Chapter 5
Faculty of Engineering and Information Technology

Faculty of Engineering and Information Technology

Contents

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Introduction

The Faculty of Engineering and Information Technology was established in 1993 and comprises the Department of Engineering and the Department of Computer Science.

The Faculty represents the commitment of the ANU to developments in engineering and information technology, and recognises the strength of the university's undergraduate and graduate programs in these disciplines. The Australian National University has a world-wide reputation in many fields including computing and engineering. Each of the two departments in the Faculty is a key participant in two Cooperative Research Centres funded jointly by the Australian Government and industry to carry out collaborative research.

Further information is available on the Faculty Web site: http://feit.anu.edu.au

Undergraduate Courses Offered

Degree course	Usual course duration (yrs)
Bachelor of Engineering	4
Bachelor of Engineering (Telecommunication Systems)	4
Bachelor of Engineering (Mechatronic Systems)	4
Bachelor of Engineering (Manufacturing and Management Systems)	4
Bachelor of Engineering (Materials and Mechanical Systems)	4
Bachelor of Engineering (Sustainable Energy Systems)	4
Bachelor of Engineering (Photonic Systems)	4
Bachelor of Engineering (Environmental Systems)	4
Bachelor of Engineering (Digital and Electronic Systems)	4
Bachelor of Software Engineering	4
Bachelor of Information Technology	3
Bachelor of Engineering/Bachelor of Science	5
Bachelor of Engineering/Bachelor of Information Technology	5
Bachelor of Engineering/Bachelor of Arts	5
Bachelor of Asian Studies/Bachelor of Engineering	5
Bachelor of Commerce/Bachelor of Engineering	5
Bachelor of Engineering/Bachelor of Economics	5
Bachelor of Arts/ Bachelor of Information Technology	4
Bachelor of Commerce/Bachelor of Information Technology	4
Bachelor of Economics/Bachelor of Information Technology	4
Bachelor of Information Technology/Bachelor of Science (Forestry)	5
Bachelor of Information Technology/Bachelor of Laws	5

Course Prerequisites

Bachelor of Engineering

ACT

(a) Advanced Mathematics*
(b) Assumed Knowledge: Physics Major

NSW

(a) Mathematics*
(b) Assumed Knowledge: HSC Physics

* The Faculty recommends that where possible, students undertake Advanced Mathematics Extended Major/Minor (ACT), or Mathematics Extended 1 (NSW) or equivalent program.

Bachelor of Information Technology

ACT

Advanced Mathematics

NSW

Mathematics

Bachelor of Software Engineering

ACT

(a) Advanced Mathematics*

NSW

(a) Mathematics*

* The Faculty recommends that where possible, students undertake Advanced Mathematics Extended Major/Minor (ACT), or Mathematics Extended 1 (NSW) or equivalent program.

Bachelor of Engineering

(Course code 4700)

The ANU Bachelor of Engineering degree programs are four-year, Engineers Australia (IEAust) accredited undergraduate programs that integrate selected areas of electrical and mechanical engineering with computer systems and engineering management to produce well-rounded and multi-skilled engineering professionals. The systems engineering approach at ANU is underscored by technological trends that cut across boundaries between traditional disciplines of engineering and computer science.

Aims of the BE degree programs

The aim of the BE degree programs is to prepare students for successful careers as professional engineering managers, designers, analysts, educators and researchers.

All ANU Bachelor of Engineering degrees build on a foundation of basic science and engineering fundamentals, offer a unique systems approach built into professional development courses and the diverse range of engineering discipline courses available, and provide for the opportunity to diversify through a wide range of combined degree options, and to specialise through a suitable choice of engineering major. The following four-year BE degree programs are offered:

- engineering (generic systems)
- telecommunication systems
- mechatronics
- manufacturing and management systems
- materials and mechanical systems
- sustainable energy systems
- digital and electronic systems
- photonic systems
- environmental systems

The program of study is the same for all students in the first year, with specialisation opportunities starting in year 2 through the selection of at least one of the major disciplines listed below, appropriate professional electives and project work.

It is the aim that the BE graduate: has a sound and broad knowledge of basic science and engineering; is able to communicate effectively with engineers and the general public; has

the capacity to acquire in-depth discipline knowledge; is able to use common sense, scientific and engineering knowledge to identify, formulate and solve problems; is able to use a systems approach to engineering analysis, design, operation and management; is able to contribute to a multidisciplinary and multicultural team; is conscious of the social, cultural, global, environmental, legal and business aspects of engineering, including a commitment to the principles of sustainable development; has an understanding of the responsibilities of an inclusive and socially aware engineering professional, including a commitment to the Engineers Australia (IEAust) Code of Ethics, life-long learning and continuing professional development.

These attributes are engendered by: formal courses in basic science, engineering fundamentals, engineering management and law; discipline courses that introduce students to the cutting edge of selected areas of engineering; hands-on experience in the analysis, design and development of telecommunications, manufacturing, energy and management systems; final-year project work which is relevant to industry research, development, operations and management; emphasis in all units on the functions, goals and wider context of engineering; teaching and assessment processes which reflect the importance of written and oral communications, project and design work; small-group teaching that encourages collaborative learning and problem solving; group laboratory, analysis and design exercises; and a student seminar program.

Students may specialise through a choice of named BE degrees. Students may also specialise through their choice of Engineering majors and electives and other University electives. Students are encouraged to create a diverse program of study from a variety of engineering disciplines to take full advantage of the unique educational opportunities offered by ANU Engineering.

Practical Experience

Engineers Australia (IEAust) specifies that students are required to complete at least 60 days of engineering work experience during the course through approved professional employment taken in the vacation periods. For details, see entry for ENGN3100 - Practical Experience.

Program requirements

The BE degree program requires the completion of at least 192 credits points of courses including:

1.48 units of the following professional development courses:
ENGN1211 Discovering Engineering (6 unit)
ENGN2225 Systems Design (6 unit)
ENGN3211 Investment Decisions & Financial Systems (6 unit) (or specified equivalent: COMM1020 or ASHI2012 or ASHY2014 or ASHI2023 or POLS1004 or ECHI1105 or ECHI1106.)
ENGN3221 Engineering Management (6 unit)
ENGN3100 Practical Experience (0 unit)
ENGN4200 Individual Project (12 unit)
ENGN4221 Systems Engineering Project (6 unit)
ENGN4611 Engineering Law (6 unit) (or specified equivalent: COMM1101 or ASHI2268 or POLS1002 or ECHI1105 or ECHI1106.) (6 unit)

2. 78 units of engineering discipline courses listed in Schedule 1, including ENGN1221 Electromechanical Technologies (6 unit), ENGN1215 Introduction to Materials (6 unit) and at least one engineering discipline major (42 unit).

3. 12 units of mathematics, being
MATH1013 Mathematics & Applications 1 (or MATH1115) (6 unit)
MATH1014 Mathematics & Applications 2 (or MATH1116) (6 unit)

4. 12 units of computing, being
COMP1100 Introduction to Programming & Algorithms (6 unit) and COMP1110 Foundations of Software Engineering (6 unit), or, alternatively, COMP1120 From Programming to Software Engineering (6 unit) plus an additional 6 units of computing courses (COMPxxxx).

5. 6 units of physics, being
PHYS1101 Advanced Physics I (6 unit)

6. 36 units of courses offered by the University.

The degree program may not include more than 60 units of 1000-series courses.

Engineering Majors

The faculty offers six engineering majors that may be selected in terms of fulfilling item 2 of the BE degree requirements.

Telecommunication Systems

ENGN1221	Electromechanical Technologies	6 unit
ENGN2211	Electronic Circuits &Devices	6 unit
ENGN2223	Signals & Systems	6 unit
ENGN3214	Telecommunication Systems	6 unit
ENGN3226	Digital Communications	6 unit
ENGN4535	Telecommunication Networks	6 unit
ENGN4536	Mobile and Wireless Communications	6 unit
TOTAL		42 units

Electronic Systems

ENGN1221	Electromechanical Technologies	6 unit
ENGN2211	Electronic Circuits & Devices	6 unit
ENGN2224	Electronics	6 unit
ENGN3213	Digital Systems and Microprocessors	6 unit
ENGN4625	Power Electronics	6 unit
ENGN4507, OR ENGN2223	Microelectronic and Photonic Technology, OR Signals & Systems	6 unit
ENGN4519, OR ENGN4528	Semiconductor and Optoelectronic Devices, OR Computer Vision	6 unit
TOTAL		42 units

Robotics and Computer Vision

ENGN1221	Electromechanical Technologies	6 unit
ENGN2211	Electronic Circuits & Devices	6 unit
ENGN2223	Signals & Systems	6 unit
ENGN3213	Digital Systems and Microprocessors	6 unit
ENGN3223	Control Systems	6 unit
ENGN4627	Robotics	6 unit
ENGN4528	Computer Vision	6 unit
TOTAL		42 units

Manufacturing and Management Systems

ENGN1215	Introduction to Materials	6 unit
ENGN2214	Mechanics of Materials	6 unit
ENGN2221	Systems Dynamics	6 unit
ENGN3212	Manufacturing Technologies	6 unit
ENGN3222	Manufacturing Systems	6 unit
ENGN4615, OR ENGN4532	Finite Element Analysis OR Logistics and Operational Systems	6 unit
ENGN4601, OR ENGN4627	Engineering Materials, OR Robotics	6 unit
TOTAL		42 units

Materials and Mechanical Systems

ENGN1215	Introduction to Materials	6 unit
ENGN2214	Mechanics of Materials	6 unit
ENGN2221	Systems Dynamics	6 unit
ENGN2222	Thermal Energy Systems	6 unit
ENGN3224	Energy Systems Engineering	6 unit
ENGN4601	Engineering Materials	6 unit
ENGN4511	Composite Materials	6 unit
TOTAL		42 units

Sustainable Energy Systems

ENGN1221	Electromechanical Technologies	6 unit
ENGN2211	Electronic Circuits and Devices	6 unit
ENGN2224	Electronics	6 unit
ENGN2222	Thermal Energy Systems	6 unit
ENGN3224	Energy Systems Engineering	6 unit
ENGN4516	Energy Resources and Renewable Technologies	6 unit
ENGN4524	Solar Energy Technology	6 unit
TOTAL		42 units

Science and FEIT majors and named engineering degrees

The 36 units of courses under Item 6 of the BE program requirements may be used by students to further their interests in other subject areas. The Faculty of Engineering and Information Technology has developed named engineering degrees in photonic systems, environmental systems, and electronics and digital systems by incorporating non-engineering majors offered by the Faculty of Science and the Faculty of Engineering and Information Technology in fulfillment of the requirements under Items 5 and 6 of the BE program requirements. These are the Photonic Systems major, the Environmental Systems major, and the Digital Systems major. Note that these majors cannot be counted towards Item 2 of the BE program requirements.

Note that the named degrees BE (Photonic Systems) and BE (Environmental Systems) may only be taken as a single degree, not as a combined degree. BE (Digital and Electronic Systems) may be combined with the Bachelor of Information Technology degree.

Photonic Systems

PHYS1101 and PHYS1201	Advanced Physics I and Advanced Physics II	6 unit 6 unit
PHYS2013	Quantum Physics	6 unit
PHYS2017	Lasers and Photonics Fundamentals	6 unit
PHYS2016	Electromagnetism and Continuum Mechanics	6 unit
PHYS3057	Laser Physics and Electro-Optics	6 unit
PHYS3050	Optical Fibre and Waveguide Transmission	3 unit
PHYS3051	Devices for Optical Systems and Networks	3 unit
TOTAL		42 units

Note: Engineering students who wish to undertake PHYS3050 and PHYS3051 in fulfillment of part 2 of the BE program requirements are advised to enrol in ENGN4522 Special Topics in Engineering II.

Environmental Systems

PHYS1101	Advanced Physics I	6 unit
GEOG2106	Introduction to Greenhouse	6 unit
	five recommended courses in Geographic Sciences, or five courses in Human Systems, or five courses in Renewable Materials, or five courses in Geological and Soil Systems	30 unit
TOTAL		42 units

Note: For details on the four different course patterns that may be followed satisfying the requirements of the Environmental Systems major please refer to the Engineering website http://engn.anu.edu.au or contact the Faculty of Engineering and IT.

Digital Systems

COMP1110	Foundations of Software Engineering	6 unit
COMP2100	Software Construction	6 unit
COMP2300	Introduction to Computer Systems	6 unit
COMP2310	Concurrent and Distributed Systems	6 unit
COMP3300	Operating Systems Implementation	6 unit
COMP3310	Computer Networks	6 unit
COMP4330	Real Time and Embedded Systems	6 unit
TOTAL		42 units

Named Bachelor of Engineering Degrees

In addition to the Bachelor of Engineering degree, students may be eligible to enrol in one the following named degrees. The specification of a named degree is optional. Students should note that all completed majors will be listed on their academic transcript. The degree testamur will only list a named Bachelor of Engineering degree (other than the generic 4700-Bachelor of Engineering) if: a) all requirements have been satisfied for that degree and b) the student notifies the Faculty Office of this before commencement of their intended final semester.

