: Total Quality Control methods, lot acceptance sampling plans, continuous sampling plans, process control charts, and Taguchi methods of quality evaluation.

34960 THEORY OF PROBABILTY
Three semester hours
Corequisite: 34852 Statistics 2

Probability axioms. Combinatorial analysis. Conditional probability and independence. Random variables. Expectations. Limit theorems.

34961 STOCHASTIC PROCESSES 1
Three semester hours
Prerequisite: 34852 Statistics 2

Random walks. Markov chains: classification of states; limit results for irreducible recurrent chains; absorption probabilities. Discrete state Markov processes: Poisson process; pure birth process; birth-death processes; application to queueing problems. Stationary processes; moving average and autoregressive models. Introduction to Wiener process and renewal processes.

34975 COMPUTER GRAPHICS
Three semester hours
Prerequisites: 34790 Numerical Computing, 34802 Algebra 2

Hardware - capabilities of typical devices such as plotters and raster scan instruments. Standard system software including point plotting and line drawing (Bresenham's algorithm), transformations (scaling, translations, rotations) in two dimensions, clipping and windowing. Area filling algorithms - flood-fill, raster scan. Three-dimensional drawing - transformations,

projections (orthogonal and perspective), homogeneous coordinates, floating horizon hidden surface algorithm. Curve and surface interpolation - cubic splines, Bezier curves and surfaces, B-splines. Graphic standards - GKS, PHIGS.

34976 NEURAL NETWORKS
Three semester hours
Prerequisites: 34751 Statistics 1, 34790 Numerical Computing, 34802 Algebra 2, 34817 Vector Calculus

Fundamental concepts: theories of mind and brain (ancient to modern), cybernetics (deterministic systems, feedback, communication, control, adaptation), brain theory (neurons, brain structures, representation), rise of connectionism (the Von Neumann bottleneck, the parallel distributed processing paradigm). Neural network models and learning algorithms, the latter in parentheses: associative nets (Hebbian learning), the Perceptron (error-correcting rule), multi-layer networks (back-propagation, Boltzmann machines), interactive activation and Grossberg models (competitive learning), Barto model (reinforcement learning). Applications: travelling salesman problem, NETtalk (a network that learns to talk).

34977 FORMAL SPECIFICATION
Three semester hours
Prerequisite: 34982 Mathematical Foundations of Computing 2

An introduction to the mathematical basis of formal specification theory, including linguistic systems and models of specification systems. Software development by linguistic transformations. A comparative study of the principles and practices of important formal specification methods used in modern software construction, including algebraic specification, the Vienna Development Method and Z.

34982 MATHEMATICAL FOUNDATIONS OF COMPUTING 2
Three semester hours
Prerequisites: 34803 Algebra 3, 34873 Computing 3

This subject, offered in the final year of the computing major, consists of an introductory but systematic survey of the logical, algebraic and categorical foundations of formal programme semantics, together with associated verification methods. Operational and denotational semantics, and the axiomatic methods of Floyd, Hoare and Dijkstra will be introduced. The theoretical basis of algebraic semantics will be fully established and its implications considered. The lambda and combinatorial calculi will be developed within the context of the semantics of functional programming languages.

34983 MATHEMATICAL FOUNDATIONS OF COMPUTING 3
Three semester hours
Prerequisite: 34982 Mathematical Foundations of Computing 2
Corequisite: 34984 Language Theory

An important aim of this mainly theoretical subject is to develop an appreciation of current directions in research on the nature of computation, and acquaint students with sources of information in this field. The course will consider additional topics in the denotational semantics of applicative and imperative programming languages, in greater depth than its prerequisite subject. Further topics in algebraic semantics will include initial and final algebra approaches to specification of data types, as well as the initial algebraic specification of languages. Selected topics in the theory of computation will include computability, Turing machines, the Church-Turing thesis, decidability, complexity issues, completeness and tractability.

34984 LANGUAGE THEORY
Three semester hours
Prerequisite: 34982 Mathematical Foundations of Computing 2

The aim of this subject is to provide students with skills sufficient for the design and implementation of simple problem-oriented languages and environments. Topics include: Chomsky's categorisation of grammars; regular and context-free grammars and languages; finite state recognisers; parsing strategies; recursive descent and table-driven parsers; operational semantics and programme transformation; language design, translation and implementation of a simple, block-structured imperative language; issues in the implementation of functional languages (combinator compilation, strict and lazy evaluation, supercombinators).

34985 DIGITAL IMAGE PROCESSING
Three semester hours
Prerequisites: 34802 Algebra 2, 34790 Numerical Computing

Preliminaries: human vision, digital image models, image geometry and transformations, display devices. Image transforms: the Fourier transform, convolution, cross correlation and autocorrelation, basic transform theorems. The discrete Fourier transform and its properties: fast Fourier transform implementation, aliasing, leakage. The 2-dimensional transform and its associated implementation. Image enhancement and restoration: histogram modification techniques, low, high and band-pass filters, image sharpening and smoothing,

psuedo-colouring. Models of degradation, inverse filtering, removal of linear blur, frequency modification. Image segmentation: point, line and edge detection, the Hough transform, thresholding and region segmentation.

34987 CRYPTOLOGY
Three semester hours
Prerequisite: 34790 Numerical Computing

The subject gives students an elementary understanding of cryptology, including an emphasis on factorisation and primality testing, relevant to public key cryptosystems. Topics covered include: divisibility and prime numbers; the fundamental theorem of arithmetic; congruences; applications; Fermat's Theorem. Applications to primality testing and factorisation; Fermat's and Pollard's 'p-1' methods. Multiplicative functions; Euler's function, sum and number of divisors; perfect numbers. Cryptology: block ciphers, exponentiation ciphers, public key cryptography, knapsack ciphers. Continued fractions, application to factorisation.

34992 NUMERICAL METHODS B
Three semester hours
Prerequisites: 34790 Numerical Computing, 34821 Partial Differential Equations 1

Solution of ordinary differential equations, including some revision of earlier work. Initial value problems: single step and multi-step methods. VSVO, extrapolation and implicit methods. Stiff differential equations and methods appropriate thereto. Stability theory. Boundary value problems: shooting, finite difference and finite element methods. Differential eigenvalue problems. Solution of partial differential equations: finite difference and finite element methods. Optimisation: methods for unconstrained nonlinear optimisation, steepest descent, damped Newton-Raphson and matrix updating techniques. Overdetermined systems.

34995 ADVANCED NUMERICAL ANALYSIS
Three semester hours
Prerequisites: 34913 Modern Analysis or 34013 Modern Analysis (Honours)

Differentiation in normed linear spaces. Mean Value Theorem and Taylor's Theorem in Banach spaces. Product spaces and partial differentials. Nonlinear equations and the Newton-Kantorovich method.

34996 CONVEXITY AND OPTIMISATION
Three semester hours
Prerequisites: 34913 Modern Analysis or 34013 Modern Analysis (Honours)

Convex sets in a linear space. Affine sets and hyperplanes. Algebraic interior and closure. Separation theorems. Geometric Hahn-Banach theorem. Convex functions. Epigraphs. Subdifferentiability and differentiability. Duality. Polars. Support functions. Linear and convex programming. Kuhn-Tucker conditions.

34013 MODERN ANALYSIS (Honours)
Three semester hours
Prerequisites: 34812 Analysis 2, 34802 Algebra 2

As for 34913 Modern Analysis. Additional content: topological spaces, continuous functions, compactness, separation properties.

34014 MEASURE THEORY (Honours)
Three semester hours
Prerequisite: 34013 Modern Analysis (Honours)

As for 34924 Measure Theory. Additional content: the further pi-lambda theorem, Fubini's theorem, Hanh decomposition, Radon-Nikodym theorem and conditional probability.

34019 FUNCTIONAL ANALYSIS
Three semester hours
Prerequisite: 34014 Measure Theory (Honours)

Banach spaces. Bounded linear transformations. Spectrum. Dual space. Adjoint operator. Hahn-Banach theorem. Compact operators. Riesz theory. Fredholm integral equations. Fredholm alternative. Application to potential theory. Hilbert spaces. Operators and adjoints. Riesz representation theorem. Orthogonality. Orthonormal bases. Abstract Fourier theory. Self-adjoint operators. Projections. Compact operators. Spectral theory for compact operators. Application to Sturm-Liouville theory. Fourier series.

34023 PARTIAL DIFFERENTIAL EQUATIONS 3
Three semester hours
Prerequisite: 34922 Partial Differential Equations 2

First order equations. Classification of second-order linear equations. Wave equation. D'Alembert's formula. Poisson's formula. Huygen's principle. Heat Equation. Maximum principles. Regularity of solutions. Nonlinear problems. Laplace's equation. Properties of harmonic functions. Green's function. Method

of images. Integral equations. Fredholm theory. Application to Dirichlet and Neumann problems. Introduction to scattering theory. Scattering of plane waves by cylinders.

34026 FRACTAL GEOMETRY
Three semester hours
Prerequisite: 34914 Measure Theory or 34014 Measure Theory (Honours)

Review of relevant aspects of metric space theory, compactness, and contraction mappings. The space of fractals. Collage Theorem. Chaotic dynamics on fractals. Fractal dimension; theoretical and experimental determination. Fractal interpolation. Julia sets; attractors of iterated function systems, applications to Newton's method. Parameter spaces and Mandelbrot sets. Measures on fractals. Application to computer graphics.

34028 STOCHASTIC OPTIMAL CONTROL
Three semester hours
Prerequisites: 34927 Deterministic Optimal Control, 34062 Stochastic Processes 2

Formulation of stochastic control problems. Examples of controls. The Hamilton-Jacobi-Bellman equation. Necessary and sufficient conditions. Reduction to Markov controls. Dynamic portfolio strategies. The optimal portfolio selection problem. Discussion of solutions in various particular cases.

34029 NONLINEAR DYNAMICAL SYSTEMS
Three semester hours
Prerequisites: 34815 Ordinary Differential Equations, 34013 Modern Analysis (Honours)

Review of linear systems. Nonlinear systems. Phase plane analysis. Linearisation. Local stability and instability. Global asymptotic stability. Stable and unstable manifolds. Limit cycles and strange attractors. Introduction to chaos theory. Asymptotic methods. The methods of Poincare and Lindstedt. The method of averaging. Applications to finance.

34033 DYNAMIC OPTIMISATION
Three semester hours
Prerequisites: 34790 Numerical Computing, 34931 Linear Programming, 34961 Stochastic Processes 1

Bellman's principle of optimality. Recursive relations. Production scheduling. Resource allocation. Equipment replacement. Two or more state variables. Continuous state variables. Application to linear and nonlinear programming. Computational feasibility. Stochastic state space. PDP formulations. Markov decision processes. Approximation in policy space with discounting.

34062 STOCHASTIC PROCESSES 2
Three semester hours
Prerequisites: 34960 Theory of Probability, 34961 Stochastic Processes 1, 34014 Measure Theory (Honours)

Formal definitions of probability space and stochastic processes. Martingales. Riemann-Stieltjes integration. Brownian motion and related processes. Stochastic calculus and stochastic differential equations. Financial applications.

34065 TIME SERIES ANALYSIS
Three semester hours
Prerequisites: 34960 Theory of Probability, 34961 Stochastic Processes 1

Model identification, estimation, diagnostic examination and forecasting for time series. Nonseasonal/seasonal, stationary/nonstationary and linear/nonlinear time series are considered. Models covered are Box-Jenkins, time series regression, exponential smoothing, transfer functions and classical regression.

34066 NONLINEAR STATISTICAL MODELS
Three semester hours
Prerequisites: 34955 Regression Analysis, 34065 Time Series Analysis

Nonlinear regression; least squares estimation; hypothesis testing. Use of SAS. Multivariate nonlinear regression. Nonlinear simultaneous equation models; method of moment estimators.

34067 MULTIVARIATE STATISTICS
Three semester hours
Prerequisite: 34955 Regression Analysis

Multivariate normal distribution: definition; moments; characteristic function; estimation of mean and covariance matrices; Wishart distribution; Hotellings' T2. Multivariate linear regression. Principal components. Factor analysis: different models - Spearman, Burt, Thurstone; geometric models; unit rank; invariance.

34068 STATISTICAL MODELLING
Three semester hours
Prerequisite: 34956 Design of Experiments

Revision of linear models and exponential families. Generalised linear models. Applications including logistic regression and contingency tables. Modelling using statistical distributions; continuous distribution models; discrete distribution models.

34069 LINEAR MODELS AND EXPERIMENTAL DESIGN

Three semester hours

Prerequisites: 34956 Design of Experiments, 34067 Multivariate Statistics

The subject provides the linear model theory for experimental design models and presents advanced experimental designs. Topics include: linear models - the linear model of less than full rank, the analysis of variance, completely randomised and randomised block designs, response surfaces, incomplete block designs, repeated measures designs.

34096 CONVEXITY AND OPTIMISATION (Honours)

Three semester hours

Prerequisite: 34013 Modern Analysis (Honours)

As for 34996 Convexity and Optimisation. Additional content includes: application of Kuhn-Tucker theorem to calculus of variations. Introduction to applications in optimal control theory.

34098 PROJECT (Honours)
34099 PROJECT (Honours)

34098 (Autumn) Three semester hours
34099 (Spring) Six semester hours

Prerequisite: Admission to the BAppSc(Hons) programme

Students will perform an independent investigation of an area of the mathematical sciences chosen in consultation with a supervisor who will be appointed by the Head of School. The project commences in the Autumn Semester of the honours year and students will enrol in the three hour unit 34098. The project continues in the Spring Semester with the six hour unit 34099. At the end of the Spring Semester identical results will be awarded for both 34098 and 34099 (based on assessment consisting of the presentation of a report and seminar).

SCHOOL OF COMPUTING SCIENCES

The School of Computing Sciences is one of 7 Key Centres for Teaching and Research established by the Federal Government in 1985. It was the first federally funded Centre for Advanced Computing Sciences in Australia.

The School of Computing Sciences offers a degree course in Computing Science leading to the award of Bachelor of Applied Science. In 1988, at the request of government and industry, a new degree course was introduced, leading to the award of Bachelor of Information Technology. In addition, the School offers a graduate course leading to the award of a Graduate Diploma in Data Processing.

The School also offers a three year, part-time course leading to a Master of Applied Science (Information Science) by course work. In addition, the School offers two degrees by research and thesis: the Master of Applied Science (by Thesis) and the Doctor of Philosophy.

Prospective applicants for graduate courses should firstly ascertain from the Graduate Studies Officer whether they conform with the general University requirements for admission before consulting with the School about special requirements.

The School has appointed a number of academic advisors: two for undergraduate full-time students; one for undergraduate part-time students; one for Graduate Diploma students; one for Masters students; and one to advise prospective students.

The functions of the academic advisors are: (i) to advise students regarding course progress and academic progression; (ii) to approve changes to enrolment details; (iii) to advise, when necessary, on personal matters; (iv) to arrange specialist tutorial assistance or counselling.

The School provides subjects in Computer Science for other Faculties.

DOUBLE DEGREE IN BUSINESS AND COMPUTING SCIENCES

From 1989 a double degree in Business and Computing Science will be offered. Students enrol initially in the normal Bachelor of Business degree and take the Computing Science sub-major. On satisfactory completion of the Business Degree and the Computing Science sub-major, a student should then apply to be admitted to the Bachelor of Applied Science (Computing Science). On admittance, the student would be granted advanced standing in view of (a) the student's Computing Science sub-major and (b) part of the student's Business major which would be used in lieu of the requirement for external electives in the BAppSc(CompSc). Students could expect to complete the double degree in approximately 6 years full-time or equivalent part-time.

DOCTOR OF PHILOSOPHY (BY THESIS)

In general terms, the PhD degree entails a more extensive investigation than the MAppSc (by thesis) degree. In addition, the PhD students are expected to demonstrate significant originality in the conduct of their research work. Areas of particular interest for research towards the Doctor of Philosophy (by thesis) degree in the School of Computing Sciences include:

- Operating Systems
- Computer Performance Evaluation
- Intelligent Office Automation Systems
- Computer Graphics, Image Processing
- Artificial Intelligence, Expert Systems, Knowledge Bases, Inference
- Local Networks and Network Interface Technology
- Neural Networks
- Parallel Processing and Transputers
- Information Modelling
- Auditing Large Data Bases
- Microprocessors and their Applications
- Distributed Data Bases
- Computer Systems Security
- Object Oriented Techniques.

The Doctor of Philosophy degree is available on both a full-time and a part-time basis. The normal duration of enrolment for this degree is three years on either attendance pattern; however, candidates who already possess a degree at the Masters level may be permitted to complete in two years. The maximum duration of enrolment is five years for full-time students and six years for part-time students.

Applicants should hold a first class, or second class division one, Bachelor's degree with a major computing component, or should hold a Master's degree in an appropriate area, or should have previously undertaken other post-graduate studies in computing. Prospective applicants are expected to have developed interests in a specific area of research, and should have one or more specific proposals for research work in that area. Before submitting a formal application for admission to this degree course, applicants should first seek the approval

of the School for their proposed research work. To gain this approval, applicants should initially:

either send a summary proposal of at least 1,000 words to the Director, Centre for Graduate and External Studies, School of Computing Sciences. This summary proposal should contain references to seminal works in the area of proposed research. If the proposal is of interest to the School then the Director will direct the applicant to a suitable member of staff for further detailed discussion

or approach a suitable member of the School's academic staff directly and discuss the proposed research.

When the applicant's proposed research has been approved by a member of the School's academic staff, and if that member of staff is prepared to supervise the research, then the applicant may formally apply for admission. Formal application for admission should consist of:

* a completed "Application For Admission - Graduate Courses" Form, which is available from the UTS Information Service, and

* a description of the proposed research of at least 1,000 words which should be signed by both the applicant and the proposed supervisor.

Criteria for admission to the Doctor of Philosophy (by Thesis) support the University's Equal Opportunity policy: "It is the policy of the University of Technology, Sydney to provi-de equal opportunity for all persons regardless of race, sex, marital status, physical disability or homosexuality".

Application forms may be obtained from the UTS Information Service. General enquiries should be directed to either the UTS Information Service, telephone 330-1222, or the Faculty Graduate Assistant, telephone 330-1806. Note that all prospective applicants should contact the Faculty Graduate Assistant BEFORE submitting an application to this course.

MASTER OF APPLIED SCIENCE DEGREE (BY THESIS)

The MAppSc (by thesis) degree enables graduates to extend and deepen their knowledge of a specialised area in computing by undertaking research under the supervision of a member of the academic staff. Areas of particular interest for research in the School of Computing Sciences include:

- Operating Systems
- Computer Performance Evaluation
- Intelligent Office Automation Systems
- Computer Graphics, Image Processing
- Artificial Intelligence, Expert Systems, Knowledge Bases, Inference
- Local Networks and Network Interface Technology
- Neural Networks
- Parallel Processing and Transputers
- Information Modelling
- Auditing Large Data Bases
- Microprocessors and their Applications
- Distributed Database
- Computer Systems Security
- Object Oriented Techniques.

This degree is available on a full-time, part-time and external basis. The normal duration of enrolment for this degree is two years on full-time attendance or three years on part-time attendance. The School of Computing Sciences has a strong preference for research work which proceeds at a full-time pace. This preference should not be seen as a deterrent to those students who wish to remain in employment. External students, who are working in a full-time job, are encouraged to select a topic for their research which is closely aligned with their professional work. Once such a topic has been selected, the School usually requires that the student's employer provide a statement to the effect that *at least* half of the student's working week will be devoted to work which is directly relevant to the research. The student is then expected to contribute some of his or her own time to the project which brings the total number of hours devoted to research within that expected of full-time attendance.

There are no tuition fees for this course, and students are not required to pay the HECS (i.e. Higher Education Contribution Scheme). However students are required to pay Students' Association and Student Union fees.

Applicants should hold a first degree with a major computing component or should have previously undertaken other postgraduate studies in computing. Prospective applicants are expected to have developed interests in a specific area of research, and should have one or more specific proposals for research work in that area. Before submitting a formal application for admission to this degree course, applicants should first seek the approval of the School for their proposed research work. To gain this approval, applicants should initially:

either send a summary proposal of at least 1,000 words to the Director, Centre for Graduate and External Studies, School of Computing Sciences. This summary proposal should contain references to seminal works in the area of proposed research. If the proposal is of interest to the School then the Director will direct the applicant to a suitable member of staff for further detailed discussion

or approach a suitable member of the School's academic staff directly and discuss the proposed research.

When the applicant's proposed research has been approved by a member of the School's academic staff, and if that member of staff is prepared to supervise the research, then the applicant may formally apply for admission. Formal application for admission should consist of:

* a completed "Application For Admission - Graduate Courses" Form, which is available from the UTS Information Service, and

* a description of the proposed research of at least 1,000 words which should be signed by both the applicant and the proposed supervisor.

Criteria for admission to the Master of Applied Science (by Thesis) support the University's Equal Opportunity policy: "It is the policy of the University of Technology, Sydney to provide equal opportunity for all persons regardless of race, sex, marital status, physical disability or homosexuality".

Application forms may be obtained from the UTS Information Service. General enquiries should be directed to either the UTS Information Service, telephone 330-1222 or Faculty Graduate Assistant, telephone 330-1806). Note that all prospective applicants should obtain approval for their proposed research work *either* from the Director, Centre for Graduate and External Studies *or* from their chosen supervisor BEFORE submitting an application form for admission to this course.

MASTER OF APPLIED SCIENCE DEGREE (BY COURSE WORK) IN INFORMATION SCIENCE

The MAppSc (by course work) in Information Science enables graduates to select a programme of study which suits individual career goals. For example, a programme may be chosen which develops specialised expertise in computer systems, which provides a general update of Information Science technology or one which equips the student for a position in corporate management as an information scientist.

The course is intended for Computing Professionals. Applicants should have both:-

1) a bachelor's degree from the University of Technology, Sydney, or equivalent, preferably with a major computing component. Those applicants whose degrees do not have a major computing component will be required to submit evidence to the effect that the extent of their formal knowledge of computing is equivalent to that of a graduate from the University's Bachelor's degree in Computing Science.

and

2) an established professional career within the Information Industry. As a guide, the extent of the applicant's professional experience should be equivalent to that of an Associate Member of the Australian Computer Society of at least two years standing.

The course is offered on a part-time basis only, over 6 semesters (3 years), as it is considered important that students remain in professional employment whilst undertaking their graduate studies in Information Science. Attendance is required for at least two evenings per week for lectures, and at the periodical seminar evenings.

Each semester the School publishes the MAppSc (by course work) in Information Science Handbook. This Handbook contains much administrative information as well as a detailed statement of the course regulations. Students and prospective applicants are advised to obtain a copy of this Handbook and to study it carefully. An "admission package" containing a copy of the Handbook, the application forms and other relevant information is available from July onwards each year. Prospective applicants may obtain one of these packages by contacting either the the UTS Student Information Service, telephone 330-1222 or Faculty Graduate Assistant, telephone 330-1806) or the University's Graduate Studies Office. Note that completed application forms must be submitted to the University by October 31 in the year prior to that in which admission is sought.

The minimum total duration of the course is 54 semester hours, consisting of the following:

(a) Formal lectures and laboratory requirements will total a minimum of 40 semester hours;

(b) There is a specific requirement for seminar attendance for one hour per week throughout the time the candidate is enrolled. Thus, depending on the duration of the course, this will add a minimum of six semester hours to the total contact time in the course.

(c) The remainder of the course will be comprised of the equivalent of eight semester hours of Project work.

The course work is structured into four "strands". These four strands comprise the fundamental areas of Computer Systems, Information Systems and Computing Methods, as well as a Management strand. Students select a total of ten subjects. This selection will contain at least one subject from each of the four strands, and at least one entire strand.

Students enrol in the Seminar subject each semester, and are required to attend at least 70% of the research seminars presented in any semester to be eligible to take examinations at the end of that semester.

The Project is undertaken during the final year of enrolment.

Any Master's Degree candidate enrolled in the MAppSc (by course work) in Information Science who records two failures *at any stage* will be excluded from the course absolutely.