Schedule 1: Engineering Discipline Courses

ENGN1215 Introduction to Materials
ENGN1221 Electromechanical Technologies
ENGN2211 Electronic Circuits and Devices
ENGN2214 Mechanics of Materials
ENGN2221 System Dynamics
ENGN2222 Thermal Energy Systems
ENGN2223 Signals and Systems
ENGN2224 Electronics
ENGN3212 Manufacturing Technologies
ENGN3213 Digital Systems and Microprocessors
ENGN3214 Telecommunication Systems
ENGN3222 Manufacturing Systems
ENGN3223 Control Systems
ENGN3224 Energy Systems Engineering
ENGN3226 Digital Communications
ENGN4507 Microelectronic and Photonic Technology
ENGN4511 Composite Materials
ENGN4516 Energy Resources and Renewable Technologies
ENGN4519 Semiconductor and Optoelectronic Devices
ENGN4520 Special Topics in Engineering 1,
ENGN4521 Special Topics in Engineering 2,
ENGN4522 Special Topics in Engineering 3,
ENGN4523 Special Topics in Engineering 4,
ENGN4524 Solar Energy Technology
ENGN4528 Computer Vision
ENGN4530 Engineering and Public Policy
ENGN4532 Logistics and Operational Systems
ENGN4533 Biomedical Engineering
ENGN4535 Telecommunication Networks
ENGN4536 Mobile and Wireless Communications
ENGN4601 Engineering Materials
ENGN4612 Digital Signal Processing and Control
ENGN4615 Finite Element Analysis
ENGN4625 Power Electronics
ENGN4627 Robotics

Alternation of ENGN4000 series courses

Each ENGN4000 series course listed in Schedule 1 will be offered either in an ODD year or an EVEN year. All ENGN1000, 2000 and 3000 series courses will be offered EVERY year, as will compulsory 4000 series courses. This leads to two possible alternation patterns (A and B):

Students will need to bear this in mind when enrolling each year, particularly in years 3 and 4. It is recommended that students finalise their elective choices and planned enrolment patterns for years 3 and 4 at the end of year 2 at the latest. Please refer to the Department's web page, http://engn.anu.edu.au/undergraduate, for recommended enrolment patterns and other helpful information.

The Bachelor of Engineering degree with Honours

Honours grades in the BE degree are awarded by the Faculty on the basis of a recommendation from the Head of Engineering and may be awarded with first class honours; second class honours, division A; or second class honours, division B.

The awarding of honours in engineering is based on meritorious performance over the entire four-year program. The assessment of meritorious performance includes the calculation of an average percentage mark (APM), together with the consideration of the overall academic progress of the student and the Individual Project result. To determine the global APM, the first year average mark is weighted by a factor 0.1, and the combined average of years 2, 3 and 4 by a factor 0.9.

The first year average mark is the average of the marks awarded in the following courses: ENGN1211Discovering Engineering, ENGN1221 Electromechanical Technologies, ENGN1215 Introduction to Materials, MATH1013 Mathematics & Applications 1 (or MATH1115), MATH1014 Mathematics & Applications 2 (or MATH1116), PHYS1101Advanced Physics I, COMP1100 Introduction to Programming &Algorithms and COMP1110 Foundations of Software Engineering. The last two courses may be replaced with COMP1120 From Programming to Software Engineering.

The average mark for the remainder years is the average mark awarded in all the additional engineering courses (that is,

Named Bachelor of Engineering Degrees

Degree Program	Code	Requirements
Bachelor of Engineering, BE	4700	No major specified, although at least one must be completed.
BE (Telecommunication Systems)	4700/4001	Must include the Telecommunication Systems major.
BE (Mechatronic Systems)	4700/4002	Must include both the Robotics and Computer Vision major and the Manufacturing and Management Systems major.
BE (Digital and Electronic Systems)	4700/4003	Must include both the Electronic Systems major and the Digital Systems major.
BE (Manufacturing and Management Systems)	4700/4004	Must include the Manufacturing and Management Systems major.
BE (Materials and Mechanical Systems)	4700/4005	Must include the Materials and Mechanical Systems major.
BE (Sustainable Energy Systems)	4700/4006	Must include the Sustainable Energy Systems major.
BE (Photonic Systems)	4700/4007	Must include at least one of the engineering majors (Telecommunication Systems, Robotics and Computer Vision, Manufacturing and Management Systems, Electronic Systems, Materials and Mechanical Systems, or Sustainable Energy Systems) and the Photonic Systems Major.
BE (Environmental Systems)	4700/4008	Must include both the Sustainable Energy Systems major and the Environmental Systems major.

having an ENGNxxxx code number) completed by the student, excluding ENGN4200 Individual Project, which is considered separately.

ENGN4100 Engineering Honours

In order to be considered for the award of a degree offered by the Department of Engineering, students must formally enrol in ENGN4100 – Engineering Honours, at the commencement beginning of their intended final semester.

Combined degrees

All BE combined degrees are 5 EFTSU, 5 year programs comprising 240 units:

Bachelor of Engineering may be combined with a

- Bachelor of Science
- Bachelor of Information Technology
- Bachelor of Commerce
- Bachelor of Economics
- Bachelor of Asian Studies
- Bachelor of Arts

The named Bachelor of Engineering degrees are not available as combined degree programs. Students can choose however to undertake the major(s) that form this specialization and have these majors listed on their academic transcript but not on their degree testamur.

Standard Bachelor of Engineering recommended program pattern

	FIRST SEMESTER		SECOND SEMESTER	
Year 1	ENGN1211 Discovering Engineering	6 unit	ENGN1221 Electromechanical Technologies	6 unit
AB	MATH1013 Mathematics & Applications 1	6 unit	MATH1014 Mathematics & Applications 2	6 unit
48 unit	PHYS1101 Advanced Physics I	6 unit	ENGN1215 Introduction to Materials	6 unit
	COMP1100 Introduction to Programming OR University elective	6 unit	COMP1110 Foundations of Software Engineering OR ENGN1227 Topics in Chemistry and Physics OR University elective	6 unit
Year 2	MATH2305 Calculus and Differential Equations OR University elective	6 unit	ENGN2225 System Design	6 unit
AB	Engineering major	6 unit	Engineering major	6 unit
48 unit	Engineering elective	6 unit	Engineering elective	6 unit
	University elective OR COMP1100 Introduction to Programming	6 unit	University elective OR COMP1110 Foundations Software Engineering	6 unit
Year 3 ODD	ENGN3211 Investment Decisions (or equivalent)	6 unit	ENGN3221 Engineering Management	6 unit
A	Engineering major	6 unit	Engineering major	6 unit
48 unit	Engineering elective	6 unit	Engineering elective	6 unit
	University elective	6 unit	University elective	6 unit
Year 3 EVEN	ENGN3211 Investment Decisions (or equivalent)	6 unit	ENGN3221 Engineering Management	6 unit
B	Engineering major	6 unit	Engineering major	6 unit
48 unit	Engineering elective	6 unit	Engineering elective	6 unit
	University elective	6 unit	University elective	6 unit
Year 4 ODD	ENGN4200A Individual Project	6 unit	ENGN4200B Individual Project	6 unit
B	ENGN4221 Systems Engineering Project	6 unit	ENGN4611 Engineering Law (or equivalent)	6 unit
48 unit	Engineering major	6 unit	Engineering major	6 unit
	Engineering elective	6 unit	University elective	6 unit
Year 4 EVEN	ENGN4200 Individual Project	6 unit	ENGN4200 Individual Project	6 unit
A	ENGN4221 Systems Engineering Project	6 unit	ENGN4611 Engineering Law (or equivalent)	6 unit
48 unit	Engineering major	6 unit	Engineering major	6 unit
	Engineering elective	6 unit	University elective	6 unit

The above pattern is indicative only and may be tailored to suit individual needs. The choice of electives in a particular year will depend on the major chosen, the alternation pattern and on any recommended electives for a named degree (if desired). These should be decided before commencing year 3. Detailed recommendations for enrolment patterns for all BE programs including named degrees and majors are available on the Department of Engineering web site http://engn.anu.edu.au

Bachelor of Information Technology

(course code 3701)

The Bachelor of Information Technology is a three-year degree that prepares graduates to enter the computing industry work force as novice practitioners to develop software or to apply computing in human organisations. The graduate attains the technical knowledge of fundamentals of computer systems, programming languages, computer systems, computer applications, and information systems. The computing industry has always been subject to rapid change, and so we also aim to prepare graduates to meet the changes in practice and in technology that will be met during their working careers. The graduate can enter the fields of software development and support, information systems development and support, or many other broad areas of choice in computing or general industry.

The Bachelor of Information Technology degree is structured to enable students to choose between a Computer Systems major, an Information Systems major and a Software Development major. All the majors are founded on an introduction to computer programming, a broad perspective on the computing discipline and profession, and an introduction to the functional structure of computers. They also require a grounding in mathematics and theoretical computer science, which is a means of developing the ability to work with abstractions, a fundamental requirement for understanding and applying ideas in computing.

During later years of the course, students can choose the Software Development major, to develop the conceptual and practical skills for software development and the technology of computer systems; or the Information Systems major, to develop understanding of organisations, the management of computer systems applications in them, and the accompanying systems analysis and design; or the Computer Systems major, to develop a sound knowledge in the area of computer systems, including distributed systems, networks and digital systems.

Program requirements

The degree requires the completion of 144 units of courses offered, or approved by, the Faculty of Engineering and Information Technology, including:
(a) completion of 90 units of IT courses, of which at least 36 units must be 3000/4000 series courses. The 90 units must include:

- all the courses from Schedule 1 and
- all the courses from a major chosen from Schedule 2

(b) completion of MATH1005 Mathematical Modelling 2 or MATH1014 Mathematics and Applications 2 or MATH1116 Mathematics and Applications 2 Honours;
(c) completion of a further 6 units of 2000/3000/4000 series IT courses or a 6 unit elective chosen from Schedule 3.
(d) completion of a further 42 units of courses from anywhere in the university, of which no more than 18 units may be 1000-series courses;
(e) no more than 48 units of 1000 series courses.

IT courses are:
COMP courses
INFS courses
ENGN1211 Discovering Engineering
ENGN2225 System Design
ENGN3213 Digital Systems and Microprocessors
ENGN3214 Telecommunications
ENGN3226 Digital Communications
ENGN4512 Digital Signal Processing
ENGN4528 Computer Vision
MATH2501 Foundations of Computational Science

Schedule 1

- COMP1100 Introduction to Programming and Algorithms AND COMP1110 Foundations of Software Engineering OR COMP1120 From Programming to Software Engineering AND 6 units of unspecified 2000/3000 COMP
- COMP1200 Perspectives on Computing OR ENGN1211 Discovering Engineering
- COMP2300 Introduction to Computer Systems
- COMP2400 Relational Databases
- COMP2600 Formal Methods in Software Engineering
- COMP3110 Software Analysis and Design

Schedule 2

Computer Systems Major

- COMP2100 Software Construction
- COMP2310 Concurrent and Distributed Systems
- COMP3120 Managing Software Development OR COMP3100 Software Engineering Group Project
- COMP3300 Operating Systems Implementation
- COMP3310 Computer Networks
- ENGN3213 Digital Systems and Microprocessors OR COMP4330 Real-Time and Embedded Systems

Information Systems Major

- COMP2410 Networked Information Systems OR COMP3400 Internets, Intranets and Document Systems
- COMP3410 IT in E-Commerce OR COMP3420 Database Systems
- INFS2024 Information Systems Analysis
- INFS3024 Information Systems Management
- INFS3059 Project Management and Information Systems

Software Development Major

- COMP2100 Software Construction
- COMP2110 Software Design
- COMP2310 Concurrent and Distributed Systems
- COMP2410 Networked Information Systems OR COMP3310 Computer Networks OR COMP3400 Internets, Intranets and Document Systems
- COMP3100 Software Engineering Group Project

Schedule 3

- BUSN1001 Business Reporting and Analysis
- BUSN1101 Introduction to Commercial Law
- ECON1101 Microeconomics 1
- EMET1001 Foundations of Economic and Financial Models
- FINM1001 Money, Markets and Finance
- MATH1003 Mathematical Modelling 1
- MATH1013 Mathematics and Applications 1
- MATH1115 Mathematics and Applications 1 Honours
- MATH2301 Games, Graphs and Machines
- PSYC1002 Introduction to Organizational Psychology
- SCOM1001 Science and Public Awareness
- STAT1003 Statistical Techniques
- STAT1008 Quantitative Research Methods

The Bachelor of Information Technology with Honours

The Bachelor of Information Technology degree with honours requires an additional year of study after the pass degree of Bachelor of Information Technology. Admission is by invitation based on performance in your best 36 units of 2000 and 3000 series Information Technology and Mathematics units and generally requires an average performance at better than Credit level. The honours program includes advanced coursework and a major individual project worth 50% of the year. Honours grades are awarded on the result of the whole year's work.

Degree Structure

BInfTech (3701:Computer Systems) possible enrolment pattern

	First semester	Second semester
Year 1	COMP1100 Introduction to Programming and Algorithms COMP1200 Perspectives on Computing Schedule 3 elective (6u) Elective (6u)[1]	COMP1110 Foundations of Software Engineering COMP2400 Relational Databases MATH1005 Mathematical Modelling 2 Elective (6u)[1]
Year 2	COMP2100 Software Construction COMP2300 Intro to Computer Systems 2000/3000/4000-series IT (6u) Elective (6u)[1]	COMP2310 Concurrent & Distributed Systems COMP2600 Formal Methods in Software Engineering Elective (12u)[1]
Year 3	COMP3310 Computer Networks COMP3110 Software Analysis and Design 3000/4000-series IT (6u)[2][3] Elective (6u)[1]	COMP3300 Operating Systems Implementation ENGN3213 Digital Systems and Microprocessors (6u) OR COMP4330 Real-Time & Embedded Systems 3000/4000-series IT (6u)[2][3] Elective (6u)[1]

[1] May include no more than 18 units of 1000-series courses.
[2] Must include one of COMP3100A&B Software Engineering Group Project or COMP3120 Managing Software Development.
[3] Some 3000/4000-series IT electives may have specific prerequisites that are not covered by the courses specified in the table.

BInfTech (3701: Information Systems) possible enrolment pattern

	First semester	Second semester
Year 1	COMP1100 Introduction to Programming and Algorithms COMP1200 Perspectives on Computing Schedule 3 elective (6u) Elective (6u)[1]	COMP1110 Foundations of Software Engineering COMP2400 Relational Databases MATH1005 Mathematical Modelling 2 Elective (6u)[1]
Year 2	INFS2024 Information Systems Analysis COMP2300 Introduction to Computer Systems COMP2410 Networked Information Systems Elective (6u)[1]	COMP2600 Formal Methods in Software Engineering 2000/3000/4000-series IT (6u) Elective (12u)[1]
Year 3	COMP3110 Software Analysis and Design INFS3024 Information Systems Management 3000/4000-series IT (6u)[2][3] Elective (6u)[1]	INFS3059 Project Management and Information Systems 3000/4000-series IT (12u) [2][3] Elective (6u)[1]

[1] May include no more than 18 units of 1000-series courses.
[2] Must include one of COMP3410 IT in E-Commerce or COMP3420 Database Systems.
[3] Some 3000/4000-series IT electives may have specific prerequisites that are not covered by the courses specified in the table.