GENERAL COURSE DESCRIPTION

Students select a programme from the following subjects:

COMPUTING METHODS
32100 Advanced Programming Techniques
32101 Intelligent Systems
32104 Decision Making and Modelling
32105 Specialist Topics in Artificial Intelligence

INFORMATION SYSTEMS
32200 Information Processing Strategy
32201 Data Base
32202 Communication Systems
32203 Information Management

COMPUTER SYSTEMS
32301 Performance Evaluation
32302 Computer Architecture
32304 Computer Languages
32305 Operating Systems

MANAGEMENT
21718 Organisation Analysis and Design
32400 Accounting for Management
32401 Management Policy and Strategy
79729 The Legal Environment of Business

GRADUATE DIPLOMA IN DATA PROCESSING

This course aims to provide students with the basi knowledge and skills required for a professional caree in programming and/or systems work. It is designed fo people who have already taken a first degree in whic computing has not been included or only covered lightly

The course is not open to students who have alread completed the Bachelor of Applied Science (Comput ing Science), Diploma of Technology (Informatio Processing), or a similar course at an equivalent level

Satisfactory completion of this course leads to the awar of Graduate Diploma in Data Processing. Holders o Graduate Diploma in Data Processing are granted ex emption from the Associate examinations of the Austra lian Computer Society.

It is anticipated that students entering the course wil have previously studied courses from a wide range o disciplines. Some will have graduated with no previou contact with computing and data processing; some wil have had some familiarisation with computing; an others will be familiar with computing concepts in area such as programming, and will be seeking to consolidat their present knowledge by attaining a formal qualifica tion.

Admission Requirements

The pre-requisite for entry to the Graduate Diplom course is a working knowledge of the programmin languages PASCAL and COBOL. For intending appli cants who do not have the required knowledge o PASCAL and COBOL, extension courses are offered by INSEARCH each semester. There is a cost attached t these which may be ascertained by contactin INSEARCH on 330-2152.

The courses in PASCAL and COBOL are each of 4 hours duration, and have been assessed by the School o Computing Sciences as meeting the standards require to satisfy the language component of the admissio criteria. However, the number of applicants for th Graduate Diploma is always in excess of the number o places; therefore completion of these courses does no guarantee a place in the Graduate Diploma in Dat

Processing. Applicants may present for consideration evidence of successful completion of any PASCAL and/or COBOL course, or of substantial work experience using these languages. The committee will assess this evidence and ascertain whether it satisfies the prerequisites for the course. Any PASCAL or COBOL course undertaken should not, as a general rule, be shorter than that offered by INSEARCH.

In addition, applicants should have a first degree, equivalent to an undergraduate 3 year degree from the University of Technology, Sydney. If in any doubt about the ranking of your qualification, you should contact the Graduate Studies Office or the Admissions Branch at the University, or write to the National Office of Overseas Skills Recognition, PO Box 25, Belconnen, ACT, 2616.

For further information, candidates should telephone Bruce Irvine on 330-1806, or the School Office on 330-1803, where a "call back" message may be left, or write to:

The Co-ordinator
Graduate Diploma in Data Processing
School of Computing Sciences
University of Technology, Sydney
PO Box 123
BROADWAY NSW 2007

All applications should be well documented, including proof of graduate status, the applicant's academic record, and other documentation the applicant wishes to provide in support of their application.

Course Fees

Australian citizens and permanent residents will contribute to the cost of the course through HECS (i.e. the Higher Education Contribution Scheme). The HECS charge for a part-time student taking three subjects per semester will be approximately $1,125 per annum for 1992.

It is the responsibility of each student to ensure that he/she is correctly enrolled for each subject attempted. A student will not be credited for any work done in a subject for which he/she is not formally enrolled. No refund of HECS will be given for subjects deleted after the published deadlines.

In addition to course charges students are required to pay Student's Association fees and University Union fees.

Mode and length of study

The course is normally taken on a part-time attendance pattern over two years (two evenings and one afternoon per week). However, some students may take longer to complete the course. This is possible, subject to approval, but it must be noted that the attendance pattern in this latter case will require students to attend the University for at least six hours a week, depending upon the times at which subjects are scheduled for a particular semester. In exceptional circumstances, the course may be undertaken on a full-time attendance pattern over one year.

Students may be permitted to enter the course with advanced standing but, in order to qualify for an award, a student must complete at least twenty four semester hours of the prescribed thirty six hours for the course. Exemptions from some compulsory subjects will normally only be granted where a student has partially completed a similar Graduate Diploma elsewhere. A maximum of 12 (twelve) semester hours **ONLY** may be exempted.

Where a student can demonstrate proficiency in a subject area, approval for substitution of Semester 1 and 2 subjects by other approved subjects from the undergraduate course may be granted.

Unsatisfactory Student Progress

All students in the Graduate Diploma in Data Processing course should be aware that unsatisfactory performance in the course will result in the Faculty Board in Mathematical and Computing Sciences ruling that the student's enrolment is terminated. Any of the following will be taken to indicate unsatisfactory progress.

1. Failure to complete the course in 6 semesters from the time of registration in the case of a part-time student, or in 3 semesters from the time of registration in the case of a full-time student. This is not inclusive of periods of leave of absence.

2. Failure in any subject 3 times.

Course Rules

To complete the Graduate Diploma students must pass 36 semester hours. Since all subjects for this course are 3 semester hour subjects, this means you must complete 12 subjects.

Of these you must take SIX core subjects:

31071 Introduction to Information Systems
31073 Introduction to Computer Systems
31021 Systems Analysis
31022 Commercial Programming Development
31031 Database
and one of
31032 Communications and Networks
or
31017 Accounting Fundamentals

In addition you must take SIX electives These are usually chosen from the list given below or from elective subjects in the BAppSc(Computing Science). You must have completed the appropriate prerequisites for the electives which you chose and your choice must be approved by the Graduate Diploma Co-ordinator.

Graduate Diploma Electives Usually Offered in Autumn

		Hours/Week
31032 *	Communications and Networks	3
31017 *	Accounting Fundamentals	3
31015	Discrete Mathematics	3
31041	Systems Design	3
31042	On-Line Systems	3
31058	Project Management	3
31023	Computer Systems Architecture 2	3

* If not taken as a core subject.
Other electives may be available during the day.

Graduate Diploma Electives Usually Offered in Spring

31024	Data Structures and Algorithms	3
31025	Introduction to Software Engineering	3
31026	Probability and Statistics	3
31033	Operating Systems	3
31041	Systems Design	3
31042	On-Line Systems	3
31047	Management Control Systems	3
31048	Business Tools and Applications	3
31053	Communications Software	3

Other electives may be available during the day.

A RECOMMENDED PART-TIME PROGRAMME

Semester 1 (Autumn)		*Hours/Week*
31021	Systems Analysis	3
31071	Introduction to Information Systems	3
31073	Introduction to Computer Systems	3
Semester 2 (Spring)		
31022	Commercial Programming Development	3
31031	Database	3
	Elective	
Semester 3 (Autumn)		
31032	Communications and Networks	3
	and/or	
31017	Accounting Fundamentals	3
	One or two electives	3 or 6
Semester 4 (Spring)		
	Three electives	9

NOTE that the hours per week are lecture and tutorial hours. Plan to spend at least the same time again on private study.

STUDENTS WHO COMMENCED PRIOR TO 1990 WILL FOLLOW THE PART-TIME PROGRAMME AS SET OUT IN THE SCHOOL OF COMPUTING SCIENCES HANDBOOK FOR THE YEAR IN WHICH THEY ENTERED THE GRADUATE DIPLOMA COURSE.

BACHELOR OF APPLIED SCIENCE (COMPUTING SCIENCE)

The aim of the course is to provide a sound education in all aspects of computing for students who intend to make a career in the profession. It is intended that the course will provide a suitable background covering all aspects of computing science, short of the actual design and construction of "hardware" systems.

The course has been designed to provide for the study in depth of computing science and its applications, and, in addition, support subjects are included to enable the graduate to fulfil an appropriate function in the sphere of business activity. It is intended that the formal studies will be treated in a manner which will encourage initiative. Not only will the course provide a suitable framework for a professional career, but it will also form a basis from which postgraduate studies may begin.

The course comprises six academic semesters of full-time study or the equivalent in part-time attendance and a period of industrial training.

Holders of the degree are granted exemption from the Associate examinations of the Australian Computer Society.

Industrial Training

All students in the BAppSc(Computing Science) are required to enrol in, and pass, the two Industrial Training subjects. There are a substantial number of pre-requisites for Industrial Training; these pre-requisites are noted in the subject description section. Full-time students normally undertake Industrial Training after completing Semester 4; the Industrial Training subject numbers for the full-time attendance pattern are 31696 and 31697. Part-time students normally undertake Industrial Training after completing Stage 4; the Industrial Training subject numbers for the part-time attendance pattern are 31698 and 31699.

To gain credit for Industrial Training, students are required to obtain an approved, full-time job within the Information Industry. The duration of Industrial Training is nine months for full-time students and eighteen months for part-time students. During Industrial Training students are required to behave in a professional manner, and, to enable the School to assess their experience, are required to keep the School informed of the status of their employment at all times. Each year the School of Computing Sciences published an Industrial Training "Student Guide" which sets out in detail what is required to pass these two subjects; students are advised to obtain a copy of this guide and to study it carefully.

Although the securing of suitable employment during Industrial Training is the student's responsibility, the School will assist students in obtaining a placement.

Those who wish to seek an Industrial Training position without the direct assistance of the School should first make an appointment to see the School's Co-operative Education Officer who will provide a description of the requirements of an Industrial Training position. If a student finds employment an appointment should be made to see the School's Co-operative Education Officer and to obtain certification that the employment is suitable for Industrial Training.

Students who wish to benefit from the direct assistance of the School in finding an Industrial Training position should obtain a copy of the Industrial Training "Student Guide" from the School Office and carefully study the procedure to be followed.

Industrial Training students are assessed by senior members of the academic staff.

In general, students find Industrial Training extremely beneficial in relating the final year of course work to the practical needs of the Information Industry, and this experience can be cited when applying for graduate career positions.

Laboratory Sessions

These sessions are designed to give students formal tuition in using computer systems and to give practical experience of the course work. Every laboratory session is attached to a specific subject. (For example, Commercial Programming Development is 5 semester hours, lectures and tutorials being scheduled for 3 hours and the laboratory session being 2 hours.) Full-time students have laboratory sessions totalling 6 hours per week scheduled in each semester, excluding the Industrial Year, and part-time students have laboratory sessions of three hours per week scheduled in each semester.

Exemptions

Exemptions may only be granted on the basis of recent academic study towards an incomplete degree. The student must be able to demonstrate that the knowledge is current. Exemptions for core subjects may be granted where subjects successfully studied previously coincide with BAppSc subjects. For further information consult the current School Handbook.

Exemptions are usually processed by the School immediately following enrolment.

BACHELOR OF APPLIED SCIENCE (COMPUTING SCIENCE)

A RECOMMENDED FULL-TIME PROGRAMME

YEAR 1

Autumn Semester		*Hours/Week*
31611	Information Systems	4
31613	Computer Systems Architecture 1	3
31614	Programming Principles	7
31615	Discrete Mathematics	5
31617	Accounting Fundamentals	3
51370	Human Communication	2

Spring Semester		*Hours/Week*
31621	Systems Analysis	3
31622	Commercial Programming Development	5
31623	Computer Systems Architecture 2	5
31624	Data Structures and Algorithms	5
31625	Software Engineering	3
31626	Probability and Statistics	3

YEAR 2

Autumn Semester		
31631	Database	4
31632	Communications and Networks	5
31633	Operating Systems	5
31636	Simulation and Modelling	4
	CS/IS Elective 1	3
	Elective 1	3

Spring Semester		
31641	Systems Design	4
31642	On-Line Systems	5
31647	Management Control Systems	4
31648	Business Tools and Applications	5
	CS/IS Elective 2	3
	Elective 2	3

YEAR 3

Autumn Semester		
31696	Industrial Training	6

Spring Semester		
31697	Industrial Training	6

YEAR 4

Autumn Semester		
31653	Communications Software	6
31655	Theory of Computer Science	4.5
31658	Project Management	4.5
	CS/IS Elective 3	3
	Elective 3	3
	Elective 4	3

Spring Semester		
31662	Information Systems Case Study	6
31666	Performance Evaluation	6
31669	Social Implications of Computers	3
	CS/IS Elective 4	3
	Elective 5	3
	Elective 6	3

A RECOMMENDED PART-TIME PROGRAMME

YEAR 1

Autumn Semester		*Hours/Week*
31611	Information Systems	4
31615	Discrete Mathematics	5
31617	Accounting Fundamentals	3

Spring Semester		
31613	Computer Systems Architecture 1	3
31614	Programming Principles	7
51370	Human Communication	2

YEAR 2

Autumn Semester		
31621	Systems Analysis	3
31622	Commercial Programming Development	5
31623	Computer Systems Architecture 2	5

Spring Semester		
31624	Data Structures and Algorithms	5
31625	Software Engineering	3
31626	Probability and Statistics	3

YEAR 3

Autumn Semester		
31631	Database	4
31632	Communications and Networks	5
	CS/IS Elective 1	3

Spring Semester		
31633	Operating Systems	5
31648	Business Tools and Applications	5
	Elective 1	3

YEAR 4

Autumn Semester		
31641	Systems Design	4
31642	On-Line Systems	5
	CS/IS Elective 2	3

Spring Semester		
31636	Simulation and Modelling	4
31647	Management Control Systems	4
	Elective 2	3

YEAR 5

Autumn Semester		
31655	Theory of Computer Science	4.5
31658	Project Management	4.5
	CS/IS Elective 3	3
31698	Industrial Training	3

Spring Semester		*Hours/Week*
31653	Communications Software	6
	Elective 3	3
	Elective 4	3
31698	Industrial Training	3

YEAR 6

Autumn Semester		
31669	Social Implications of Computers	3
31666	Performance Evaluation	6
	CS/IS Elective 4	3
31699	Industrial Training	3

Spring Semester		
31662	Information Systems Case Study	6
31699	Industrial Training	3
	Elective 5	3
	Elective 6	3

Computing Science Electives

Students who do not wish to take a sub-major or strand from another school may choose electives from those offered by the School of Computing Sciences.

In lieu of elective(s) students may take one 3 hour project, two 3 hour projects, or one 6 hour project over one or two semesters. In many cases, these projects may be completed over the Christmas or between-semester breaks, if desired.

Students may not use as a project work done in the normal course of duties as an Industrial Training student or as a part-timer. However, a student may do something extra related to work as a project. In this case, his work superior would probably become a joint supervisor.

A student in a 3 hour subject is expected to do at least as much work again at home, so a MINIMUM of six hours a week would be spent on the project.

A list of electives available in 1992 appears in the Subject Synopses section.

BACHELOR OF INFORMATION TECHNOLOGY.

This course is a co-operative education programme in computer information systems and has been developed by the School of Computing Sciences in co-operation with a group of private and public sector employers. The course is of three years duration and involves four semesters of full-time study at the University and two semesters of full-time study and practical experience in industry. The industry semesters are of 24 weeks duration, and a 42 week academic year is the norm for the course.

Year	Semester 1	Semester 2
1	UTS	Industry
2	UTS	UTS
3	Industry	UTS

The programme differs from existing co-operative education courses in that, during the industry-based semesters, students will follow a structured programme designed jointly by the University and the employer group, including formal course work taught in industry. This course work is assessed to University and business standards and familiarises students with business needs and requirements. During the industry periods students will be exposed to real problems within an environment quite different from that of the University. The resources of industry will be available to support the education of students.

The central curriculum of the course is information systems; this is supported by studies in management, accounting, finance and marketing as well as the necessary background subjects in computing science and programming. The active participation of industry practitioners in course design and course delivery will further ensure that graduates of the course are well equipped with skills relevant to present and future industry needs.

The two industry semesters will be spent with two different companies. Students are not employees of the company, and will not be obliged to find employment with a given company on completion of their studies. Nevertheless students are encouraged to find employment within the group of sponsoring employers.

The number of students admitted each year will be limited by the number of sponsorship commitments secured from employers, to a maximum of fifty places.

Each student admitted to the course will receive a scholarship for the duration of the course, subject to satisfactory performance and to certain conditions detailed further in this Handbook. Each of the industry partners undertakes to sponsor a stated number of students, and contributes the full amount of their scholarship to a fund administered by the University.

Each company also provides the industry semester facilities for the number of students being sponsored.

Selection to the course is based on HSC results and on performance at interview. Interviews are conducted by panels comprising representatives of the University and the industry group. Applicants will be assessed for their suitability to the industrial as well as the academic components of the course.

RECOMMENDED PROGRAMME

Semester 1 - UTS		*Hours/Week*
31711	Information Systems	4
31713	Computer Systems Architecture	3
31714	Programming Principles	7
31715	Discrete Mathematics	5
31717	Accounting Fundamentals	3
31721	Systems Analysis	3
Semester 2 - Industry		
31722	Commercial Programming	5
31770	Industry Project 1	14
31771	Business Requirements Analysis	3
31779	Applications of Information Technology 1	3
Semester 3 - UTS		
23106	Economics	3
24105	Principles of Marketing	3
31731	Database	4
31732	Communications and Networks	5
31733	Operating Systems	5
31738	Management Principles for IT Professionals	3
Winter		
31780 *	Industry Studies	6
Semester 4 - UTS		
31725	Software Engineering	6
31726	Probability and Statistics	3
31741	Systems Design	4
31742	On-Line Systems	5
31747	Management Control Systems	3
31788	Organisation Theory for IT Professionals	3
Semester 5 - Industry		
31756	Project Management	3
31781	Business Systems Design	3
31789	Applications of Information Technology 2	3
31790	Industry Project 2	14
Semester 6 - UTS		
25314	Business Finance 1	3
31762	Technology Planning	6
31766	Performance Modelling and Management	6
31767	Auditing the Computer	3
31768	Business Planning for IT Professionals	3
31769	Social Implications of Computers	3

* This subject requires commitment of time over the winter period, in order to complete the 42 week requirement of the course.

Conditions Relating to Students Enrolled in the Bachelor of Information Technology.

Students enrolled in the Bachelor of Information Technology are notified here of certain special conditions.

Leave of absence will not normally be granted to students, except under exceptional circumstances and subject to satisfactory arrangements being possible. Likewise, withdrawal from the course and subsequent re-admission is not normally granted. Students are reminded that withdrawal without penalty from any course at the University is only possible up to the deadlines imposed by the University. After such deadlines, students will be expected to complete all assessment tasks for subjects in which they are enrolled.

Variations to the approved programme of study for the Bachelor of Information Technology are restricted. No industry-based subject may be deleted from the programme, except under extraordinary circumstances and at the discretion of the course Steering Committee and the School of Computing Sciences. No industry-based subject can be taken during a University-based semester. The taking of additional subjects during an industry-based semester is seen as unusual and may only be done at the discretion of the Steering Committee and the School.

The School will not recommend probation for unsatisfactory academic performance. Instead, the School will recommend to the Academic Board that a student be excluded under the following circumstances:

* a student fails any subject for the second time
* a student has a Weighted Average Mark of less than 45% at the end of any assessment period
* a student fails any subject that is part of the programme of an industry-based semester (there is provision for a supplementary examination to be taken in these subjects following a failure at the first

attempt) or a student performs unsatisfactorily during an industry-based semester

* a student who, immediately prior to the commencement of an industry-based semester, has still to complete more than one subject in the normal programme of the course to that stage.

Appeals against exclusion will be dealt with at the Exclusion Appeals Committee, who will take into account the recommendation of the course Steering Committee.

Industry Semesters

The dates of the industry-based semesters for 1992 are as follows:

Autumn Semester (3rd year students)
Monday, January 20, 1992 - Friday, July 3, 1992

Spring Semester (1st year students)
Monday, July 6, 1992 - Thursday, December 18, 1992

Students are expected to attend their assigned sponsoring company on a full-time basis throughout these periods. Students cannot expect any absences to be approved during the industry semesters.

Scholarship

The scholarship will be paid at three different and increasing levels, Levels 1, 2 and 3, where Level 2 is the average of the three levels. All first year students will start at Level 1; at the end of each year all BInfTech students with *satisfactory progress* will move from their current level to the next level.

The levels for 1992 are as follows:-

Level 1	$9,000 per annum
Level 2	$9,450 per annum
Level 3	$9,900 per annum

The scholarship paid to BInfTech students has been ruled as tax exempt.

Name Change

The Bachelor of Information Technology was formerly known as the Bachelor of Technology (Information Systems). This change is to the name only, the objectives and content of the course remain unchanged.

EXTENSION COURSES

The School offers courses which run regularly each semester for fifteen weeks, one evening per week, in:

UNIX/C
COBOL
Pascal
Auditing Computer Systems

The School also offers other extension courses at various times during the academic year. These include:

Auditing Computer Systems
Database Design
C and UNIX for the Professional
Expert Systems Design
4th Generation Languages and Application Building
Introduction to Capacity Planning
OCCAM and the Transputer
Object Oriented Programming in Eiffel
Object Oriented Design.
Software Quality Assurance
Using Relational and E-R Models

In addition, the School offers weekly "State-of-the-Art" seminars, usually on Wednesday afternoons. Visitors are welcome.

SYNOPSES FOR BACHELOR OF APPLIED SCIENCE 1992

CORE SUBJECTS

31611 INFORMATION SYSTEMS

Four semester hours

This subject focuses on the use of computer based systems in an organisational context. Typical computer based systems: data processing and information systems, office support systems, personal computers, embedded systems. Organisational benefits of computer based systems, objectives, costs and risks. On-line, off-line, real time systems. Batch, interactive and transaction processing. Description of data flows: process flow charting. Introduction to simple business applications and the commercial system development life cycle. Operational issues.

31613 COMPUTER SYSTEMS ARCHITECTURE 1
Three semester hours

This subject is an introduction to computer hardware and software systems. The relationship between hardware and software is discussed by considering the structure of the computer, the inter-relationship of the various components and the processing by the computer of data and program. Students will be introduced to machine-language and to assembly-language programming.

31614 PROGRAMMING PRINCIPLES
Seven semester hours

This subject provides an introduction to problem analysis and solution on the computer. Students gain experience at using the Unix operating system, program compilation and execution, and interactive and noninteractive processing. Methods of problem analysis, pseudocoding, coding, debugging, testing and documentation are introduced through the use of the procedural language Pascal. The principles of object oriented programming are discussed, and students implement this approach in the language Eiffel.

31615 DISCRETE MATHEMATICS
Five semester hours

This subject develops the mathematics of discrete objects and models. Logic: propositions, truth tables, predicate logic, proof techniques. Set theory: sets, relations, relational algebra, functions, iteration, recursive definitions and inductive proof, partial orders and equivalence relations. Discrete structures: natural numbers, lists, trees. Functional programming (Miranda) is used to illustrate the mathematical concepts introduced.

31617 ACCOUNTING FUNDAMENTALS
Three semester hours

This subject provides a general introduction to financial accounting and business law. Accounting related applications are the backbone of many commercial computing systems and an understanding of business law facilitates the study of business methods.

31621 SYSTEMS ANALYSIS
Three semester hours
Prerequisites: 31611 Information Systems

Introduces systems concepts and a range of techniques used in systems analysis. Covers the techniques used to analyse all discrete systems data functions and flows inclusive of data flow diagrams, relational analysis and normalisation and E-R modelling. Describes systems life cycles and the role of these techniques within life cycles in evaluating requirements and proposals and setting objectives for new systems.

31622 COMMERCIAL PROGRAMMING DEVELOPMENT
Five semester hours
Prerequisites: 31614 Programming Principles, 31611 Information Systems

This subject covers structured design techniques and their application to COBOL programming in an offline commercial environment.

31623 COMPUTER SYSTEMS ARCHITECTURE 2
Five semester hours
Prerequisites: 31613 Computer Systems Architecture 1, 31614 Programming Principles

This subject is a continuation of Computer Systems Architecture 1. The concepts introduced there are elaborated upon and study of CPU internals is facilitated by use of assembler language on a real machine. Additional requirements of architectures for performance enhancement and support of high-level languages and operating systems are discussed.

31624 DATA STRUCTURES AND ALGORITHMS
Five semester hours
Prerequisites: 31614 Programming Principles, 31615 Discrete Mathematics, 31625 Software Engineering should be done before or concurrently

Structured approach to programming including: modular design, step-wise refinement, top down design, documentation and layout, complexity analysis program correctness and program testing strategies. The data structures covered include records, sets, files and the pointer based dynamic data structures: stacks, queues, lists and binary trees. Each data structure is presented as an abstract data type, and then discussed at the user and implementation levels. Common searching and sorting algorithms are also discussed.

31625 SOFTWARE ENGINEERING
Three semester hours
Prerequisites: 31614 Programming Principles, 31615 Discrete Mathematics

This subject introduces the formal aspects of modern software engineering. Topics: an overview of the software engineering environment, the practice of formal

mathematical specification, programme development via refinement of specifications, programmes correctness, machine executable specifications, an overview of software testing and reliability.