BInfTech (3701: Software Development) possible enrolment pattern

	First semester	Second semester
Year 1	COMP1100 Introduction to Programming and Algorithms COMP1200 Perspectives on Computing Schedule 3 elective (6u) Elective (6u)[1]	COMP1110 Foundations of Software Engineering COMP2400 Relational Databases MATH1005 Mathematical Modelling 2 Elective (6u)[1]
Year 2	COMP2100 Software Construction COMP2300 Introduction to Computer Systems Elective (12u)[1]	COMP2110 Software Design COMP2310 Concurrent & Distributed Systems COMP2600 Formal Methods in Software Engineering Elective (6u)[1]
Year 3	COMP3100A Software Engineering Group Project COMP3110 Software Analysis and Design COMP3310 Computer Networks Elective (6u)[1]	COMP3100B Software Engineering Group Project 3000/4000-series IT (12u) [2] Elective (6u)[1]

[1] May include no more than 18 units of 1000-series courses.
[2] Some 3000/4000-series IT electives may have specific prerequisites that are not covered by the courses specified in the table.

Bachelor of Software Engineering

(course code 4708)

The Bachelor of Software Engineering is a four-year degree accredited by the Engineers Australia (IEAust). The course emphasises the development of professional skills in the technical area of software engineering, that is, the systematic application of analysis, design, and construction techniques for computer systems and applications.

The computing industry has grown rapidly in the last 40 years, despite a widely acknowledged, continual state of crisis in our abilities to manage reliably the process of developing software. The need for a mixture of technical computing knowledge with the skills of the computer programmer, and the disciplined organisation and judgement of the professional engineer, has been seen as desirable for many years. The introduction of the Bachelor of Software Engineering degree in 1999 was aimed to meet this need.

The BSEng graduate will acquire technical knowledge of the fundamentals of computer systems, programming languages, and the mathematical foundations of algorithms and data structures that are required to establish reliability and safety in software. Technical knowledge is honed by a selection of advanced technical topics. The principles and practices of the design and implementation of software are built up in a sequence of units combining theoretical study and practical laboratory exercises, individual projects, and group projects. Of no less importance is an introduction to the professional skills of a competent engineer: management, communication with others and teamwork in particular, and ethical and other responsibilities. Graduates will also build their own skills of individual software development in university studies and in practical work experience which is required during the course, and will learn a systems approach developed and exemplified in individual and group project work.

Mathematics is an essential component of the degree for developing the languages and ability for abstraction that is the core of the computing discipline, and to allow rigorous formal description of aspects of the software engineering process. Discrete mathematics also has significant applications in the modelling and rigorous description of software properties, computing processes and programming languages.

The best computing professionals are informed by knowledge of a wider field than computing alone. The course includes the choice of a major line of study in another discipline in the university which can broaden the understanding of the social and cultural responsibilities of the software engineer, and strengthen the ability to communicate with others, or may be used to specialise in further fundamental sciences, or in specialised engineering streams. Both develop the capacity for lifelong learning by exposure to a broader range of ways of studying at university level.

Program Requirements

The program requires the completion of 192 units including:

(a) completion of 129 units of prescribed courses as follows:

COMP1100 Introduction to Programming and Algorithms and COMP1110 Foundations of Software Engineering OR COMP1120 From Programming to Software Engineering and 6 units of unspecified 2000/3000 COMP
COMP2100 Software Construction
COMP2110 Software Design
COMP2300 Introduction to Computer Systems
COMP2310 Concurrent and Distributed Systems
COMP2400 Relational Databases
COMP2600 Formal Methods in Software Engineering
COMP3110 Software Analysis and Design
COMP3120 Managing Software Development
COMP3500 Software Engineering Project
COMP3600 Algorithms
COMP4100 Software Quality Management
COMP4110 Software Process
COMP4500 Software Engineering Practice
COMP4540 Software Engineering Research Project
COMP1800 Art and Science of Computing I
COMP2800 Art and Science of Computing II
COMP3800 Art and Science of Computing III
COMP4800 Industrial Experience
ENGN1211 Discovering Engineering
ENGN3211 Investment Decisions and Financial Systems
ENGN4211 Engineering Law
MATH1013 Mathematics and Applications 1 OR MATH1115 Mathematics and Applications 1 Honours
MATH1014 Mathematics and Applications 2 OR MATH1116 Mathematics and Applications 2 Honours

(b) completion of a further 15 units of 3000/4000-series COMP courses other than those prescribed in (a);

(c) completion of a further 12 units of Engineering or Science courses excluding COMP courses;

(d) completion of a further 36 units of courses, including no more than 12 units of 1000-series courses from anywhere in the University;

(e) no more than 60 units of 1000-series courses.

Bachelor of Software Engineering elective options

The Bachelor of Software Engineering (BSEng) program provides for students to choose:

(a) 12 units Science or Engineering;

(b) 36 units of courses (which must include at least 6 units at 3000-series level). The following suggestions are highlighted for BSEng students who want to consider engineering-related areas:
Telecommunications
PHYS1101, ENGN1221, ENGN2211, ENGN2223, ENGN3214, ENGN3226, ENGN4612, ENGN4536
Robotics and Computer Vision
PHYS1101, ENGN1221, ENGN2211, ENGN2223, ENGN3213, ENGN3223, and choose 6 units from ENGN4627, ENGN4528
Manufacturing and Computational Engineering
PHYS1101, ENGN1221, ENGN2214, ENGN2221, ENGN3212, ENGN3222, ENGN4615, ENGN4627
Electronics and Semiconductors
PHYS1101, ENGN1221, ENGN2211, ENGN2224, ENGN3213, ENGN4625, ENGN4507, ENGN4519

BSEng students who are pursuing elective interests outside the Faculty of Engineering and Information Technology are advised to consult the relevant section of the ANU Undergraduate Handbook and the relevant Sub-Dean or Departmental course adviser.

Degree Structure

Bachelor of Software Engineering (4708) possible enrolment pattern

	First semester	Second semester
Year 1	COMP1100 Introduction to Programming and Algorithms MATH1013 Mathematics and Applications 1 ENGN1211 Discovering Engineering COMP1800A Art and Science of Computing I Science/Engineering Elective (6u)	COMP1110 Foundations of Software Engineering MATH1014 Mathematics and Applications 2 COMP2400 Relational Databases (6u) COMP1800B Art and Science of Computing I Science Engineering elective (6u)
Year 2	COMP2100 Software Construction COMP2300 Introduction to Computer Systems COMP2800A Art and Science of Computing II ENGN3211 Investment Decisions and Financial Analysis Elective (6u)[1]	COMP2110 Software Design COMP2310 Concurrent and Distributed Systems COMP2800B Art and Science of Computing II COMP2600 Formal Methods in Software Engineering Elective (6u)[1]
Year 3	COMP3500A Software Engineering Project COMP3110 Software Analysis and Design COMP3800A Art and Science of Computing III 3000/4000-series COMP (6u)[2] Elective (6u)[1]	COMP3500B Software Engineering Project COMP3120 Managing Software Development COMP3600 Algorithms COMP3800B Art and Science of Computing III Elective (6u)[1]
Year 4	COMP4500A Software Engineering Practice COMP4100 Software Quality Management ENGN4211 Engineering Law (3u) 3000/4000-series COMP (3u)[2] Elective (6u)[1]	COMP4500B Software Engineering Practice COMP4110 Software Quality Management 3000/4000-series COMP (6u)[2] Elective (6u)[1]

[1] May include no more than 12 units of 1000-series courses.
[2] Some 3000/4000-series COMP electives may have specific prerequisites that are not covered by the courses specified in the table.

Accreditation

The Bachelor of Software Engineering degree has been accredited with Engineers Australia (IEAust) and the Australian Computer Society. Students who complete the Bachelor of Information Technology degree are eligible for associate membership of the Australian Computer Society. The Bachelor of Engineering is accredited to the appropriate level with Engineers Australia (IEAust).

Status

Advanced standing or status towards undergraduate degree programs of the Faculty may be granted for studies completed elsewhere. Requests for status are assessed individually.

Combined Courses

Detailed information about degree programs combined with the Bachelor of Engineering or the Bachelor of Information Technology degrees is provided in the Combined Courses section of this Handbook.

Note that there are no combined programs with the Bachelor of Software Engineering.

Computer Science

T. D. Gedeon, BSc (Hons), PhD UWA
Head of Department

How do people understand and use computers? The subject matter of the computing discipline has many names, including software engineering, computer science, informatics, information systems, information technology, and computer programming. The discipline is only young, and the nature of the subject has been debated many times since the first electronic computers and the foundation of the first professional association in 1947. The nature of the discipline has changed in that time from a focus on computer hardware in a very small number of uniquely designed computers, and the highly specialised mathematical algorithms that were programmed into them, to the graphically interfaced, largely non-numerical, general purpose commodity computing of today's information technology industry. The focus of that industry has shifted from details of interaction with computers to the breadth of interaction with people, and so has the computing discipline broadened to include the ways in which its professional graduates apply computing to the information needs of organisations and individuals.

Information Technology is the common global term which covers all aspects of computing, data storage, and communications - the generality of equipment, systems and services that involve the use of computers, advanced telecommunications, and digital electronics. The IT industry is now reckoned to be the world's largest. Although the Department's name continues to refer to "Computer Science," it is a centre for the study of wider aspects of IT: software engineering, which is the profession of designing and constructing complex groups of programs; information systems, which involves the ways in which computer systems are meshed with organisations; and computer science, the systematic study of the fundamental algorithms and processes behind the technology. The department provides professional, technical, and service courses in these areas and introductory information technology for students in many areas of the university.

Department Aims and Objectives

The Department aims to produce graduates with a professional education in Software Engineering and offers a four year professional Software Engineering degree program. This includes technical, professional, communications skills, and individual and group project work on a sound basis of mathematics and computer science. A pass degree or a degree with honours can be awarded after four years of study. Engineers Australia has accredited this program as an engineering degree.

The Faculty also offers a three-year technical and professional degree program, the Bachelor of Information Technology, in combination with the Faculty of Economics and Commerce.

BInfTech students can choose to specialise in software development, information systems or computer systems. The BInfTech program can also be combined with programs in Commerce or with Economics for a four year combined degree program that aims to provide a professional, business-oriented education. It can be combined with the Bachelor of Engineering program for five years of study that includes more computing within a full multidisciplinary Engineering degree. It is also possible to combine the BInfTech program with the Bachelor of Science (Forestry), the Bachelor of Arts, or with the Bachelor of Laws programs.

Many of the same computer science and software development courses can be taken within the more generalist Bachelor of Science degree. Students can thereby combine study of a Science subject with as much computing as they wish or take combined Science degrees such as Science and Law. The specialised Bachelor of Computational Science degree (described under the Faculty of Science entry) combines the study of computing, mathematics, and their application to modelling in the physical sciences.

A fourth year of honours study can be added to the BSc and the BInfTech. In all of these degrees, the Department aims to produce first class honours graduates who can enter postgraduate studies at leading international computer science laboratories. A Graduate Diploma in IT for Science graduates who have little computing background, and a Masters coursework program, are also available.

The Department has an active research program and educates Master of Philosophy and PhD students by research.

Introductory courses

The Department offers several courses that can be taken by students with no previous background in computing or information technology. COMP1900 is an information technology service course offered to students in other faculties, which provides a university-level introduction to applied computing for students in any area who wish to use computers in their studies or their careers but do not necessarily need to study computer programming. COMP1200 provides a broad perspective on the field of computing for those with a deeper interest in the underlying science and technology, and it is a required part of the Information Technology degrees.

COMP1100 provides an introduction to computer programming, both as a service course and as a foundation for all further studies in information technology. It assumes a prior knowledge of secondary college advanced mathematics, but does not require any previous computing experience. COMP1110 provides further study of programming and software engineering, consolidating the study of constructing larger programs. It leads to further software development and software engineering studies. Students with good background experience in programming can combine these two courses into one fast-track course COMP1120.

COMP2400 can also be taken in first year, following COMP1100. It provides an introduction to the use of databases and to their underlying technology. This course can be used as part of a major in Commerce as well as contributing to Information Technology and Software Engineering degrees.

Further Information

Further information on the coures offered and the structures of the courses is available from the Department's World Wide Web site, at http://cs.anu.edu.au.

Course Descriptions

Introduction to Programming and Algorithms — COMP1100 (6 units)

First Year Course
First and second semester
Thirty one-hour lectures. twelve two-hour tutorial/laboratory sessions.

Syllabus: This course is an introduction to the basic principles of programming from an object-oriented perspective. These principles are applied in a study of straightforward algorithms for searching and sorting. It provides a foundation for studies in computer science, information systems and software engineering. The following topics are covered: basic concepts of programming (data types, assignment, control structures, the procedural abstraction), basic concepts of object-oriented programming in Eiffel (class, object, attributes, routines), the basic Eiffel library classes, straightforward algorithms for search and searching, object-oriented methods (class inheritance, assertions on routines, design by contract).
The course has a strong practical emphasis, with required attendance at laboratory sessions.

Proposed Assessment: Assignments (50%); Final exam (50%)

Foundations of Software Engineering — COMP1110 (6 units)

First Year Course
Second semester
Thirty one-hour lectures and twelve two-hour tutorial/laboratory sessions

Prerequisites: COMP1100

Syllabus: This course introduces students to the tools and techniques for developing software systems of a size and quality of an industrially relevant nature. The course teaches the fundamental strategies of abstraction, decomposition and reuse as methods for constructing such systems. Verification and validation techniques, with an emphasis on testing, are taught as a means to ensure that students are able to deliver software products of the quality required.
In particular, the course will cover: recursive data structures and algorithms; structured data types, abstract data types and their applications; object-oriented programming; and software life-cycle. The course will also introduce some of the theoretical fundamentals that underpins software engineering, including: reasoning about software and its application to specifications, and verification and validation.

From Programming to Software Engineering — COMP1120 (6 units)

First Year Course
First Semester
May not be offered in 2004
Thirty one-hour lectures and twelve two-hour tutorial/laboratory sessions

Prerequisites: Admission is by approval of Head of Department. Students will be required to demonstrate an appropriate level of prior programming experience. Students are assumed to have achieved a level of knowledge of mathematics comparable to at least ACT Advanced Mathematics major or NSW 2 unit Mathematics or equivalent.

Incompatible: with COMP1100, COMP1110

Syllabus: This course presents the principles of programming from an object-oriented perspective and introduces students to the tools and techniques for developing software systems of a size and quality that is industrially relevant. The course teaches the fundamental strategies of abstraction, decomposition and reuse as methods for constructing such systems. Verification and validation techniques, with an emphasis on testing, are taught as a means to ensure that students are able to deliver software products of the quality required.
In particular, the course will introduce concepts of object-oriented programming in Eiffel (class, object, attributes, routines), the basic Eiffel library classes, straightforward algorithms for sorting and searching, object-oriented methods (class inheritance, assertions on routines, design by contract). The course will also cover the foundations and use of recursive algorithms in problem solving; structured data types, abstract data types and their applications; system life-cycle, modularisation, and construction of large systems. The course has a strong practical emphasis, with required attendance at laboratory sessions.

Proposed Assessment: Assignments (36%); Tutorials and Laboratories (4%), Mid-semester Exam (18%); Final Exam (42%)

Perspectives on Computing — COMP1200 (6 units)

First Year Course
First semester
Thirty one-hour lectures, twelve two-hour tutorial and laboratory sessions.

Prerequisites: none

Syllabus: This course presents the important concepts in the computing discipline and places them in context, in order to introduce the nature of the computing profession and the education of a computing professional.The unit covers the following topics, through case studies. Abstractions and the user view: the interactive machine, the stored-program machine, data, programming languages and virtual machines, computational objects. Applications of computer systems: personal computation, application software, information systems, knowledge-based systems, and real-time control. Computer systems and their environment: the personal computer, networked computers and concurrency, the world wide web. The nature of the computing discipline: mathematical theory, scientific experimentation and engineering design. Professional issues: the engineering of software systems, the client focus, and professional ethics. Educational issues: curriculum issues, the ANU experience.

Art and Science of Computing I — COMP1800 (0 units)

First Year Course
Annual (Part A & B)
About eight sessions of occasional seminars.

Prerequisites: Enrolment in BSEng or approval of Head of Department
Syllabus: The Art and Science of Computing I is a seminar-style program. It consists of about 4 events per semester, such as seminars from visiting or staff academics, or discussion or debate sessions on topical subjects. Other sessions might include learning and studying skills, talks from industry representatives, department and unit overviews, hot topics, and surveys. It aims to involve staff and students in debate on computing issues. Some sessions will be led by staff from areas such as the library, counselling, study skills, and other university resource centres.

Introduction to Information Technology Applications — COMP1900 (6 units)

First Year Course
First semester
(May be offered in second semester)
Twenty one-hour lectures, and six two-hour assessable laboratory sessions; plus one laboratory session for marking group project

Prerequisites: Not available to students enrolled in BInfTech or BSEng. Cannot be taken after successful completion of COMP1100 or COMP1120.

Syllabus: An introduction to the basic concepts and skills of computer literacy through modern applied information technology. Good data management practices using files and folders; word processing using styles; data manipulation and display using spreadsheets; World Wide Web information searching; simple website construction. Practical work will be done in supervised computer laboratory sessions.

Proposed Assessment: Assignments (40%); Laboratories (10%); Final Exam (50%)

Software Construction — COMP2100 (6 units)

Later Year Course
First semester
Thirty one-hour lectures and twelve two-hour tutorial/laboratory sessions

Prerequisites: COMP1110 or COMP1120 and MATH1005 or MATH1014 or MATH1116.

Syllabus: This course is about the implementation and test phases of the software construction process. It is based around an individual project lasting the whole semester. In this project, students work on the construction of a substantial application, relevant to their experience as computer users. The project is closely specified, and involves a graphical user interface. During the semester, students follow the Personal Software Process, learning time-management, planning, and quality control.
The following topics are covered: working with larger systems; code review and inspections; test planning and procedures

(derived from specification and design documents); object-oriented (Eiffel), procedural (C) and scripting (Bash) languages; recursive data structures; graphical user interfaces; the Personal Software Process; build tools (Make) and version control (RCS); use of external libraries.

Proposed Assessment: Homework (10%); Assignments (30%); Lab Exam (10%); Final Exam (50%)

Software Design — COMP2110 (6 units)

Later Year Course
Second semester
Twenty four one-hour lectures and twelve two-hour tutorial/laboratory sessions

Prerequisites: COMP1110 or COMP1120; and MATH1005 or MATH1014 or MATH1116

Syllabus: This course is one of three courses (COMP2100, COMP2110, COMP3110) which address constructive aspects of the software development process. It has a primary focus on the design phase.
The following topics are covered. Introduction to requirements specifications. Designing to specifications. The design milieu (notations, documentation standards). Design techniques (object-oriented, software architectures, design patterns, structured). Design review. Design in the context of requirements change. Principles of quality in design.

Proposed Assessment: Assignments (50%); Presentation (10%); Final Exam (40%)

Introduction to Computer Systems — COMP2300 (6 units)

Later Year Course

First semester
Thirty one-hour lectures and nine two-hour laboratory/tutorial sessions.

Prerequisites: COMP1110 or COMP1120; and 6 units of 1000-level MATH/STAT/EMET courses.

Syllabus: An introduction to the hardware and software components of a modern computer system. Comparisons of different types of instructions sets and corresponding addressing modes. Emphasis on the relationships among instruction sets, fetch and execute operations, and the underlying architecture. Introduction to the concept of interrupts, as well as the purpose and specifications of a control course with respect to logic operations. Consideration of the physical implementation of large memory systems, together with the techniques of data storage and checking. Overall concepts of virtual memory, operating system functions, file systems and networks.
Virtual machines and the levels of machine organization, the assembly and linking process and software libraries.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Concurrent and Distributed Systems — COMP2310 (6 units)

Later Year Course

Second semester
Thirty one-hour lectures, nine one-hour tutorials/laboratory sessions.

Prerequisites: COMP1110 or COMP1120; COMP2100 or COMP2300; and MATH1005 or MATH1014 or MATH1116

Syllabus: This course is concerned with the issues that arise when computational processes are supported in a computer system. The scope is broad enough to include discussion of all the layers of a computer system - from the hardware to large information systems applications, and all sizes of computer system - from systems as small as a single processor, to systems as large as the entire Internet. The principal areas of study are processes and process coordination, concurrency support in operating systems and high level languages, and distributed systems.
The following topics are addressed: operating system structure, process management, interaction between system components (processes, devices and processors), mutual exclusion, concurrent programming, semaphores and monitors, inter-process communication, distributed systems, crash resilience and persistent data, deadlock, transaction processing.

Proposed Assessment: Assignments and Laboratories (50%); Quiz and Final Exam (50%)

Relational Databases — COMP2400 (6 units)

Later Year Course

Second semester
Thirty one-hour lectures and six two-hour laboratory/tutorial sessions

Prerequisites: COMP1100 or COMP1120

Incompatible: with INFS2051, INFS3055

Syllabus: Introduction to the basic goals, functions, models, components, applications, and social impact of database system applications. The course introduces the relational data model and the database query language SQL. Entity-Relationship Diagrams are introduced as a tool for conceptual modeling. Effective mapping of a conceptual model to a relational database schema requires some appreciation of the role of integrity constraints, and the impact of DBMS characteristics.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Networked Information Systems — COMP2410 (6 units)

Later Year Course
First semester
Thirty one-hour lectures and six two-hour tutorial/laboratory sessions

Prerequisites: COMP1100; and 6 units of 1000-level MATH/STAT courses

Incompatible: COMP3400

Syllabus: This course studies networking fundamentals including LANS, MANS, WANS, the Internet, intranets, extranets and the WWW, with the focus being the Internet. The topics covered include: hardware, software, network topologies, architecture and protocols; network and web applications; website design and construction; information architecture; standards; privacy, security, firewalls and reliability; systems integration; network monitoring and management; and professional ethics and social issues.

Formal Methods in Software Engineering — COMP2600 (6 units)

Later Year Course
Second semester
Thirty one-hour lectures, eight one-hour tutorials and four two-hour laboratory sessions.

Prerequisites: COMP1110 or COMP1120 and 12 units of 1000-level MATH/STAT including MATH1005 or MATH1014 or MATH1116.

Incompatible: with COMP1013.

Syllabus: This course presents some formal notations that are commonly used for the description of computation and of computing systems, for the specification of software and for mathematically rigorous arguments about program properties. The following areas of study constitute the backbone of the course. Predicate calculus and natural deduction, inductive definitions of data types as a basis for recursive functions and structural induction, formal language theory (particularly regular expressions, finite state machines and context free grammars), specification languages, propositional programming language semantics, partial correctness and proofs of termination.

Proposed Assessment: Assignments (40%); Tutorials and Laboratories (5%); Quiz (10%); Final Exam (45%)

Art and Science of Computing II — COMP2800 (0 units)

Later Year Course
Annual (Part A & B)
About eight sessions of occasional seminars.

Prerequisites: COMP1800A and COMP1800B and enrolment in BSEng or approval of Head of Department.

Syllabus: The Art and Science of Computing II is a seminar-style program. It consists of about 4 events per semester, such as seminars from visiting or staff academics, or discussion or debate sessions on topical subjects. Other sessions might include talks from industry representatives, department and unit overviews, hot topics and surveys. It aims to involve staff and students in debate on computing issues.
As for COMP1800 except that events in Art and Science of Computing II will be targeted to those students in second year.

Proposed Assessment: Attendance and reports

Software Engineering Group Project — COMP3100 (12 units)

Later Year Course
Annual (Part A & B)
Forty one-hour lectures and 300 hours of group project work

Prerequisites: COMP2100 and COMP2110; and 12 units of courses from COMP2300, COMP2310, COMP2400 and COMP2600

Co-requisites: COMP3110
Incompatible: with COMP3500

Syllabus: This course provides the student with project experience to complement the studies of the software development process in courses COMP2100, COMP2110, COMP3110 and COMP3120. Students work in small groups and participate in all the development phases (requirements analysis, design, construction, testing and documentation) of a nontrivial software system. As well, each group has to address the control of the development process by constructing and following a detailed software development management plan.

Proposed Assessment: Project (70%); Final Exam (30%)

Software Anaylsis and Design — COMP3110 (6 units)

Later Year Course
First semester
Thirty one-hour lectures and five two-hour laboratory sessions

Prerequisites: 12 units of 2000-level COMP or INFS courses including COMP2110 or INFS2024; and 6 units of 1000-level MATH courses

Incompatible: with INFS2047, INFS2048, INFS3047, INFS3048.

Syllabus: This course is one of three courses (COMP2100, COMP2110, COMP3110) which address constructive aspects of the software development process. It has a primary focus on the software requirements and design phases.
This course provides a practical introduction to requirements analysis methods and design specification techniques that are either structured or object-oriented. The essential rationale for the requisite components of a number of such methods will be taught together with some techniques for their application. As always, the emphasis of applying any such method is to create, from a set of original requirements, a semi-formal representation or model of a system software specification that is unambiguous, consistent and understandable. The various techniques for achievement of such requirements and specifications often seem straight forward and even conceptually simple. However, despite the apparent simplicity of a technique, students will discover that a good deal of effort and diligence is required to produce accurate, meaningful, understandable and easily maintainable specifications.
Software system requirements specifications are essential for creating and trading-off design specification alternatives. There are several representations available for specifying a software design. Some of these will be discussed and applied including some very recent approaches to design that allow for the inclusion of multiple architectural alternatives and simple verification. The latest design techniques place appropriate emphasis on accurate, semi-formal models, transformation rules and direct code generation.
Whenever appropriate, computer aided modelling tools will be used to reinforce the various concepts that are covered theoretically.

Proposed Assessment: Assignments (30%), Tutorials (20%); Final Exam (50%)

Managing Software Development — COMP3120 (6 units)

Later Year Course
Second semester
Thirty one-hour lectures and five two-hour laboratory sessions.

Prerequisites: COMP3110; and 6 units of 2000-level MATH courses or COMP2600

Syllabus: This course addresses the control of the software development process. It is a companion course to COMP2100, COMP2110 and COMP3110, which address construction aspects of the process. COMP3120 addresses some of the initial tasks for effectively planning and managing the development process

within which the techniques introduced in those courses might be used. The following topics are covered. Choosing or tailoring a software development life cycle. Constructing a software development plan. Applying techniques and tools for determining size, effort and cost of a software development. Constructing a schedule and determining resource requirements and allocations. Identifying, assessing and managing risks (including technical, schedule and resource risks). Choosing and using metrics for different purposes such as monitoring progress, controlling resources and estimating rework.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Operating Systems Implementation — COMP3300 (6 units)

Later Year Course
Second semester
Twenty-six one-hour lectures and six one-hour tutorials and six three-hour laboratory sessions.

Prerequisites: COMP2300 and COMP2310; and 6 units of 2000-level MATH courses or COMP2600

Syllabus: This course takes a detailed look at the services provided by, and the internals of, an existing operating system to see how each part is constructed and integrated into the whole. The lectures will also address recent literature describing advances in operating systems. The following topics are addressed: system programming and its facilities (including I/O, signals, job control, interprocess communication, sockets, transport layers, remote operations), system calls and their relation to the system libraries, process management and coordination, implementation of message passing, memory management, interrupt handling, real-time clocks, device-independent input/output, serial-line drivers, network communication, disk drivers, deadlock avoidance, scheduling paradigms, file systems, security.