31626 PROBABILITY AND STATISTICS
Three semester hours

Descriptive statistics. Probability theory, random variables, conditional probabilities, independence and Bayes' theorem, and modelling of uncertainty, measures of central tendency and dispersion, moments. Processes and distributions: binomial, Poisson, normal and sampling. Theorems: Chebychev, central limit. Applied statistics: estimation, confidence intervals, hypothesis testing and types of errors; problem solving by theory, statistical tables and machine packages.

31631 DATABASE
Four semester hours
Prerequisites: 31621 Systems Analysis

This subject deals with database design and implementation methodologies. Both entity-relationship and relational models are described and used to facilitate database design. The SQL language is described in detail illustrating database query and update techniques. Traditional database approaches including codasyl and hierarchical databases are described.

31632 COMMUNICATIONS AND NETWORKS
Five semester hours
Prerequisites: 31611 Information Systems, 31613 Computer Systems Architecture 1

This subject introduces communication concepts and terminology. It describes the problems involved in the Physical and Data Link Layers of communication and their solutions. It discusses network architectures, topologies and carrier services.

31633 OPERATING SYSTEMS
Five semester hours
Prerequisites: 31623 Computer Systems Architecture 2, 31624 Data Structures and Algorithms

An introduction to the student of the concepts and facilities available in computer operating systems. The subject includes scheduling, multiprogramming, protection and resource control.

31636 SIMULATION AND MODELLING
Four semester hours
Prerequisites: 31626 Probability and Statistics, 31624 Data Structures and Algorithms

Principles and practice of modelling: analysis, data gathering, solution, validation, implementation. Modelling in and of computer systems, queueing theory, continuous simulation, languages, corporate modelling, forecasting and inventory.

31641 SYSTEMS DESIGN
Four semester hours
Prerequisite: 31631 Database

This subject focuses on the user and business aspects of systems design. User interface issues cover dialogue, screen, report and forms design as well as designing and writing user documentation. Integration with business environment includes business procedures, security, control and implementation. A variety of design and implementation strategies are introduced, such as prototyping, CASE tools and 4GL's.

31642 ON-LINE SYSTEMS
Five semester hours
Prerequisites: 31622 Commercial Programming Development, 31632 Communications and Networks
Co-requisite: 31641 Systems Design - can be done before or concurrently

This subject covers aspects of systems development that are specific to on-line application systems. Real Time and Distributed systems are also covered with respect to their impact on the development of application systems. Practical work involves developing a series of programs in an On-Line Transaction Processing environment. A research report is also included in the assessment for the subject.

31647 MANAGEMENT CONTROL SYSTEMS
Four semester hours
Prerequisite: 31617 Accounting Fundamentals

The principles and techniques of cost accounting, budgeting and financial planning and their use in computer based accounting and business decision making systems.

31648 BUSINESS TOOLS AND APPLICATIONS
Five semester hours
Prerequisites: 31631 Database, 31617 Accounting Fundamentals

This subject aims to give students familiarity with microcomputers in the office and business environment and as stand alone machines or workstations. The use of

database and file management programmes and the physical operation of microcomputers are discussed. Students will become familiar with specific packages such as business databases, spreadsheets and programme development aids.

31653 COMMUNICATIONS SOFTWARE
Six semester hours
Prerequisites: 31633 Operating Systems, 31632 Communications and Networks

This subject examines the mechanics of operation of communication systems using as a reference model the ISO definitions of OSI (Open Systems Interconnection) seven-layer protocols. A rudimentary protocol verification and protocol efficiency calculation methods are introduced.

Each of the OSI seven layers is examined in detail. Some well-known communications protocols as well as international standard protocols are analysed. They are: Aloha (Pure and Slotted) Systems; Arpanet; IEEE 802.3 CSMA/CD (Ethernet); IEEE 802.4 Token Bus; IEEE 802.5 Token Ring; Fastnet and Expressnet Systems.

In addition, the following networks are introduced and discussed briefly to provide up-to-date knowledge of the communications industry: ISDN (Integrated Services Digital Network); BISDN (Broadband ISDN); IN (Intelligent Network); MAN (Metropolitan Area Network).

31654 LANGUAGES AND TRANSLATORS
Three semester hours
Prerequisites: 31613 Computer Systems Architecture 1, 31624 Data Structures and Algorithms

Translation and execution of expressions and statements. Syntactic analysis and parsing. Attribute grammars. Compile-time type checking. Syntax and table-driven compilers. Compiler-compilers. Code generation, error diagnostics and error correction of code. Code optimisation. Memory allocation during compilation and execution.

31655 THEORY OF COMPUTER SCIENCE
Four and one half semester hours
Prerequisites: 31624 Data Structures and Algorithms, 31625 Introduction to Software Engineering

Topics from the theory of machines, the theory of languages - syntax and semantics, the theory of processes, the theory of data, the complexity of problems. Applications of the theory particularly in the area of language translation and compiler writing.

31658 PROJECT MANAGEMENT
Four and a half semester hours
Prerequisite: 31696-7 or 31698 Industrial Training

Provides students with the practical knowledge and skills that are necessary to effectively manage project teams and software development projects. The major topics are: leadership, people management, communication and control; planning a software project, project life cycles, project/milestones and development plans; software time and cost estimation; controlling software projects; development aids and alternatives.

31662 INFORMATION SYSTEM CASE STUDY
Six semester hours
Prerequisites: 31658 Project Management, 31641 Systems Design, 31642 On-Line Systems, 31666 Performance Evaluation - should be done before or concurrently

This case study deals with the issues involved in strategic level analysis and design in a corporate wide information systems environment. It reinforces material previously studied while giving groups of students scope to use their own judgment in applying their knowledge. It stresses the development and assessment of alternative approaches to a system strategy and senior management communication skills.

31666 PERFORMANCE EVALUATION
Six semester hours
Prerequisites: 31636 Simulation and Modelling

This subject reviews considerations involved in configuring, selecting or upgrading a computer system in the most cost effective way. Operating systems and other software factors affecting computer performance are also studied. Measurement and modelling techniques are emphasised.

31669 SOCIAL IMPLICATIONS OF COMPUTERS
Three semester hours
Prerequisite: 31696-7 or 31698 Industrial Training

This subject aims to identify areas of society where the use of computer technology is of concern; and to apply an understanding of the social issues to the actual work situation. Topics include: history of computing (social and economic factors), effects on workforce, professionalism and ethics, social responsibility of computer practitioners, privacy, the DP workforce. These areas are discussed in the context of contemporary issues.

31696 INDUSTRIAL TRAINING
(F/T - First Semester)
Six semester hours
Prerequisites: 31621 Systems Analysis, 31622 Commercial Programming Development, 31624 Data Structures and Algorithms, 31633 Operating Systems, 51370 Human Communication plus at least eight other core subjects from the BAppSc programme.

31697 INDUSTRIAL TRAINING
(F/T - Second Semester)
Six semester hours
Prerequisites: 31696 Industrial Training (F/T First Semester)

The first and second semesters of the compulsory industrial requirement for the course. ALL F/T students must enrol in these subjects and obtain a minimum of 9 months' of full-time employment. Students must normally have completed the equivalent of at least four F/T semesters before obtaining employment.

31698 INDUSTRIAL TRAINING
(P/T - First Semester- Stage 5)
Three semester hours for two semesters
Prerequisites: 31621 Systems Analysis, 31622 Commercial Programming Development, 31624 Data Structures and Algorithms, 31633 Operating Systems, 51370 Human Communication plus at least eight other core subjects from the BAppSc programme.

31699 INDUSTRIAL TRAINING
(P/T Second Semester - Stage 6)
Three semester hours for 2 semesters
Prerequisites: 31698 Industrial Training (P/T First Semester)

The first and second years of the compulsory industrial requirement for the course, normally taken for a total of four semesters in Stages 5 and 6. ALL P/T students must enrol in these subjects and obtain a minimum of 18 months' of full-time employment.

51370 HUMAN COMMUNICATION
Two semester hours

This subject outlines the principles and practice of written and oral reporting. It is designed to help students in researching, organising, writing and presenting material appropriate to technical and commercial contexts. Topics covered include adaptation of content and style to suit the medium of communication, e.g., letters, memoranda, reports, articles and graphs, tables and diagrams; short talks on technical subjects: visual aids. Students will investigate various theories of communication and apply these principles to their practical work. Research, organisation, composition and presentation will be developed in the areas of written, spoken and non-verbal communication.

Electives

Prerequisites are given as the BAppSc subject number. GradDip students should have the GradDip equivalent prerequisite.

31140 INTRODUCTION TO COMPUTER GRAPHICS
Three semester hours
Prerequisite: 31624 Data Structures and Algorithms

This subject provides a thorough introduction to the field of computer graphics. Topics covered include passive and interactive graphics hardware devices and programming; mathematical tools for two and three dimensional graphics; two and three dimensional vector and raster graphics algorithms, colour in computer graphics; graphics standards; graphics packages; applications of computer graphics - business graphics, computer aided design, cartography, animation and advertising.

31163 KNOWLEDGE-BASED SYSTEMS
Three semester hours
Prerequisites: 31901 Artificial Intelligence Theory and either 31892 Logic Programming or 31896 LISP Programming

This subject introduces the student to recent developments in artificial intelligence, based on the representation and manipulation of knowledge. The student will obtain an understanding of the principles of expert systems together with some experience constructing small knowledge-based systems with the aid of current development tools. Topics: Representation of knowledge; Plausible reasoning; Knowledge acquisition; Development methodologies; Evaluation of current tools.

31240 TOPICS IN COMPUTER GRAPHICS
Three semester hours
Prerequisite: 31140 Introduction to Computer Graphics

For students who have passed 31140, this subject provides a study of several additional computer graphics topics, with an emphasis on image synthesis techniques. Topics covered include fractals, illumination models, ray tracing, textures, antialiasing, halftoning and ordered dither, hidden line and surface removal algorithms, computer animation and radiosity.

31350 PROJECT (31350, 31351, 31352 AND 31894)
Three or six semester hours - See School Handbook
Prerequisite: 31641 Systems Design

A project is intended to give a student experience in working independently and responsibility for scientific research or the development of a small system from initial analysis to user documentation. Projects may be drawn from any area of computer science or information systems. Each project is supervised by a member of academic staff.

31738 MANAGEMENT PRINCIPLES FOR IT PROFESSIONALS
See BInfTech synopses of this subject

31768 BUSINESS PLANNING FOR IT PROFESSIONALS
See BInfTech synopses of this subject

31777 HUMAN-COMPUTER INTERACTION
Three semester hours
Prerequisite: 31641 Systems Design

This subject focuses on human factors and management aspects of "user-centred" systems development and design. It provides students with HCI principles, concepts, tools and techniques needed to build "user-centred" systems, particularly in terms of the design of interfaces that satisfy user needs and create usable products that support user tasks and goals. Major topics include: role and scope of HCI, methodologies such as requirements analysis, task analysis and usability testing, usability evaluation, user-centred design support and user interface management systems.

31778 RESOURCES MANAGEMENT FOR IT PROFESSIONALS
Three semester hours
Prerequisite: 51370 Human Communication

Developed to instil the knowledge and skills required for effective management of hardware and software resources within an Information System organisation. The major topics: resource acquisition, developing software, workplace environment, hardware and software security, operations management, EDP accounting.

31788 ORGANISATIONAL THEORY FOR IT PROFESSIONALS
See BInfTech synopses of this subject

31853 OFFICE AUTOMATION
Three semester hours
Prerequisite: 31621 Systems Analysis

Covers the advanced concepts of office automation and the impact on the organisational structure. Analysis of the social issues of the implementation of office automation systems into the corporate structure and the current information systems. The management of office automation systems is discussed. Current research issues in office automation are presented by the researchers. Practical exposure is given in the requirements stage of office automation.

31854 DISTRIBUTED DATABASES
Three semester hours
Prerequisite: 31631 Database, 31632 Communications and Networks

This elective subject addresses both the theoretical and practical issues associated with design and implementation of distributed database. Relational database concepts will form the basis for the theoretical material presented in this course. The material presented in lectures will be supported by practical assignment work using a commercially available distributed database management system.

31875 PARALLEL PROGRAMMING
Three semester hours
Prerequisites: 31624 Data Structures and Algorithms, 31633 Operating Systems

This subject provides an introduction to parallel programming by covering the following topics: a parallel programming language and program development system; modularising a problem into a set of co-operating sequential processes running in parallel; the prevention of deadlock; orderly termination of a set of parallel processes; use of multiple intercommunication processors; comparison of performance under different physical configurations.