Proposed Assessment: Assignments (24%); Tutorials and Laboratories (4%); Laboratory Test (4%); Mid-semester Exam (8%); Final Exam (60%)

Computer Networks — COMP3310 (6 units)

Later Year Course
First semester
Thirty one-hour lectures and six two-hour laboratory/tutorial sessions.

Prerequisites: 12 units of 2000-level COMP or INFS courses including COMP2300; and 6 units of 2000-level MATH courses or COMP2600

Incompatible: ENGN 4535, ENGN4514, COMP3036

Syllabus: This course studies the standard models for the layered approach to communication between autonomous machines in a network and the main characteristics of data communication (transmission protocols) for the lower layers. It introduces several application layer protocols from a distributed systems viewpoint, and considers alternative lower layer methods such as ATM, and problem areas in the Internet protocol suite.
The following topics are included: introduction to communication network architectures (protocol hierarchies, layered services, the OSI model); the physical layer (transmission media, signal representation, limits to data capacity); the data link layer (error detection and recovery, point-to-point protocols); the medium access layer (protocols for Local Area Networks and satellite communication); the network layer (routing algorithms, congestion control); internetworking (addressing, internetwork routing and protocols, quality of service); the transport layer (connection-oriented transport layer services and protocols); application protocols for distributed systems.

Proposed Assessment: Assignments (30%); Laboratories (12%); Quizzes (8%); Final Exam (50%)

High Performance Scientific Computation — COMP3320 (6 units)

Later Year Course
First semester
Thirty one-hour lectures and six two-hour tutorial/laboratory sessions

Prerequisites: 12 units of 2000-level COMP courses including COMP2100 or COMP2300; and 6 units of 2000-level MATH courses or COMP2600

Syllabus: This course provides an introduction to High Performance Computing with an orientation towards applications in science and engineering. Aspects of numerical computing and the design and construction of sophisticated scientific software will be considered. The focus will be on the C and C++ programming languages, although reflecting the reality of modern scientific computation this course will also touch on other languages such as Python, Java and FORTRAN95. The course will study high performance computer architectures, including modern parallel processors, and will describe how an algorithm interacts with these architectures. It will also look at practical methods of estimating and measuring algorithm/architecture performance.
The following topics will be addressed: the C++ programming language; basic numerical computing from aspects of floating point error analysis to algorithms for solving differential equations; the engineering of scientific software; general high performance computing concepts and architectural principles; modern scalar architectures and their memory structure; performance and programmability issues, and program analysis techniques for high performance computing; parallel computing paradigms and programming using the OpenMP standard; trends in HPC systems.

Proposed Assessment: Assignments (30%); Laboratories (20%); Final Exam (50%)

Internet, Intranet and Document Systems — COMP3400 (6 units)

Later Year Course
First semester
Thirty one-hour lectures and six two-hour tutorial/laboratory sessions.

Prerequisites: COMP1100 or COMP1120; 12 units of 2000-level IT courses; and 6 units of 1000-level MATH/STAT/EMET.

Syllabus: This course studies the methods, software architecture, and standards for computer communications over networks, at the upper level, and examples of major applications, with the focus being on the Internet. The following topics are included. Introduction to open systems and the Internet reference model. Foundations of Internet applications: electronic mail, file transfer application, MIME, hypertext transfer protocol, World Wide Web system architecture and operation. Standards, ISO and

other standardisation, conformance and acceptance. Information structure; static, dynamic and active pages; HTML, CSS, XML, SGML; mobile code, cgi scripts; a simple introduction to symmetric and public key systems; study of applications like PGP, SSL; E-Commerce; design/study of an internet based business system.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Information Technology in Electronic Commerce — COMP3410 (6 units)

Later Year Course
Second semester
Thirty one-hour lectures and six two-hour tutorial/laboratory sessions

Prerequisites: COMP1100 or COMP1120; 12 units of 2000-series IT courses; and 6 units of MATH/STAT courses

Syllabus: This course studies some of the current and potential applications of information technology in electronic commerce. Topics will be chosen from areas such as document representation (XML, XSL, DTD, CSS), knowledge discovery (meta-data, web-based data mining), data management (digital library, electronic document management), trading (spontaneous, deliberative, auctions) and security (encryption, public key, symmetric key, PKI, authentication, etc). Case studies will be used wherever appropriate. Other topics will be included to match developments and maturation of the area.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Database Systems — COMP3420 (6 units)

Later Year Course
First semester
Thirty one-hour lectures and twelve one-hour tutorials and two two-hour laboratory sessions

Prerequisites: COMP1100 or COMP1120; 12 units of 2000-level IT courses including COMP2400; 6 units of 1000-level MATH/STAT/EMET.

Syllabus: This course examines the design and use of databases in computer-based systems and investigates associated issues.Topics will include: conceptual modelling; security; privacy; statistical databases; distributed databases; data warehousing; web technology and databases.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Software Engineering Individual Project — COMP3500 (12 units)

Later Year Course
Annual (Part A & B)
Fourty one-hour lectures and 300 hours of project work.

Prerequisites: Enrolment in BSEng; COMP2100 and COMP2110; and 12 units of courses from COMP2300, COMP2310, COMP2400 and COMP2600

Corequisites: COMP3110

Incompatible: COMP3100.

Syllabus: This course provides the student with project experience to complement the studies of the software development process in courses COMP2100, COMP2110, COMP3110 and COMP3120. Students work in small groups and participate in all the development phases (requirements analysis, design, construction, testing and documentation) of a nontrivial software system. As well, each student has to address the control of the development process by constructing and following a detailed software development management plan.

Proposed Assessment: Project (70%); Final exam (30%)

Algorithms — COMP3600 (6 units)

Later Year Course
Second semester
Thirty one-hour lectures and nine two-hour tutorial/laboratory sessions.

Prerequisites: COMP2100; 6 units of 2000-level COMP courses or enrollment in BComptlSci; and 6 units of 2000-level MATH courses or COMP2600

Syllabus: This course deals with the study of algorithms for solving practical problems, and of the data structures used in their implementation. Detailed analysis of the resource requirements of algorithms will be an important issue. A large variety of algorithms are candidates for study. These include, but are not limited to, the following: greedy algorithms, dynamic programming, divide-and-conquer, exhaustive search, graph algorithms, advanced data structures such as binomial heaps and Fibonacci heaps, network flow algorithms, algorithms for string matching, parallel algorithms, heuristics and approximation algorithms, and an introduction to intractability. As well as studying the implementation, the mathematical tools used to study the resource usage of algorithms will be considered.

Proposed Assessment: Assignments (45%); Final Exam (55%)

Principles of Programming Languages — COMP3610 (6 units)

Later Year Course
First semester
Thirty one-hour lectures, five one-hour tutorials and four two-hour laboratory sessions.

Prerequisites: COMP2100 and COMP2600

Syllabus: The course will provide an introduction to the major declarative paradigms of functional programming and logic programming. It will give the student some experience with Prolog and a representative functional language in problem domains where these paradigms are most suited. The theoretical underpinnings of each paradigm will be introduced, as will elementary aspects of implementation.
As well as exploring these new classes of languages the course will introduce the students to ideas that apply across the language landscape. Firstly, languages can only be defined rigorously when some systematic notation is used to assign meanings to each program and program fragment. The course will discuss formal semantics in general and will focus on a widely used system - denotational or structured operational. The requirement that a language be implementable means that some aspects of formal language theory become part of the programming languages area. The course will approach the topic in-so-far-as it supports the construction of language acceptors. It will also give introductions to topics that underpin run-time structures of language

Proposed Assessment: Assignments (40%); Final Exam (60%)

Topics in Software Engineering I — COMP3700 (6 units)

Later Year Course
First and second semesters
Contact hours as appropriate

Prerequisites: Written approval of Head of Department of Computer Science.
Minimal background is 18 units of 2000 series COMP or INFS courses including COMP2100 and COMP2110; and 6 units of 2000-level MATH or COMP2600.

Syllabus: This course is available so that senior students can pursue, under supervision, topics that are not covered in the regular curriculum or to execute a project that will significantly increase their knowledge of software engineering theory or practice.
The activities in the course will be some combination of lectures, reading, writing and project work, as appropriate to the topic.

Proposed Assessment: An appropriate combination of written report, exercises, examination and seminar presentation

Topics in Computer Science — COMP3710 (6 units)

Later Year Course
First and second semesters
Contact hours as appropriate

Prerequisites: Written approval of Head of Department of Computer Science.
Minimal background is 18 units of 2000-level COMP or INFS courses including COMP2100; and 6 units of 2000-level MATH or COMP2600.

Syllabus: This unit is available so that senior students can pursue, under supervision, topics that are not covered in the regular curriculum or to execute a project that will significantly increase their knowledge of some aspect of computer science. The activities in the course will be some combination of lectures, reading, writing and project work, as appropriate to the topic.

Proposed Assessment: An appropriate combination of written report, exercises, examination and seminar presentation

Art and Science of Computing III — COMP3800A (0 units)

Later Year Course
Annual (Part A & B)
About eight sessions of occasional seminars

Prerequisites: COMP2800 and enrolment in BSEng or approval of Head of Department

Syllabus: Same as for COMP2800 except that events in Art and Science of Computing III will be targetted to those students in their third year.

Proposed Assessment: Attendance and reports

Information Technology IV Honours (S) — INFT4005 (12/24 units)

Later Year Course
Available in part-time or full-time intensity

Prerequisites: Enrolment in the BInfTech Honours degree.

Syllabus: The honours program consists of a coursework component and a project component, of equal weight. A student's individual course program is selected in consultation with the BInfTech honours co-ordinator.The coursework component involves courses in advanced aspects of the computing discipline and information systems. The coursework is drawn from the fourth year honours courses in Computer Science (see the COMP4005 course description), Information Systems (see the entry in Faculty of Economics and Commerce), and other Science departments.
The project component involves a substantial individual constructive project under detailed academic supervision. Several formal project reports are submitted for assessment.

Proposed Assessment: Courses (50%); Project (50%)

Computer Science IV Honours (S) — COMP4005 (12/24 units)

Later Year Course
Available in part-time or full–time intensity

Prerequisites: Enrolment in the BSc Honours Degree, with specialisation in Computer Science

Syllabus: The honours program consists of a coursework component and a project component, of equal weight. The coursework component involves courses in advanced aspects of the computing discipline, which in recent years have been drawn from: architecture of parallel systems, artificial intelligence, computational logic, algorithms, object oriented databases, programs for parallel computer systems, formal aspects of software engineering, software engineering project, document technologies and automated reasoning. The project component involves a substantial individual project under detailed academic supervision. A formal thesis is submitted (nominally 10,000 words), and a seminar is presented.

Proposed Assessment: Courses (50%); Project (50%)

Software Quality Management — COMP4100 (6 units)

Later Year Course
First semester
Thirty one-hour lectures and five two-hour laboratory sessions

Prerequisites: Enrolment in BSEng or permission of Head of Department of Computer Science; COMP2600; COMP3100 or COMP3500; and COMP3120

Syllabus: This course introduces students to advanced topics on managing the quality of products to be delivered as part of the progression within a software development project. Several causal aspects of software (bad) quality will be introduced and discussed so that students can understand the context for undertaking risk and bad quality avoidance.
The focus will be on practical techniques for identifying and removing defects as well as implementing procedures to track the success or failure of risk and defect resolutions.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Software Process — COMP4110 (6 units)

Later Year Course
Second semester
Thirty one-hour lectures and five two-hour laboratory sessions

Prerequisites: Enrolment in BSEng or permission of Head of Department of Computer Science; COMP3100 or COMP3500; and COMP3120

Syllabus: This course covers advanced topics concerning software process improvement (SPI) frameworks and standards. There are several SPI frameworks/standards available, each one possessing its own merits and difficulties. Most are regarded as being more appropriate to large software development organisations where the assumed expenses of incorporated SPI initiatives typically provide significant return on investment. The content of COMP4110 will introduce the various well known frameworks and standards in the context of importance to organisations but then also discuss tailored versions of some SPI frameworks that are more suitable to small organisations or teams of software developers.
COMP4110 is intended to provide students with further important possible options for a career in software engineering. SPI is a relatively new area within the overall subject of software engineering and requires a relatively deep knowledge of most if not all facets of software engineering activities. Hence it is a course especially constructed for those who wish to pursue a career loaded with experiences and research.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Component-Based Software Development — COMP4120 (6 units)

Later Year Course
Not offered in 2004
Thirty one-hour lectures and twelve two-hour laboratory sessions

Prerequisites: 24 units of 3000 level COMP courses

Syllabus: Component-based development is the construction of software systems out of pre-packaged generic elements. It involves the convergence of four distinct software themes

- the emphasis of software engineering on reuse;
- the widespread practice of building parts of applications (such as graphical user interfaces and databases) out of components;
- interconnection technologies: such as CORBA, COM and Enterprise JavaBeans, and
- the generalisation of object technology, which provides both the conceptual basis and the practical tools for building and using components.

This unit builds awareness of these themes and some experimental experience of representative elements of the technology.

Milestone Papers in Computing — COMP4200 (3 units)

Later Year Course
First semester
Contact hours as appropriate

Prerequisites: Enrollment in the BInfTech Honours or the BSc Honours degree; or permission of Head of Department of Computer Science

Syllabus: Each week, students in this course will read, discuss and review a landmark paper from one of the various disciplines of computer science. The papers will be chosen so as to expose the students to a broad array of topics. The unit will also introduce students to the resources, like the science citation index, necessary to research and evaluate the origins and impact of a paper.