31876 OPERATING SYSTEMS FACILITIES
Three semester hours
Prerequisites: 31624 Data Structures and Algorithms, 31633 Operating Systems

The development of applications to make use of the facilities offered by an operating system offering support for a graphical user interface, such as Microsoft Windows will be covered. Included is the methodology involved in building applications that are driven by user actions such as the mouse as well as input from a keyboard. Issues related to inter-application communication will also be explored.

31882 ADVANCED THEORETICAL COMPUTER SCIENCE (not offered 1992)
Three semester hours
Prerequisite: 31655 Theory of Computer Science

To review advanced work in the theory of machines, theory of languages, theory of programmes and theory of data.

31885 ADVANCED MATHEMATICS
Three semester hours
Prerequisites: 31615 Discrete Mathematics, 31626 Probability and Statistics
This subject is a compulsory prerequisite for a Maths sub-major or any subjects in the School of Mathematics.

Linear Mathematics: matrices, determinants, eigenvalues and eigenvectors, inversion, pivoting and conditioning, complex numbers and functions.

Calculus: Calculus methods and theory, ordinary and partial differential equations.

Analysis: real numbers, real functions, continuity, formal calculus.

31888 LOGIC DESIGN 1
Three semester hours
Prerequisites: 31623 Computer Systems Architecture 2

To provide an introduction to the concepts of logic design, gates, Boolean algebra, combinational and sequential circuits.

31889 LOGIC DESIGN 2 (not offered in 1992)
Three semester hours
Prerequisite: 31888 Logic Design 1

A continuation of Logic Design 1 to include the concepts of machine structure as a controlled combination of registers and gates.

31892 LOGIC PROGRAMMING
Three semester hours
Prerequisites: 31624 Data Structures and Algorithms

This subject should give the student an understanding of the principles and techniques underlying logic programming. A student should become proficient in PROLOG and its applications to AI problems.

31893 COMPARATIVE PROGRAMMING LANGUAGES
Three semester hours
Prerequisite: 31624 Data Structures and Algorithms

Programming language constructs, their syntax and semantics. A comparative study of different language styles through particular languages: for example Prolog, Lisp, C, Modula 2, Smalltalk, Occam.

31895 NUMERICAL ANALYSIS (not offered 1992)
Three semester hours
Prerequisite: 31885 Advanced Mathematics

Errors, numerical linear algebra, interpolation and approximation, solution of non-linear equations in one and many unknowns, numerical differentiation and integration, numerical solution of ordinary and partial differential equations. Computer implementation of numerical algorithms and use of packages.

31896 LISP PROGRAMMING
Three semester hours
Prerequisite: 31624 Data Structures and Algorithms

This subject introduces the student to (i) various aspects of common LISP, (ii) their application to AI problems and methodologies, and (iii) important programming concepts in LISP. Different aspects of LISP include various datatypes of LISP, recursion, iteration, functions and Macros. AI applications include Expert Systems, Model based Reasoning and Diagnosis. Programming concepts include Variable Binding, Lexical and Dynamic Scoping, Data and Procedure Abstractions, and Building Large Programmes.

31897 COMPUTER SYSTEMS ARCHITECTURE 3
Three semester hours
Prerequisite: 31633 Operating Systems

A systematic treatment of more advanced topics in machine organisation and systems architecture. Particular emphasis is placed on parallelism in general and its exploitation in a number of special purpose machines. Some practical work with a distributed parallel system will be included.

31898 MICROPROCESSORS AND APPLICATIONS
Three semester hours
Prerequisite: 31888 Logic Design 1

An examination of the current range of microprocessors and their applications in embedded systems. The

subject is highly hardware-oriented. Emphasis is on interfacing peripheral devices to microcomputers

31899 SYSTEMS ARCHITECTURE
(not offered 1992)
Three semester hours
Prerequisite: 31897 Computer Systems Architecture 3

In-depth study at the architectural level of one or more state-of-the-art or experimental computer systems.

31901 ARTIFICIAL INTELLIGENCE THEORY
Three semester hours
Prerequisites: 31625 Software Engineering, 31624 Data Structures and Algorithms

This subject covers Artificial Intelligence to give a professional basis in the basic methods and algorithms of the subject. It includes knowledge representation, machine reasoning, planning, problem solving and research, constraint based systems, learning robotics and computer vision.

31902 AUDITING THE COMPUTER
Three semester hours
Prerequisites: 31617 Accounting Fundamentals

Audit concepts and techniques in the EDP audit field. Control measures that must be embedded in computer accounting and information systems. Different systems of control, administrative, operational and security. Audit techniques and the DP audit function. Risk analysis, quality assurance.

An introduction to audit concepts and techniques in the EDP audit field of activity. The emphasis is oriented to control measures possible and desirable in various computer systems e.g. Billing, Creditors, Payroll, etc. and Non Monetary Information Systems.

31904 SYSTEMS PROGRAMMING
Three Semester Hours
Prerequisite: 31633 Operating Systems

The role of the systems programmer. Comparison of programming languages for systems programming. UNIX operating system. C programming language. Comparison of using tools vs writing a new programme.

31931 SOFTWARE QUALITY ASSURANCE
Three semester hours
Prerequisites: 31621 Systems Analysis

This subject aims to provide students with the practical knowledge and skills that are necessary to effectively measure and control the quality of software products. Major topics are: quality assurance principles, quality metrics, verification, validation and test, implementing quality assurance, software engineering methods and tools.

SUBJECT SYNOPSES FOR BACHELOR OF INFORMATION TECHNOLOGY

31711 INFORMATION SYSTEMS
Four semester hours

This subject focuses on the use of computer based systems in an organisational context. Typical computer based systems: data processing and information systems, office support systems, personal computers, embedded systems. Organisational benefits of computer based systems, objectives, costs and risks. On-line, off-line, real time systems. Batch, interactive and transaction processing. Description of data flows: process flow charting. Introduction to simple business applications and the commercial system development life cycle. Operational issues.

31713 COMPUTER SYSTEMS ARCHITECTURE
Three semester hours

This subject is an introduction to computer hardware and software systems. The relationship between hardware and software is discussed by considering the structure of the computer, the inter-relationship of the various components and the processing by the computer of data and programme. Students will be introduced to machine-language and to assembly-language programming.

31714 PROGRAMMING PRINCIPLES
Seven semester hours

This subject provides an introduction to problem analysis and solution on the computer. Students gain experience at using the Unix operating system, program compilation and execution, and interactive and noninteractive processing. Methods of problem analysis, pseudocoding, coding, debugging, testing and documentation are introduced through the use of the procedural language Pascal. The principles of object oriented programming are discussed, and students implement this approach in the language Eiffel.

31715 DISCRETE MATHEMATICS
Five semester hours

This subject develops the mathematics of discrete objects and models. Logic: propositions, truth tables, predicate logic, proof techniques. Set theory: sets, relations, relational algebra, functions, iteration, recursive definitions and inductive proof, partial orders and equivalence relations. Discrete structures: natural numbers, lists, trees. Functional programming (Miranda) is used to illustrate the mathematical concepts introduced.

31717 ACCOUNTING FUNDAMENTALS
Three semester hours

This subject provides a general introduction to financial accounting and business law. Accounting related applications are the backbone of many commercial computing systems and an understanding of business law facilitates the study of business methods.

31721 SYSTEMS ANALYSIS
Three semester hours
Prerequisite: 31711 Information Systems should be done before or concurrently

Introduces systems concepts and a range of techniques used in systems analysis. Covers the techniques used to analyse all discrete systems data functions and flows inclusive of data flow diagrams, relational analysis and normalisation and E-R modelling. Describes systems life cycles and the role of these techniques within life cycles in evaluating requirements and proposals and setting objectives for new systems.

31722 COMMERCIAL PROGRAMMING
Five semester hours
Prerequisites: 31711 Information Systems, 31714 Programming Principles

Commercial structured design techniques and commercial programming in either a batch or on-line environment. Students will be taught the design technique and language of the particular industry organisation using approved assignment work.

31725 SOFTWARE ENGINEERING
Six semester hours
Prerequisites: 31714 Programming Principles, 31715 Discrete Mathematics

This subject introduces the formal aspects of modern software engineering. Topics: an overview of the software engineering environment, the practice of formal mathematical specification, programme development via refinement of specifications, programs correctness, machine executable specifications, an overview of software testing and reliability.

31726 PROBABILITY AND STATISTICS
Three semester hours

Descriptive statistics. Probability theory, random variables, conditional probabilities, independence and Bayes' theorem, and modelling of uncertainty, measures of central tendency and dispersion, moments. Processes and distributions: binomial, Poisson, normal and sampling. Theorems: Chebychev, central limit. Applied statistics: estimation, confidence intervals, hypothesis testing and types of errors; problem solving by theory, statistical tables and machine packages.

31731 DATABASE
Four semester hours
Prerequisites: 31721 Systems Analysis, 31711 Information Systems

This subject deals with database design and implementation methodologies. Both entity-relationship and relational models are described and used to facilitate database design. The SQL language is described in detail illustrating database query and update techniques. Traditional database approaches including codasyl and hierarchical databases are described.

31732 COMMUNICATIONS AND NETWORKS
Five semester hours
Prerequisites: 31711 Information Systems, 31713 Computer Systems Architecture

This subject introduces communication concepts and terminology. It describes the problems involved in the Physical and Data Link Layers of communication and their solutions. It discusses network architectures, topologies and carrier services.

31733 OPERATING SYSTEMS
Five semester hours
Prerequisites: 31713 Computer Systems Architecture

An introduction to the student of the concepts and facilities available in computer operating systems. The subject includes scheduling, multiprogramming, protection and resource control.

31738 MANAGEMENT PRINCIPLES FOR IT PROFESSIONALS

Three semester hours

Prerequisite: 51370 Human Communication or equivalent

The environment of business organisations and the challenges facing large and small business. Management theory, evolution and schools of thought. Management principles, style, decision making, mechanistic and organic systems. Personnel management, planning, job analysis and design, selection and training, career planning, appraisal and counselling, compensation and incentives. Operations management.

31741 SYSTEMS DESIGN

Four semester hours

Prerequisite: 31731 Database, 31721 Systems Analysis

This subject focuses on the user and business aspects of systems design. User interface issues cover dialogue, screen, report and forms design as well as designing and writing user documentation. Integration with business environment includes business procedures, security, control and implementation. A variety of design and implementation strategies are introduced, such as prototyping, CASE tools and 4GL's.

31742 ON-LINE SYSTEMS

Five semester hours

Prerequisites: 31722 Commercial Programming, 31732 Communications and Networks

Corequisite: 31741 Systems Design - can be done before or concurrently

This subject covers aspects of systems development that are specific to on-line application systems. Real Time and Distributed systems are also covered with respect to their impact on the development of application systems. Practical work involves developing a series of programs in an On-Line Transaction Processing environment. A research report is also included in the assessment for the subject.

31747 MANAGEMENT CONTROL SYSTEMS

Three semester hours

Prerequisite: 31717 Accounting Fundamentals

The principles and techniques of cost accounting, budgeting and financial planning and their use in computer based accounting and business decision making systems.

31756 PROJECT MANAGEMENT

Three semester hours

Pre-requisite: 31788 Organisation Theory for IT Professionals

Provides students with the practical knowledge and skills that are necessary to effectively manage project teams and software development projects. The major topics are: leadership, people management, communication and control; planning a software project, project life cycles, project phases/milestones and development plans; software time and cost estimation; controlling software projects; development aids and alternatives.

31762 TECHNOLOGY PLANNING

Six semester hours

Prerequisites: 31756 Project Management, 31781 Business Systems Design

The various frameworks within which a business and its information system operates, taking into account goals objectives and strategies. Enterprise business analysis - high level, in terms of mission, goals strategies; enterprise business modelling - top-down development of function and data models; information systems architecture - development of standard policies within which information systems can be established; business systems planning - prioritising information systems projects to best meet the overall needs of an organisation.

31766 PERFORMANCE MODELLING AND MANAGEMENT

Six semester hours

Prerequisites: 31733 Operating Systems, 31726 Probability and Statistics

Understanding the basic techniques of system performance modelling and the application of systems modelling techniques to the assessment of present and future required system capacity; basic principles of capacity management and its importance to IS management and senior management. Simple queueing theory and operational analysis modelling techniques; systems performance analysis - measurement and models; modelling and analysis of on-line systems; workload characterisation; workload forecasting; relations between capacity planning, IS management, corporate planning and corporate management.

31767 AUDITING THE COMPUTER

Three semester hours

Prerequisite: 31617 Accounting Fundamentals

Audit concepts and techniques in the EDP audit field Control measures that must be embedded in compute accounting and information systems. Different system

of control, administrative, operational and security. Audit techniques and the DP audit function. Risk analysis, quality assurance.

31768 BUSINESS PLANNING FOR IT PROFESSIONALS

Three semester hours

Prerequisite: 51370 Human Communication or equivalent

This subject forms a coherent stream with 31738 Management Principles for ITP, 31788 Organisation Theory for ITP and 31758 Resources Management for ITP; within this stream the subjects are sequenced, or a subject can be taken as a stand-alone elective, as there are no educational pre-requisites within the stream.

Provides students with an awareness of the problems in developing corporate strategies, in general, and information technology strategies, in particular; also, develops skills in the selection and use of appropriate techniques. Major topics are: business planning/strategic planning, analysing business priorities and objectives, long term planning, models, tools and techniques; information technology planning, major tools and techniques and the changing role of the information systems manager; corporate needs for information technology.

31769 SOCIAL IMPLICATIONS OF COMPUTERS

Three semester hours

This subject aims to identify areas of society where the use of computer technology is of concern; and to apply an understanding of the social issues to the actual work situation. Topics include: history of computing (social and economic factors), effects on workforce, professionalism and ethics, social responsibility of computer practitioners, privacy, the DP workforce. These areas are discussed in the context of contemporary issues.

31770 INDUSTRY PROJECT 1

Fourteen semester hours

Understanding the function of the Information Systems Department in an organisation and also of at least one user business function serviced by IS. Understanding is via a number of strategies such as interviewing, observation and work experience. Students will be taught human communication skills in conjunction with the project work, with special emphasis on oral and written communication. Training will also be provided in a variety of development tools used in the information systems development process in order to build up a defined skills profile in conjunction with the subject Industry Project 2.

31771 BUSINESS REQUIREMENTS ANALYSIS

Three semester hours

Prerequisite: 31721 Systems Analysis

Applications of systems analysis (data flow diagrams, relational modelling, etc.) in a business setting; the roles of the business analyst and the systems analyst; systems research and requirements analysis (interviewing, document analysis, etc.) for data processing, management information systems, etc; top-down enterprise-wide perspective; evolution of the business environment; business, product and other life-cycles. Industry case studies.

31779 APPLICATIONS OF INFORMATION TECHNOLOGY 1

Three semester hours

Prerequisite: 31711 Information Systems

Formal and practical exposure to, and understanding of a variety of specific applications of information technology, such as management information systems, database, decision support systems, process control, graphics, etc. Subject material will complement that of Applications of IT 2 to ensure a common level of experience for all students.

31780 INDUSTRY STUDIES

Four semester hours

Prerequisite: 31770 Industry Project 1

Students undertake surveys of industry sponsors of the BInfTech programme, investigating contemporary topics in the field of information systems. Students may also be required to undertake other formal activities to complement the industry objectives of the BInfTech programme.

31781 BUSINESS SYSTEMS DESIGN

Three semester hours

Prerequisites: 31771 Business Requirements Analysis, 31741 Systems Design

Understanding systems design in a business setting; performance and quality criteria; alternative implementation strategies; approaches to systems construction and estimation (including package evaluation and prototyping); implementation issues; productivity issues; methods engineering; information technology in business; industry and product differences. Case studies.

31788 ORGANISATION THEORY FOR IT PROFESSIONALS

Three semester hours
Prerequisite: 51370 Human Communication or equivalent

This subject examines the structural and sociological aspects of organisations. Topics include: the nature of organisation theory; organisation effectiveness; structure and technology; structure and environment; typical organisation structures; organisations as social systems; work groups and job design; organisational learning; cultures and organisations; information technology in organisations.

31789 APPLICATIONS OF INFORMATION TECHNOLOGY 2

Three semester hours
Prerequisite: 31779 Applications of Information Technology 1

Formal and practical exposure to and understanding of a variety of specific applications of information technology, such as management information systems, database, decision support systems, process control graphics, etc. Subject material will complement that of Applications of IT 1 to ensure a common level of experience for all students.

31790 INDUSTRY PROJECT 2

Fourteen semester hours
Prerequisite: 31770 Industry Project 1

Students gain practical "hands on" experience of the role of members of an information systems development team in relation to business organisational goals and objectives; students are incorporated as members of a project team in a sponsoring company. Training will also be provided in a variety of development tools in order to build up a defined skills profile in conjunction with the subject Industry Project 1.

SUBJECT SYNOPSES FOR GRADUATE DIPLOMA IN DATA PROCESSING

31015 DISCRETE MATHEMATICS

Five semester hours
Prerequisite: PASCAL

This subject develops the mathematics of discrete objects and models. Logic: propositions, truth tables, predicate logic, proof techniques. Set theory: sets, relations, relational algebra, functions, iteration, recursive definitions and inductive proof, partial orders and equivalence relations. Discrete structures: natural numbers, lists, trees. Functional programming (Miranda) is used to illustrate the mathematical concepts introduced.

31017 ACCOUNTING FUNDAMENTALS

Three semester hours

This subject provides a general introduction to financial accounting and business law. Accounting related applications are the backbone of many commercial computing systems and an understanding of business law facilitates the study of business methods.

31021 SYSTEMS ANALYSIS

Three semester hours
Prerequisites: 31071 Introduction to Information Systems should be done before or concurrently

Introduces systems concepts and a range of techniques used in systems analysis. Covers the techniques used to analyse all discrete systems data functions and flows inclusive of data flow diagrams, relational analysis and normalisation and E-R modelling. Describes systems life cycles and the role of these techniques within life cycles in evaluating requirements and proposals and setting objectives for new systems.

31022 COMMERCIAL PROGRAMME DEVELOPMENT

Three semester hours
Prerequisites: 31071 Introduction to Information Systems, COBOL

This subject covers structured design techniques and their application to COBOL programming in an offline commercial environment. Advanced features of COBOL are presented to give the student a complete knowledge of the language.

31023 COMPUTER SYSTEMS ARCHITECTURE 2
Three semester hours
Prerequisite: 31073 Introduction to Computer Systems

This subject is a continuation of Introduction to Computer Systems. The concepts introduced there are elaborated and study of CPU internals is facilitated by use of assembler language on a real machine. Additional requirements of architectures for performance enhancement and support of high-level languages and operating systems are discussed.

31024 DATA STRUCTURES AND ALGORITHMS
Three semester hours
Prerequisites: Pascal, 31025 Introduction to Software Engineering should be done before or concurrently

Structured approach to programming including: data abstraction and ADTs, functional specification, implementation, modularity, documentation and layout, complexity analysis of algorithms, programme correctness. Abstract and dynamic data types (files, lists, trees) are covered notionally and formally, and are applied to common problems like sorting and searching, parsing, B trees and memory management.

31025 INTRODUCTION TO SOFTWARE ENGINEERING
Three semester hours
Prerequisites: 31015 Discrete Mathematics

This subject introduces the formal aspects of modern software engineering. Topics: an overview of the software engineering environment, the practice of formal mathematical specification, programme development via refinement of specifications, programmes correctness, machine executable specifications, an overview of software testing and reliability.

31026 PROBABILITY AND STATISTICS
Three semester hours

Descriptive statistics. Probability theory, random variables, conditional probabilities, independence and Bayes' theorem, and modelling of uncertainty, measures of central tendency and dispersion, moments. Processes and distributions: binomial, Poisson, normal and sampling. Theorems: Chebychev, central limit. Applied statistics: estimation, confidence intervals, hypothesis testing and types of errors; problem solving by theory, statistical tables and machine packages.

31031 DATABASE
Three semester hours
Prerequisites: 31021 Systems Analysis

This subject deals with database design and implementation methodologies. Both entity-relationship and relational models are described and used to facilitate database design. The SQL language is described in detail illustrating database query and update techniques. Traditional database approaches including codasyl and hierarchical databases are described.

31032 COMMUNICATIONS AND NETWORKS
Three semester hours
Prerequisites: 31073 Introduction to Computer Systems, 31071 Introduction to Information Systems

This subject introduces communication concepts and terminology. It describes the problems involved in the Physical and Data Link Layers of communication and their solutions. It discusses network architectures, topologies and carrier services.

31033 OPERATING SYSTEMS
Three semester hours
Prerequisites: 31073 Introduction to Computer Systems, 31071 Introduction to Information Systems

An introduction to the student of the concepts and facilities available in computer operating systems. The subject includes scheduling, multiprogramming, protection and resource control.

31041 SYSTEMS DESIGN
Three semester hours
Prerequisite: 31031 Database

This subject focuses on the user and business aspects of systems design. User interface issues cover dialogue, screen, report and forms design as well as designing and writing user documentation. Integration with business environment includes business procedures, security, control and implementation. A variety of design and implementation strategies are introduced, such as prototyping, CASE tools and 4GL's.

31042 ON-LINE SYSTEMS
Three semester hours
Prerequisites: 31022 Commercial Programme Development, 31032 Communications and Networks
Corequisite: 31041 Systems Design - can be done before or concurrently

This subject covers aspects of systems development that are specific to on-line application systems. Real Time

and Distributed systems are also covered with respect to their impact on the development of application systems. Practical work involves developing a series of programs in an On-Line Transaction Processing environment. A research report is also included in the assessment for the subject.

31047 MANAGEMENT CONTROL SYSTEMS
Three semester hours
Prerequisite: 31017 Accounting Fundamentals

The principles and techniques of cost accounting, budgeting and financial planning and their use in computer based accounting and business decision making systems.

31048 BUSINESS TOOLS AND APPLICATIONS
Three semester hours
Prerequisites: 31031 Database, 31017 Accounting Fundamentals

This subject aims to give students familiarity with microcomputers in the office and business environment and as stand alone machines or workstations. The use of database and file management programmes and the physical operation of microcomputers are discussed. Students will become familiar with specific packages such as business databases, spreadsheets and programme development aids.

31053 COMMUNICATIONS SOFTWARE
Three semester hours
Prerequisites: 31033 Operating Systems, 31032 Communications and Networks

This subject examines the mechanics of operation of communication systems using as a reference model the ISO definitions of OSI (Open Systems Interconnection) seven-layer protocols. A rudimentary protocol verification and protocol efficiency calculation methods are introduced.

Each of the OSI seven layers is examined in detail. Some well-known communications protocols as well as international standard protocols are analysed. They are: Aloha (Pure and Slotted) Systems; Arpanet; IEEE 802.4 Token Bus; IEEE 802.5 Token Ring; Fastnet and Expressnet Systems.

In addition, the following networks are introduced and discussed briefly to provide up-to-date knowledge of the communications industry: ISDN (Integrated Services Digital Network); BISDN (Broadband ISDN); IN (Intelligent Network); MAN (Metropolitan Area Network).

31058 PROJECT MANAGEMENT
Three semester hours

Provides students with the practical knowledge and skills that are necessary to effectively manage project teams and software development projects. The major topics are: leadership, people management, communication and control; planning a software project, project life cycles, project/milestones and development plans; software time and cost estimation; controlling software projects; development aids and alternatives.

31071 INTRODUCTION TO INFORMATION SYSTEMS
Three semester hours

This subject provides a fundamental foundation for the understanding of information systems and their applications to common computer-based practices and procedures used in organisations today. Elementary system models, typical business systems development life cycle and applications, and a range of techniques and resources used in developing and designing information systems are examined.

31073 INTRODUCTION TO COMPUTER SYSTEMS
Three semester hours

This subject is an introduction to computer hardware and software systems. The relationship between hardware and software is discussed by considering the structure of the computer, the inter-relationship of the various components and the processing by the computer of data and programme. Students will be introduced to machine-language and to assembly-language programming.

SYNOPSES OF SUBJECTS - MASTERS DEGREE BY COURSEWORK (INFORMATION SCIENCE)

21718 ORGANISATION ANALYSIS AND DESIGN
Three semester hours

The central concern of this subject is to develop skills in organisational analysis and on the basis of this to develop diagnostic and prescriptive skills in regard to organisational design. The method of presentation is a weekly class of three hours which will involve a combi-

nation of lectures, discussion of readings, analysis of case studies and simulation exercises. Students are expected to have read the assigned material in advance so that there can be more informal discussion of key issues.