Proposed Assessment: Reports and Presentations (70%), Discussion Questions (25%) and Seminar Participation (5%)

Usability and Design of the Human-Computer Interface — COMP4210 (3 units)

Later Year Course
Second Semester
Equivalent to fifteen one-hour lectures. May be delivered in intensive mode

Prerequisites: 12 units of 2000-level COMP or INFS courses including COMP2100 or COMP2300; and 6 units of 2000-level MATH courses or COMP2600

Syllabus: This course covers the principles behind the design of mechanisms for human-computer interaction (HCI) and develops competence in the specification and construction of user interfaces. Topics will be selected from: the human senses such as sight and touch, and their influence on user interface design; components of interaction (direct manipulation, form fill-in, menu selection and command language); characteristics of HCI; design methodologies; the impact of culture on HCI design; user interface design tools; interface and application integration.

Proposed Assessment: Assignments (20%); Final Exam (80%)

Parallel Systems — COMP4300 (6 units)

Later Year Course
First semester
Thirty one-hour lectures, six two-hour tutorial/laboratory sessions

Prerequisites: COMP2310; and 24 credit points of 3000-level COMP units including COMP3320 or COMP3600

Syllabus: A practically oriented introduction to programming paradigms for parallel computers. Considers definitions of program efficiency on parallel computers, addresses the modelling, analysis and measurement of program performance. Description, implementation and use of parallel programming languages, parallel features of operating systems, library routines and applications.

Proposed Assessment: Assignments (30%); Laboratories (20%); Final Exam (50%)

Network Security — COMP4320 (3 units)

Later Year Course
First semester
Fifteen one-hour lectures, three tutorials

Prerequisites: 12 units of 3000-level COMP courses including COMP3310, or COMP3400, or COMP3410.

Syllabus: This course is concerned with the study of security concepts and techniques achieving security requirements in the network environment. On completion, students are expected to have the knowledge of reasoning why and how documents transmitted through the network can be protected effectively. Knowledge of the foundations of secure e-business should be achieved. Students will also be able to advise industry managers

on the awareness of security threats and available tools to protect sensitive information.
Topics include: security challenges and requirements; security management; symmetric key cryptography (+ DES); public key cryptography (+ RSA); one-way hash functions and digital signatures; secret key distribution (Diffie-Hellman key exchange); public key infrastructure (X.509); network authentication protocols (Kerberos); electronic mail security (PGP); IP security (IPSec V4 V6); web security (SSL, SET); system security; and selected topics (emerging technologies).

Proposed Assessment: Assignments (40%) and final exam (60%)

Real-Time and Embedded Systems — COMP4330 (6 units)

Later Year Course
Second Semester
Three hours per week lectures and two hours per week laboratories

Prerequisites: COMP2300 and COMP2310; or ENGN2211 and ENGN2223

Syllabus: Real-time and embedded systems are all around us. Controlling cars, trains, or aeroplanes, as well as mobile phones, cameras, or A/V equipment, embedded systems are a challenging and demanding part of computer science and engineering. This course delivers foundations of real-time analysis and implementation of systems which are interconnected with the physical world (embedded systems). It also delivers the principles of fault tolerant systems and highly reliable systems. Techniques which are introduced include real-time calculus, real-time scheduling, elementary sensor data filtering and fusion methods, error recovery strategies, and graceful degradation methods.

Proposed Assessment: Laboratories (30%); Final Exam (70%)

Advanced Databases — COMP4400 (6 units)

Later Year Course
Not offered in 2004
Thirty one-hour lectures and nine two-hour laboratory sessions

Prerequisites: COMP2100 and COMP2300 and COMP2400; and 12 units of 3000-level COMP or INFS courses

Syllabus: This unit extends the study of relational databases and introduces object-oriented database technology and related research issues. Topics will include: assessment of conventional database technology; relational algebra; object-oriented modeling and languages; control concepts; physical database design.

Document Technologies — COMP4410 (3 units)

Later Year Course
Second semester
May not be offered in 2004
Fifteen one-hour lectures and four two-hour laboratory sessions

Prerequisites: 24 units of 3000-level COMP courses including COMP3400 and COMP3410

Syllabus: This course introduces fundamental models, tools, and techniques for working with documents. It motivates this from theoretical and commercial perspectives including its pivotal role in building and using the World Wide Web. The course has a strong practical component, exposing students to the computer science and software engineering aspects of building search systems and other document technologies.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Software Engineering Practice — COMP4500 (12 units)

Later Year Course
Annual (Part A & B)
As many hours as necessary for reviews and a nominal 12 hours per week

Prerequisites: Enrolment in BSEng; COMP3110, COMP3120 and COMP3500

Incompatible: COMP4540

Syllabus: At the commencement of this course, students will be introduced to customers (from industry, government or other university entities) who require a software development project to be undertaken. The typical team size will be 3 to 5 students, the members of which will be required to form/analyse customer requirements and plan (define, estimate, schedule) the project to ultimately deliver and control a software product according to the customer requirements. The implementation part of the project will include monitoring, measuring, tracking, managing change and ultimately close out the project. All teams will be required to produce a minimum set of documents including:

- Software Development Plan (inclusive of other important plans)
- Software Requirements Specification
- Software Design Specification(s)
- Acceptance, System and Integration Test Cases and Procedures
- Source and Binary Code

The typical size of the project will be limited to 1000 - 1600 person hours.

Proposed Assessment: Project (90%); Presentation (10%)

Software Engineering Research Project — COMP4540 (12 units)

Later Year Course
Second Semester
As many hours as necessary for meetings with supervisors and a nominal 20 hours per week

Prerequisites: Enrolment in BSEng and permission of the Head of Department; COMP3110, COMP3120 and COMP3500

Incompatible: COMP4500

Syllabus: Students will conduct an individual research project under the close supervision of one or more academic staff. Projects will, at least in part, require the application of theoretical or experimental research techniques. In particular, students will be expected to conduct and present a survey of the literature relevant to the research topic.
Students will prepare a thesis reporting on the research project and its outcomes. They will also be expected to present a poster and a short seminar describing their work.
Students will be expected to apply their software engineering knowledge and skills in the planning and execution of their research project.

Proposed Assessment: Project (90%); Presentation (10%)

Advanced Algorithms — COMP4600 (6 units)

Later Year Course
Second semester
Twenty-six one-hour lectures, together with occasional seminars

Prerequisites: 24 units of 3000-level COMP courses including COMP3600

Syllabus: This course is concerned with the study of algorithms for solving practical problems efficiently, and the theoretical analysis of their behaviour. There will also be a brief introduction to complexity theory, the formal study of algorithm performance. A large variety of algorithms are candidates for study. These include, but are not limited to, the following: greedy algorithms, dynamic programming, network flow algorithms, algorithms for string matching, parallel algorithms, graph algorithms and approximation algorithms.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Computer Graphics — COMP4610 (6 units)

Later Year Course
Second semester
Twelve two-hour lectures, some seminars, and ten laboratory sessions

Prerequisites: 24 units of 3000-level COMP courses including COMP3600

Syllabus: Computer graphics are an intrinsic component of many modern software applications and are often essential to the success of these applications. The objective of this course is to familiarize the student with fundamental algorithms and data structures that are used in today's interactive graphics systems as well as programming and architecture of high-resolution graphics computers. The principles and practise of computer graphics are described from their mathematical foundations to the modern applications domains of scientific visualisation, virtual reality, computer games and film animation. The course will include some practical experience of graphical software environments such as OpenGL, VRML and Java3D.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Machine Learning and Data Mining — COMP4620 (3 units)

Later Year Course
Second semester
Fifteen one-hour lectures

Prerequisites: 24 units of 3000-level COMP courses including COMP3600

Syllabus: This course introduces the key algorithms and theory forming the core of machine learning. Motivations are developed from Artificial Intelligence and Data Mining. Practical application of the technology to real-world problems will also be a theme.

Proposed Assessment: Assignments (50%); Final Exam (50%)

Applications of Logic in Computing — COMP4630 (6 units)

Later Year Course
First Semester
May not be offered in 2004
Thirty one-hour lectures, five one-hour tutorials and five two-hour laboratory sessions

Prerequisites: 24 units of 3000-level COMP courses including COMP3610

Syllabus: Many areas of computer science rely on logic for their foundations. Artificial intelligence is a particular branch of computing where knowledge and reasoning are of central concern. Also, the use of formal methods in the specification, implementation and verification of hardware and software products, requires that the developer be able to model objects using logic.
This course will cover a variety of application areas in order to acquaint the student with concepts of logic that are applicable to computing topics as described above.
The course has a strong theoretical emphasis, but gives the student practical experience with theorem proving tools, especially with those that support the engineering of computing systems.

Proposed Assessment: Assignments (50%);Final Exam (50%)

Topics in Software Engineering II — COMP4700 (3 units)

Later Year Course
First and second semesters
Contact hours as appropriate

Prerequisites: Written approval of Head of Department of Computer Science. Minimal background is 24 units of 3000-level COMP courses.

Syllabus: This course is available so that senior students can pursue, under supervision, topics that are not covered in the regular curriculum or to execute a project that will significantly increase their knowledge of software engineering theory or practice. The activities in the course will be some combination of lectures, reading, writing and project work, as appropriate to the topic.

Proposed Assessment: An appropriate combination of written report, exercises, examination and seminar presentation

Topics in Software Engineering III — COMP4710 (6 units)

Later Year Course
First and second semesters
Contact hours as appropriate

Prerequisites: Written approval of Head of Department of Computer Science. Minimal background is 24 units of 3000-level COMP courses.

Syllabus: This course is available so that senior students can pursue, under supervision, topics that are not covered in the regular curriculum or to execute a project that will significantly increase their knowledge of software engineering theory or practice. The activities in the course will be some combination of lectures, reading, writing and project work, as appropriate to the topic.

Proposed Assessment: An appropriate combination of written report, exercises, examination and seminar presentation.

Industrial Experience **COMP4800 (0 units)**

Later Year Course
First and second semesters

Prerequisites: Enrolment in BSEng and COMP3500.

Syllabus: Industrial Experience gives the student exposure to current professional practice. It consists of 60 days of work, organised by the student. Of those 60 days, 20 must be in a software engineering context, 20 must be in a professional context, and the remaining 20 may be in any employment.Industrial Experience is usually undertaken outside study periods, and is graded satisfactory or unsatisfactory. (Students must fulfil the requirements during the course of their degree; they normally enroll in COMP4800 in their final year and need to have satisfied the requirements by October in order to graduate at the ceremony the following December)

Engineering

Professor Michael Cardew-Hall BSc (Hons) Nottm., PhD Imperial College

Head of Department

Engineering is the art of transforming the resources of nature for the benefit of humanity. Its roots are traceable to the tools, huts, pottery and materials of the first humans. Its progress has relied on ingenuity, invention, teamwork and the accumulation of experience — skills which remain essential to this day.

Engineers have a responsibility to help solve our environmental problems. The Department of Engineering is at the forefront of renewable energy research, with a particular interest in photovoltaic solar cells and semiconductor technology. The ANU 'Big Dish' is the largest of its kind in the world. The Department's Centre for Sustainable Energy Systems holds several world records for solar cell efficiency. It is also developing a unique thermochemical solar energy system. The Centre has strong links with industry and several technologies are being commercialised.

Engineering is vital to the economic well-being of nations. The Department's advanced manufacturing and production systems research integrates the disciplines of materials, manufacturing, robotics and control with modern computer simulation to understand, improve and optimise manufacturing processes. Many projects are industrially focused and major elements of the work are carried out at the collaborating company's site. This provides a healthy cross fertilisation between the Department and some of Australia's largest manufacturing companies. Related interests include discrete-event modelling and control and active vision systems.

Telecommunications is the life-blood of modern commerce and government. And it helps keep us in touch with our family, our friends, and our colleagues -- relationships that span the globe. The Department's activities are primarily in advanced digital mobile communications, especially coding and modulation schemes. Researchers in the Department are patenting decoders for some mobile and satellite applications that are currently the worlds best and can achieve near optimal performance. Other areas of activity include signal processing, statistical learning theory and neural networks.

Materials are the stuff of life and advanced materials are increasingly part of everyday objects as well as space-age applications. The Department's work focuses on polymers and fibre composite materials. These can be carbon-fibre materials for use in aerospace, automotive or high-tech sporting goods. Or they can be wood-wool and cement composite boards for low-cost building materials in the Philippines. The environmental conditioning of composite materials — such as moisture resistance — is one area of interest. Other work includes composite forming technologies, rubber-toughened polymer alloys in collaboration with researchers in Japan and biodegradeable nanofibres in collaboration with researchers at the National University of Singapore.

The volatile environment faced by organisations today presents managers with continual challenges. Yet few managers understand the nature and impact of variation within complex systems. The Department carries out research aimed at enhancing the capacity of organisations to understand and improve their processes in order to achieve organisational goals under variable conditions.

The Department of Engineering offers several four-year, IEAust accredited Bachelor of Engineering degree programs (see the Faculty of Engineering & Information Technology entry), Masters of Engineering, including Industry-based Masters by research and PhD degree programs. The Department has active collaborations with a wide range of other ANU Departments and Research Schools including RSISE, RSPhysSE, RSES, Department of Physics, Department of Forestry, as well as CSIRO and DSTO. The Department has strategic collaborative research relationships with Ford Australia, Telstra, Origin Energy, Solarhart and Western Power. The Department participates in the Cooperative Research Centre for Sustainable Energy Systems. Graduates are employed in a wide range of organisations and companies both in Australia and overseas. Undergraduate scholarship support from Airservices Australia, ANUTECH, BHP Research, Boeing and Siemens Plessey is gratefully acknowledged.

The Department of Engineering buildings are located on the corner of University Avenue and North Road, opposite the ANU Sports Union, with the ANU Union, Library and other facilities all readily accessible.

For further information visit the Department's website at http://engn.anu.edu.au

Course Descriptions

Discovering Engineering **ENGN1211 (6 units)**

First Year Course
First semester
36 one-hour lectures; 10 two-hour practical classes; 10 one-hour tutorials

Coordinator: Dr. M. Rossiter

Prerequisites: Admission to the BE degree course or the BSEng degree course or approval of Head of Engineering.