32100 ADVANCED PROGRAMMING TECHNIQUES

Four semester hours

This subject deals with notations and techniques for reasoning about program behaviour. Under this broad umbrella particular topics will be drawn from the following list: program derivations, via folding and unfolding; proofs of program properties; equational reasoning; operational behaviour through pre- and post-conditions; rules for refinement of program design; concurrency and process algebra.

32101 INTELLIGENT SYSTEMS

Four semester hours

A subject concentrating on the transfer of research and development in Artificial Intelligence into functional systems. General overview of Artificial Intelligence techniques, with an emphasis on one or two specific areas. Topics treated include: expert systems, learning systems, natural language understanding, speech recognition and understanding, vision, cognitive modelling, intelligent computer assisted instruction, logic programming, game playing, planning, reasoning methodologies.

32104 DECISION MAKING AND MODELLING

Four semester hours

Prerequisites: Operations Research, Statistics

This subject looks at the theory and practice of both managerial decision making and modelling processes. Application areas for modelling will include networks, queueing models and corporate and financial models. Mathematical programming and simulation tools will be discussed, as will the role of problem formulation, data collection, sampling and sensitive analysis. An analysis of decision processes will include a study of probabilistic modelling techniques, decision making under uncertainty, decision trees, influence diagrams, utility theory and risk analysis.

32105 SPECIALIST TOPICS IN ARTIFICIAL INTELLIGENCE

Four semester hours

A subject offering in-depth coverage of the theory and practice of selected key areas of Artificial Intelligence which may include: expert systems, learning systems, speech recognition, natural language understanding, cognition, reasoning methodologies. The subject will be based on two substantial projects and underlying theory.

32200 INFORMATION PROCESSING STRATEGY

Four semester hours

Prerequisite: 32203 Information Management

Designed to develop knowledge and skills required to carry out strategic planning for corporate information systems and services. An introduction to corporate and MIS planning is followed by an examination of the applications spectrum and the technology spectrum supported by examinations of appropriate management tools for strategic planning, modelling and control of information processing.

32201 DATA BASE

Four semester hours

Prerequisite: 31631 Database

This subject deals with database design and implementation methodologies. Both entity-relationship and relational models are described and used to facilitate database design. The SQL language is described in detail illustrating database query and update techniques. Traditional database approaches including codasyl and hierarchical databases are described.

32202 COMMUNICATION SYSTEMS

Four semester hours

Prerequisite: 31632 Communications and Networks

This subject is designed to develop: understanding of typical data communication requirements in an organisation, familiarity with computer communication technologies, understanding of existing and evolving standards, proficiency in the requirements specification, design, sizing and acquisition of corporate communication facilities. Topics covered include: historical evolution of computer communication, distributed information systems, ISO-OSI Reference Model, proprietary networking architectures, communication for message transmission, automated offices, etc., local networks, design procedures for corporate communication systems.

32203 INFORMATION MANAGEMENT

Four semester hours

Information as a resource, cost of collection, storage and manipulation, validity and timeliness, security and

availability. Consistency and flows of information sets within an organization, integration of functional systems through common flows, access, authorization and encryption. Planning and implementation of enhanced information systems. Project control and estimation techniques, overall system design, implementation, testing and maintenance tools. Post implementation reviews and audits.

32301 PERFORMANCE EVALUATION
Four semester hours
Prerequisite: 31666 Performance Evaluation

Revision and extension of queueing theory. Analytic models of computer systems, and their application to performance evaluation. Operational analysis and its application to performance evaluation. Brief revision of E.D.P. planning principles. Application of performance evaluation principles to capacity management - modelling the growing system.

32302 COMPUTER ARCHITECTURE
Four semester hours
Prerequisites: 31633 Operating Systems, 31897 Computer Systems Architecture 3

An examination of the more advanced architectural features available in contemporary computer systems as well as of the likely future implications of current research. The subject will cover such topics as parallelism in processor design, the distribution of intelligence in storage technology and the incorporation of high-level language capabilities as well as operating systems features in hardware.

32304 COMPUTER LANGUAGES
Four semester hours

Revision of basic structures of procedural programming languages. Concurrency facilities. Approaches to modularization. List-structured, non-procedural and functional languages. Object oriented systems. Translation techniques for advanced high-level languages.

32305 OPERATING SYSTEMS
Four semester hours

Topics in modern operating systems. The role of standards in commercial operating systems. Concurrency in closely coupled and loosely coupled systems. Programming support environments. 'User friendly' system interfaces. Object-based systems. Fault tolerant systems. Secure systems.

32400 ACCOUNTING FOR MANAGEMENT
Four semester hours

The managerial aspects of accounting will be the main area of interest. This will involve consideration of the nature of accounting both in its traditional role and as an aid to management. The nature of costs and the various aspects of cost accounting will be covered in some detail, as are effects of tax, costs and profits on choice, and capital replacement, decisions. The use of funds analysis and balance sheet ratios to assess operational efficiency will also be covered.

32401 MANAGEMENT POLICY AND STRATEGY
Four semester hours

Management Policy and Strategy is a subject which considers the essential tasks of management in formulating, organising and implementing strategy. Topics covered include: the perspective of top management; assessing situations; formulating policies; discovering opportunities; estimating risks and planning programmes of action; organising and administering personnel; follow-up and reappraisal; the role of top management in the world of the consumer.

PROJECT AND REPORT
32908 Eight semester hours
32912 Twelve semester hours
32916 Sixteen semester hours

All students in the MAppSc (by Course Work) in Information Science are required to enrol in and pass the project subject. The project is normally undertaken in the final year of study. The project entails a substantial investigation, under the supervision of a member of the academic staff, and is examined on the quality of both a written report and an oral presentation of the project work. Students normally enrol in the eight semester hour project. In exceptional circumstances, and with the support of the project supervisor, permission may be granted for a student to enrol in the twelve or sixteen hour project. The School publishes a substantial set of guidelines for this subject in the Master's course Handbook.

32999 SEMINAR
One semester hour

All students enrolled in the Master's course must enrol in the Seminar subject each semester. To pass the Seminar subject, students are required to attend the Master's Research Seminars and to make three presentations of a satisfactory standard during their enrolment

in the Master's course. Students who have not attended at least 70% of the Research Seminars in any semester will not normally be permitted to sit for examinations in that Semester. The three presentations which students are required to make are a Literature Review, a Research Seminar and an Oral Presentation of their project work (see 32908).

79729 THE LEGAL ENVIRONMENT OF BUSINESS
Three semester hours

Aims: To develop an understanding of the basic principles relating to the law in Australia and its relation to a number of major areas of importance to business; to develop the facility for identifying legal problems and recognising situations where expert legal advice is necessary. There are two strands, one emphasising Trade Practices, the other emphasising Computer Law.

EXTENSION COURSES OFFERED EACH SEMESTER - CURRENTLY RUN THROUGH INSEARCH

COBOL Extension Course
Three semester hours

Students gain the computing knowledge necessary to deal with problems which confront them in a commercial environment. The COBOL language is an internationally standardised commercial language. In all practical work, the emphasis will be on good programming technique, adequate testing, appropriate documentation and correct syntax.

PASCAL Extension Course
Three semester hours
An introduction to the analysis and design of computer algorithms and their implementation in Pascal. The practical work will cover numeric and non-numeric aspects of computing, with the emphasis on writing well-structured and documented programmes.

UNIX/C Extension Course
Three semester hours
An introduction to the C programming language and the Unix* operating system. Students enrolling in this course are expected to have programming experience.

[C] UNIX is a trademark of AT&T and Bell Laboratories.

THE STUDENTS' ASSOCIATION (SA)

The Students' Association (SA) is the elected representative body of students at the UTS - it is an organisation run by students for students. All students become members of the Students' Association upon enrolment. It is the only body in the university which can legitimately claim to truly represent the concerns, issues and problems students face on a day-to-day basis whilst at this university. All students have the right to stand for election of the SA and to vote in the annual elections. There are twenty three general representatives on the Council that makes policy for the Students' Association. The SA also has specialised portfolios and office bearers to deal with a range of issues; the environment, women, students with special needs, gay and lesbian rights, overseas students and postgraduates.

The Students' Association maintains close links with student organisations from other universities. Its political role is to defend and extend educational standards and conditions for students both within the University and the tertiary sector as a whole. Campus Committees deal with campus specific issues (St Leonards/Gore Hill, Balmain, Kuring-gai, Haymarket and Broadway). This has proved to be the most effective and equitable means of ensuring that all campuses are adequately represented in the make-up of the SA. At this level, Campus convenors carry out the directions of campus committees, which are also elected annually.

In general the SA plays a representative and advocacy role on behalf of students. The SA acts as the voice of the student body. As part of this function it produces a fortnightly newspaper, *Vertigo*, and a weekly radio show on 2SER *Student Voice*. It liaises closely with the University Union, which provides services to students (eg the cafeteria, reading and leisure areas) and the Student Services Unit, which is funded by the university to provide welfare advice and counselling loan assistance and medical services. The SA also employs specialised education staff to assist in enquiries about Austudy, HECS, appeals against exclusion and assessment grades and any other problems that students encounter at UTS. The SA has lots to offer all students - so get down to your SA and get active!

Locations and Services

City Campus (02) 330 1155
The main office of the SA is located on the City Campus, Broadway on Level 3A of the Tower Building (near the bar and cafeteria) and offers the following services:

- General Student representatives
- Elected office bearers - Womens' officers
- Overseas students' officers
- Special needs officers
- Gay and lesbian officers
- Environment officer
- Postgraduate officer
- Specialist education, research and welfare staff
- General student enquiries
- Academic coaching service
- Photocopying
- Funding of PERC Clubs

Broadway Resource Centre (02) 3301161
Also located on Level 3A and adjacent to the Union Shop, its services include:

- Photocopying
- Secondhand books
- Use of typewriters and computers
- Book binding and paper guillotining

Haymarket Resource Centre (02) 330 3409
This is located in Room B110 and its services include:
- Photocopying
- Secondhand books
- Typing service

Design School Student Centre (02) 330 2958
This is located on the Balmain Campus, Mansfield Street, Balmain and is open Tuesday to Friday and offers:
- Photocopying
- Secondhand equipment sales
- Computer facilities

Gore Hill Resource Centre (02) 330 4040
This is located in Room 1/18 in the Dunbar Building and its services include:
- Photocopying
- Secondhand books
- Computer facilities

Kuring-gai Campus (02) 330 5237
Located next to State Bank, the services offered include:
- General and campus representatives
- Specialist education, research and welfare staff
- General student enquiries
- Resource Centre

PRINCIPAL DATES FOR 1992

AUTUMN SEMESTER

January

13 Release of HSC results
20 Closing date for changes of preference of 1991 NSW HSC applicants (4.30pm)
26 Australia Day
27 Public School Holidays end
29-31 Enrolment of continuing students at City Campus

February

3-21 Enrolment of continuing and new students at City Campus
17-28 Enrolment at Kuring-gai Campus
25-27 University Orientation Day at City Çampus
28 University Orientation Day at Kuring-gai Campus

March

2 Classes commence
13 Last day to enrol in a course or add subjects
27 Last day to apply for leave of absence
31 HECS Census Date

April

10 Last day to drop a subject without academic penalty
10 Last day to withdraw from course without academic penalty
13 Public School Holidays commence
17 Good Friday
20 Easter Monday
20-24 Vice-Chancellors' Week (non-teaching)/ Graduation period
24 Public School Holidays end
25 Anzac Day

May

29 Closing day for applications for Spring Semester

June

15 Formal examinations commence

SPRING SEMESTER

July

3 End of formal examinations
6 Public School Holidays commence
6-10 Vice-Chancellors' Week (non-teaching)
17 End of Public School Holidays
27-31 Enrolment of new students

August

3 Classes commence
14 Last day to enrol in a course or add subjects
28 Last day to apply for leave of absence
31 HECS Census Date

September

11 Last day to drop a subject without academic penalty
11 Last day to withdraw from a course without academic penalty
28 Public School Holidays commence
30 Undergraduate applications close for admission in 1992
28- Vice-Chancellors' Week (non-teaching)/
2 Oct Graduation period

October

9 End of Public School Holidays

November

16 Formal examinations commence

December

4 End of formal examinations
18 Public School Holidays commence

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