Incompatible: COMP2200, ENGN1021

Syllabus: Discovering Engineering provides an introduction to three aspects of engineering: the disciplines; the practice; and the roles and responsibilities. These three themes are interwoven throughout the course to enhance student skills in communication, teamwork, problem formulation, systems design, an understanding of the responsibilities of engineering practice, and an awareness of reflective and ethical professional practice.

A range of engineering disciplines are discovered through team research projects and guest speaker presentations by practicing engineers in the fields of biomedicine, environment, military, telecommunications, production, materials, software development, robotics, virtual environments and more. The practice of engineering is discovered in a group design and build project. From conceptualization to production and testing, students are responsible for the outcomes of an open-ended design problem. They gain an appreciation of the issues involved in taking a design from the concept phase to the manufacturing phase.

The roles and responsibilities of engineers, technologists and scientists in society are examined through analysis and debate of topical contentious issues. Students will appreciate the complexity of social issues and develop a framework for ethical, professional analysis of such issues. Contemporary issues examined include: decision-making in science and technology; environmental decision-making in support of sustainable development; the impact of technology on social health; privacy and security issues in the internet age; the future in artificial intelligence; professionalism and ethics in technological development.

Proposed Assessment: Team Project Report (50%); Individual Essay 1200 words (30%); Group Presentation (10%); In-class Reflective Response (5%)

Introduction to Materials — ENGN1215 (6 units)

First Year Course
Second semester
Twenty-six lectures, six tutorials, and nine hours of laboratory

Coordinator: Dr. A. Lowe

Prerequisites: Admission to the BE degree course, the BSEng degree course or approval of Head of Engineering.

Syllabus: Introduction to materials science for structural, electrical, magnetic, and optical engineering applications. Atomic bonding, atomic basis of physical and chemical properties. The crystalline state; crystal structures and imperfections. The amorphous state; structure of metallic, inorganic and organic glasses. Multiphase materials, phase rule, binary phase diagrams of iron-carbon, aluminium-copper and ceramic examples. Kinetics of nucleation and crystal growth, atomic diffusion. Microstructures, TTT diagrams, heat treatment, hardening. Magnetism, hard and soft magnets, ceramic magnets. Electronic structure of solids; electronic conductivity, piezo- and pyro-electricity, solar cells. Materials in optical fibres, transparency, dispersion and IR absorption. Environmental degradation and corrosion of materials.

Proposed Assessment: Materials selection exercise (15%); essays and problem sets (20%); quizzes (30%); final exam (35%)

Electromechanical Technologies — ENGN1221 (6 units)

First Year Course
Second semester
5 laboratory sessions (3 hrs), 30 lectures and 18 tutorials

Coordinator: Prof. J. Baird and Mr. M. Shephard

Prerequisites: MATH1013 (or ENGN1212 or MATH1115) and PHYS1101 (or ENGN1214)

Syllabus: This course introduces the fundamentals of electrical, mechanical and electromechanical systems. Practical laboratory sessions to help students develop and integrate theoretical knowledge, physical applications and practical skills form a substantial part of the course. Modeling and design skills are developed through group project activities. The laboratory and project work continue the process of developing teamwork skills and graphical representation skills, including graphical presentation of experimental data.
Electrical topics include: Resistors, capacitors, inductors; breadboards and simple circuit testing; voltmeter and oscilloscope operation; Kirchoff's laws; series and parallel circuits; Thevenin and Norton Equivalent circuits; loop and nodal analysis of circuits; transient and phasor analysis of RC and RL circuits; Direct current motors; laboratory technique (including notebook keeping); laboratory reporting and written technical communication; writing in a group.
Mechanical topics include: forces in planar and spatial rigid bodies, equivalent force systems, static equilibrium, static indeterminacy and friction.

Proposed Assessment: Statics section = balsa bridge design exercise (16%); 2 assignments (8%); final exam (26%)
Electro section = 2 quizzes (32%); lab notebook (8%) lab report (10%)

Topics in Chemistry and Physics — ENGN1227 (6 units)

First Year Course
Second semester
Three lectures and one tutorial a week. Four three-hour laboratories.

Coordinator: Dr P. Angus and Dr Byrne

Prerequisites: PHYS1101

Incompatible: PHYS1001, ENGN1020, PHYS1201, ENGN1226, CHEM1014, ENGN1022, ENGN1225.

Syllabus: Introduction to modern physics including waves, optics, quantum mechanics and solid state physics. Introduction to chemistry including chemical bonding, kinetics, chemical thermodynamics and electrochemistry.

Proposed Assessment: Laboratories, tutorials, final exam

Electronic Circuits and Devices — ENGN2211 (6 units)

Later Year Course
First semester
Twenty four lectures, thirty two hours of laboratory work

Coordinator: Mr. M. Shephard

Prerequisites: ENGN1221

Syllabus: This course provides an introduction to the analysis and design of electronic systems, including basic circuit theory, analog electronics and introductory digital electronics. Its objectives are that students acquire the ability to describe and analyse the operation of basic electronic circuits such as amplifiers, filters, rectifiers, RLC networks, and combinational logic circuits, to use PSpice software tools to simulate the behaviour of those circuits, implement them in the laboratory and test them with professional instrumentation. Course contents: review of circuit theory fundamentals: Kirchoff's laws; nodal and loop analysis; network theorems, equivalent circuits, Thevenin's Theorem, maximum power transfer. Introduction to amplifiers and feedback, operational amplifiers, opamp circuits. First and second order dynamic analysis of RC, RL and RLC

circuits, s-domain (Laplace transform) methods. AC analysis, complex currents, voltages and impedances, complex power. Frequency response, transfer functions, Bode diagrams. Two port networks, transformers. Diodes and diode circuits, rectifiers. BJT and FET transistors and circuits, DC and AC models and analysis amplifiers. Digital devices, digital logic, Karnaugh maps, cannonical forms, modular components. Pspice computer lab tutorials, hardware labs.

Proposed Assessment: Laboratory work (30%); two tests (30%); final exam (40%)

Mechanics of Materials — ENGN2214 (6 units)

Later Year Course
First semester
40 hours of lectures, 10 hours of laboratories and 10 hours of tutorials.

Coordinator: Dr. S. Kalyanasundaram

Prerequisites: ENGN1221

Syllabus: This course introduces the mechanical properties of materials, focusing on their importance for the design of structures, mechanical systems and manufacturing systems. Small design exercises integrate design throughout the curriculum. The course also includes an introduction to finite element modelling of mechanical structures and manufacturing processes.
Specific topics include: Hooke's law for isotropic materials, true stress/strain and engineering stress/strain; mechanical properties of materials and testing methods, Young's modulus, tensile and compressive strength, fracture and yield strength, hardness and ductility. Operation of the universal testing machine, hardness tester and impact tester; creep testing and measurement of activation energy for creep; analysis of stress and strain in statically determinant structures; beam under simple tension, compression, torsion and pure bending; angle of twist of a circular shaft under torsion; stress distribution in a thin-walled pressure vessel; transformation of stress and strain using Mohr's circle; principal stresses and maximum sheer stresses; mechanisms of fracture and fatigue; energy methods in deformation; buckling. Other concepts developed include 3D stress-strain transformation, column buckling, beam deflection and energy methods.

Proposed Assessment: Problem Sets (20%); Design (20%); Final Exam (60%)

System Dynamics — ENGN2221 (6 units)

Later Year Course
Second semester

Coordinator: Dr S. Roundy

Prerequisites: MATH1013 (or ENGN1212) and MATH1014 (or ENGN1213)

Syllabus: System dynamics is the study of the response of mechanical and electromechanical systems with changing time. The concepts learned in this unit can be used in a number of engineering disciplines including robotics, control system theory, dynamic response of mechanical, aerospace and marine structural components, manufacturing problems, biomedical engineering and interaction between electrical and mechanical systems. Several examples/design problems will be given to illustrate the principles of dynamics. The emphasis of this course will be on rigid body dynamics, electromechanical systems and computer aided design. The topics covered include kinematics of dynamics systemsmomentum formulation for system of particles, variational formulation for system of particles, dynamics of systems containing rigid bodies and dynamics of electrical and electromechanical systems.

Proposed Assessment: Problem Sets (20%); Laboratory Work (5%); Group Project (20%); Final Exam (55%)

Thermal Energy Systems — ENGN2222 (6 units)

Later Year Course
Second semester

Coordinator: Dr. K. Lovegrove

Prerequisites: PHYS1101 (or ENGN1214)

Syllabus: Energy systems are of major importance in society and are a significant engineering research activity at ANU. This course emphasises a systems approach to engineering, integrating technical fundamentals with social and environmental issues through site visits and case studies of energy systems. Engineering science fundamentals include the first law of thermodynamics and heat transfer. The thermal performance of houses is used as a major systems theme for the course. The course also introduces the second law of thermodynamics, and fluid dynamics.

Proposed Assessment: House Thermal Analysis (20%); Laboratory (15%); Field Trip (5%); Quiz (10%); Final Exam (50%)

Signals and Systems — ENGN2223 (6 units)

Later Year Course
Second semester
Thirty six lectures, eight tutorials and eight laboratory sessions (2 hours)

Coordinator: Dr. K. Blackmore

Prerequisites: ENGN2211

Syllabus: Input-output view of systems; block diagrams. Linear time-invariant systems and convolution. Fourier series and the Fourier transform. Filters. Frequency response of systems. Sampling. Applications of signals and systems concepts (e.g. basic analog modulation theory). Use of MATLAB to perform discrete time signal processing tasks.
An engineering introduction to probability and random variables; the importance of random signal in system studies-noise and signals in telecommunications, process variation analysis in manufacturing, for example. Understanding a random variables and random processes. What we can know (correlation, mean, variance, also in frequency domain), and what we cannot know (exact waveform). Analysis and simulation of how a linear time-invariant system responds to a random variable or process.

Proposed Assessment: Laboratory (10%); Tutorials (10%); Assignments (15%); Project (20%); Exam (45%)

Electronics — ENGN2224 (6 units)

Later Year Course
Second semester

Coordinator: Professor A. Cuevas

Prerequisites: ENGN2211

Syllabus: The course is divided into two parts: an introduction to semiconductor physics & devices followed by an introduction to the use of semiconductor devices in analogue circuits. Topics to be covered include basic semiconductor physics, pn junction diodes, solar cells, BJT & FET transistors, IC manufacturing techniques, and simple transistor & operational amplifier circuits.

Proposed Assessment: Laboratories (14%); Problem Sets (10%); Quizzes (30%); Final Exam (46%)

System Design — ENGN2225 (6 units)

Later Year Course
Second semester

Coordinator: Dr P. Compston

Prerequisites: ENGN1211

Syllabus: This course aims to provide a framework for the interdisciplinary systems engineering program. It looks at the design of an engineering product or service from a systems engineering perspective and introduces methods and techniques required for a systems approach to design. This will require students to understand the concepts behind systems thinking, how to identify and define a system, how it responds to input changes and the effect of variation on the system. Through a series of lectures and group workshops students will discover the stages in the systems design process, how to carry out a requirements analysis for the system leading to a system specification and how those requirements are met through design synthesis and verification phases of the process. These requirements will be cascaded to sub-system requirements and component requirements, with emphasis placed on methods to partitioning of the sub-systems and the interaction between them. Use will be made of the generic systems design V model, trade off analysis techniques, quality function deployment approaches (QFD). The importance of modelling in the analysis of design alternatives will be covered involving the use of software tools such as MatLab and ProEngineer. Basic concepts in statistics will be introduced in order to analyse the effect of variability on design robustness. The concepts and techniques covered will be illustrated with example cases and applied to an ongoing systems design problem.

Proposed Assessment: Individual Report (15%); Individual Design Assignment (15%); Group Design Report (45%); Final Exam (25%)

Practical Experience — ENGN3100 (0 units)

Later Year Course
First or second semester

Coordinator: Dr. H. Jones

Prerequisites: Completion of 2nd Year

Syllabus: welve weeks of suitable full-time employment, a requirement that applies to all BE degrees throughout Australia. The training has two purposes:

- to expose the student to the workplace and workplace issues (such as human and industrial relations, job organisation, maintenance, safety and environmental issues).
- to provide direct insight into professional engineering practice.

It is the student's responsibility to obtain the employment, although the Department of Engineering will assist in providing lists of people to contact. As a general rule, the ideal would be four weeks in any sort of employment; four weeks in employment in a technical industry of some kind; and four weeks of work with engineering staff in an engineering environment (preferably working with professional engineers). Minor variations of this scheme may be acceptable, but at least a reasonable portion must be within an engineering environment. Students are required to submit reports on their work experience and will satisfy the requirements when their portfolio is acceptable to the Head of Engineering.
Students need to complete their work experience requirements by December of their final year in order to graduate at the ceremony the following April.

Investment Decisions & Financial Systems — ENGN3211 (6 units)

Later Year Course
First semester

Coordinator: Dr J. Lee

Prerequisites: 12 units of 1000-series mathematics or statistics courses

Incompatible: BUSN1002, ASHI2021, ASHI2041, POLS1004, ECHI1105, ECHI1106, ASHI2023

Syllabus: One segment of the course will provide an introduction to the economic principles which underly decisions on private and public investment. These principles will be used to analyse relevant issues such as choice of capacity, pollution, public goods, safety standards and patents. Mathematical models will be used to inform the analysis.
The second of the two segments focuses on the recording of transactions and the generation of financial reports. Practical problems are included to motivate the lectures/workshops and provide some insight into practical accounting issues.

Proposed Assessment: Quizzes (30%); Exams (70%)

Manufacturing Technologies — ENGN3212 (6 units)

Later Year Course
First semester

Coordinator: Mr R. Gresham

Prerequisites: ENGN2214 (or corequisite)

Corequisites: ENGN2214 (or prerequisite)

Syllabus: This subject introduces the elements of a number of basic manufacturing processes and associated materials behaviour required in the design of mechanical devices. The configuration of machine tools is discussed in the context of orthogonal cutting and the basics of materials deformation processes, including, casting, forging, sheet-metal forming and

polymer processing, are developed. Graphical representation techniques include sectioning, conventional representations, dimensioning, tolerancing, and further develops computer-aided design skills (CAD). Also included are 24 hours of practical workshop experience with assorted hand and machine tools to produce a manufactured article.

Proposed Assessment: Reports (20%); Quiz (10%); Group Design Exercise (40%); Final Exam (30%)

Digital Systems and Microprocessors ENGN3213 (6 units)

Later Year Course
Second semester
Twenty four lectures and thirty two hours of laboratory work

Coordinator: Dr K. Weber

Prerequisites: ENGN2211 or 12 units B-Group COMP courses including COMP2300

Syllabus: This course provides an introduction to the analysis and design of digital systems and microprocessors. Review of combinational logic analysis and design. Systematic design methods. Analysis and design of synchronous sequential machines. Computer aided design and programming of digital electronic circuits using VHDL hardware description language and FPGA programmable logic devices. Microprocessor and microcomputer architecture. Microprocessor devices, their architecture and instruction sets. Hardware aspects of instruction execution. Assembler and C programming. Input/output, bus interfacing, interrupts. Co-design of digital hardware and microprocessor systems.

Proposed Assessment: Hardware Labs (30%); Tutorials (10%); Mid-Semester test (15%); Final Exam (45%)

Telecommunication Systems ENGN3214 (6 units)

Later Year Course
First semester
Thirty six lectures, twelve tutorials and eight hours of laboratory

Coordinator: Dr H. Jones
Prerequisites: ENGN2223

Syllabus: This course is a first course in telecommunications. It aims to give an overview of a range of topics within telecommunication systems. It serves the dual role of being a terminating course for some students, as well as a preparatory course for two digital communications subjects offered in fourth year. The contents of the course are:

- Analog modulation schemes: AM, DSBSC, SSB, FM and PM; FDM and FDMA concepts; Carrier frequency recovery and phase locked loop. AM & FM broadcasting systems; TV systems; Analog cable systems; Analog Mobile System (AMPS).
- Partial digital systems: PAM, PCM, DPCM, Delta Modulation; TDM and TDMA; Frame synchronization. Telephone systems (TDM); Digital Satellite systems (TDMA).
- Simple Digital Systems: Binary Modulation, QPSK, Binary FSK. TDMA/FDMA, phase recovery and timing recovery; Digital Mobile Systems (IS54, GSM and Japanese system). Satellite Mobile Systems.
- Simple network concepts: Telephone network, packet switched and circuit switched, simple concept of ISDN, ATM for optical fibre network. How does your telephone work? How does the mobile base-station find a moving mobile phone user?
- Key problems of all these systems: bandwidth, noise performance, delay, cost, and environment. The key information theoretic limitations.

Proposed Assessment: Assignments (20%); Quiz (5%); Laboratories (5%); Final Exam (70%)

Engineering Management ENGN3221 (6 units)

Later Year Course
Second semester

Coordinator: Dr M. Rossiter

Prerequisites: ENGN3211 (or COMM1020 or ASHY2012 or ASHY2014 or POLS1004 or ECHI1102) and ENGN1211 (or COMP2200 or ENGN1021)

Syllabus: Engineering management introduces students to a range of people and technical orientated issues in management. Students are provided with concrete strategies for addressing these issues within practical, relevant and contemporary contexts.

The course comprises the following topics:
Project Management - this topic engages almost half the course. Tools and techniques appropriate to management of both generic and software-specific projects are introduced.
Business Environments - a systems thinking approach to understanding the internal and external environments for an organisation will be used to set the stage for work in business planning and management.
Business Planning - students will gain practical experience of new venture planning.
Ethics and Corporate Responsibility - individual ethics and ethical culture - structured approach to arrive a a normative conclusion.
Planning and Strategic management - management decision-making; risk management.
Organisational Design - alignment with corporate goals; staffing and people management.
Leadership - motivating, influencing, communicating, managing groups and teams.
Control in Organisations and change management.
Quality - definition, value and scope. Quality management techniques.
Understanding Variation - the truth behind the management report, statistical process control (SPC) for managers.

Proposed Assessment: Individual Project Plan (25%); Group Business Plan (25% weighted as 15% for the document; 10% for a concept presentation & minutes of the first meeting); Final Exam (50%)

Manufacturing Systems ENGN3222 (6 units)

Later Year Course
Second semester

Coordinator: Dr A. Lowe

Prerequisites: ENGN3212 and ENGN2221

Syllabus: This course develops a comprehensive overview of the analysis, design and technology of manufacturing systems, with the emphasis on production systems. Technologies considered include machine configuration and control, CNC technol-

ogy, cellular and flexible manufacturing systems, robotics and automation, and an introduction to scheduling, operations research and process optimisation.
Using a case study approach, the course will introduce basic statistical quality control, including probability distributions, regression analysis, variance, central limit theorem, significance and hypothesis testing. This leads on to statistical quality control and the design of experiments for manufacturing systems. An introduction to hard and flexible automation systems, and the arguments for both.

Proposed Assessment: Simulation Exercise (10%); Quiz (20%); Case Study (40%); Quiz (30%)

Control Systems — ENGN3223 (6 units)

Later Year Course
First semester

Coordinator: Dr R. Mahony

Prerequisites: ENGN2223

Syllabus: Introduction to control system analysis, identification, design and implementation. Laboratory work involves real-time identification and control of a range of electrical and electromechanical systems. Topics covered include: History of Control. Representation of linear dynamics and properties of systems. Time domain specifications of performance. Discrete-time systems and the Z-transform. Closed loop and open loop control. Classical PID controllers. Steady state errors and system type. Stability and robustness. Discrete-time systems and design by emulation. Root locus analysis and design of continuous and discrete systems. Frequency response of continuous and discrete time systems. Nyquist plots and stability margins. Lead-Lag control design. Sensitivity and robustness in the frequency domain. Practical design issues approaches.

Proposed Assessment: Problem Sheets (5%); Quiz (10%); Laboratories (30%); Final Exam (55%)

Energy Systems Engineering — ENGN3224 (6 units)

Later Year Course
First semester

Coordinator: Dr K. Lovegrove

Prerequisites: ENGN2222 and ENGN3211 or (BUSN1002 or ASHI2021 or ASHI2041 or POLS1004 or ECHI1105 or ECHI1106)

Incompatible: ENGN3003

Syllabus: This course continues the study of energy systems and related environmental issues. The course begins with a revision of the first law of thermodynamics and heat transfer. It continues with a thorough examination of fluid dynamics and the second law of thermodynamics, emphasising energy analysis. Also included are quantitative economic and environmental analysis of design choices and thermo-economic optimisation (energy systems engineering). Generation of electric power is used as a systems theme for the course.

Proposed Assessment: Laboratories (30%); Field Trip (5%); Quizess (15%); Final Exam (50%)

Digital Communications — ENGN3226 (6 units)

Later Year Course
Second semester
Thirty six lectures, twelve tutorials, eight hours of laboratory

Coordinator: Dr H. Jones

Prerequisites: ENGN3214

Incompatible: ENGN4504

Syllabus: Signal Basics: Random processes; Complex envelope representation of bandpass signals and systems; Sampling theory; Nyquist criterion.
System Concepts: Structure and definition of digital communication systems.
Transmitter: Basic Digital Modulation Techniques: ASK; MPSK; FSK; MSK; Performance analysis; Power spectra calculation; Coding basics: Fundamentals of information theory; Linear block codes; Convolutional codes.
Channel: Bandlimited channels; Equalisation. Receivers: Matched filter; Correlator; Digital detection: Maximum a posteriori detection (MAP); Maximum likelihood sequence detection (MLSD); Viterbi algorithm

Proposed Assessment: Assignments (20%); Quiz (5%); Laboratories (5%); Final Exam (70)

Individual Project — ENGN4200 (12 units)

Later Year Course
Annual (Part A & Part B)

Coordinator: Dr. M. Rossiter

Prerequisites: ENGN3221 The normal expectation is that students enrolling are completing their final year.

Incompatible: ENGN4000, ENGN4700

Syllabus: Students undertake an individual engineering project, with supervision. Students are encouraged to put forward their own ideas for the individual project, or they may select a project from a range of ideas offered by researchers across the ANU. If the student initiates an idea, he or she must find a supervisor to accept the project. Students and their respective supervisors must jointly sign-off on acceptance of the project concept as part of the project registration process. Project selection is normally completed as part of ENGN3221 - Engineering Management, by week 3 of the semester prior to commencement of ENGN4200. The planning phase of the project is integrated into the Engineering Management course, providing a deliberate foundation for the project execution phase that is ENGN4200. Students are expected to manage all aspects of their individual project from conceptualization through the planning phase to the monitoring and control of the project performance and the ultimate achievement of the following deliverables:

- A thesis documenting the project
- A seminar describing the project
- A poster illustrating the project

Proposed Assessment: Individual Project Thesis (70%); Project Notebook (5%); Seminar (15%); Poster (10%)

Systems Engineering Project — ENGN4221 (6 units)

Later Year Course
First semester

Coordinator: Prof M. Cardew-Hall

Prerequisites: ENGN3221. The normal expectation is that students enrolling are completing their final year.

Incompatible: ENGN4017

Syllabus: This course is designed to mimic an industrial design problem as closely as practical in a university setting. Students are assigned to teams and given an ill-defined problem statement. From the problem statement, the students are responsible for developing the full set of requirements and key performance indicators to guide the design. The students then proceed through a systems design process including conceptual design, sub-system requirements, and quantitative tradeoff analyses, using the full range of engineering science and professional skills developed during the degree course. The course emphasises teamwork (both team leadership and membership), communication skills (formal and informal, written and oral), and team and personal management and a professional approach to engineering design.

Proposed Assessment: Planning Report (10%); Requirements Report (15%) Design Report (30%); Poster (10%); Oral (15%); Final Exam (20%)

Microelectronic and Photonic Technology — ENGN4507 (6 units)

Later Year Course
Second semester

Coordinator: Prof. A. Blakers

Prerequisites: ENGN2224

Syllabus: This is a strongly laboratory-oriented course that provides hands-on experience with the most common technologies used to fabricate electron devices: photolithography, epitaxy, oxidation, diffusion, ion implantation, thin film deposition, plasma deposition and laser technologies. Researchers from the Research School of Physical Sciences and Engineering participate in the course, offering invited lectures and laboratory experiments in their particular field of expertise. Training in clean room operation and semiconductor processing equipment is provided. The physical grounds and mathematical models for the technologies mentioned above are used in a semiconductor device design exercise. The device is fabricated in the laboratory and its electrical performance is evaluated.

Proposed Assessment: Quiz (15%); Laboratories (20%); Class Presentations (15%); Final Exam (50%)

Composite Materials — ENGN4511 (6 units)

Later Year Course
First semester

Coordinator: Dr Z. Stachurski

Prerequisites: ENGN2214

Syllabus: This course provides a broad overview of engineering composites with a specialisation towards fibre reinforced matrix materials. Emphasis is placed on composite constituents, interfaces, all aspects of composites manufacturing, processing and composite mechanics (geometric aspects, laminate theory, strength and fracture theory). Practical composites design, environmental aspects and specialised composites are also introduced, geared towards recent developments. Laboratory practice gives hand-on experience in laminate fabrication and knowledge of composite microstructures.

Proposed Assessment: Laboratories (20%); Quizzes (40%); Research Report (40%)

Energy Resources and Renewable Technologies — ENGN4516 (6 units)

Later Year Course
Second semester
Not Offered in 2004

Coordinator: Prof. A. Cuevas

Syllabus: The introductory phase of this course is dedicated to the global aspects of energy production and demand in the world, with particular attention to the environmental and social aspects of energy usage, including climate change. Australia's energy resources and consumption patterns are specifically addressed. The rest of the course is dedicated to studying the main renewable energy technologies; biomass, geothermal, hydroelectric, solar thermal, photovoltaic, and wind, including technical and economical issues. Experts in different aspects of energy production and use give invited lectures on selected topics. Objectives of the unit include gaining reliable information on available energy resources and their associated environmental and climatological impacts, and to understand the potential and limitations of renewable energy technologies.

Proposed Assessment: Oral Presentation (40%); Coursework (20%); Final Exam (40%)

Semiconductor and Optoelectronic Devices — ENGN4519 (6 units)

Later Year Course
Second semester
Not Offered in 2004

Coordinator: Prof. C. Jagadish

Prerequisites: ENGN2211

Syllabus: A good understanding of the fundamental properties of semiconductor materials and devices is necessary for the professional engineer or scientist to be able to follow the pace of such a fast changing field as microelectronics. This course provides a solid foundation for understanding the basic operation of microelectronic devices. In depth study of a particular device provides training in electronic device design and modelling, including aspects related to its ideal and practical performance, fabrication, and cost. Course topics include: physical models of semiconductor materials; current carriers: electrons and holes; fundamental electronic processes: carrier generation and recombination; electronic transport mechanisms: drift and diffusion; physics of the pn junction; optoeletronic devices; bipolar devices; field effect devices.

Proposed Assessment: Laboratory (25%); Quiz (25%); Final Exam (50%)

Special Topics in Engineering 1 — ENGN4520 (6 units)

Later Year Course
Prerequisites: Written approval of the Head of Engineering

Syllabus: Within this course, topics may be offered from time to time to take advantage of the expertise of visitors to the University and academic staff in the IAS. Admission to the course is at the discretion of the Head of Engineering.

Special Topics in Engineering 2 — ENGN4521 (6 units)

Later Year Course

Prerequisites: Written approval of the Head of Engineering
Syllabus: Within this course, topics may be offered from time to time to take advantage of the expertise of visitors to the University and academic staff in the IAS. Admission to the course is at the discretion of the Head of Engineering.

Special Topics in Engineering 3 — ENGN4522 (6 units)

Later Year Course

Prerequisites: Written approval of the Head of Engineering
Syllabus: Within this course, topics may be offered from time to time to take advantage of the expertise of visitors to the University and academic staff in the IAS. Admission to the course is at the discretion of the Head of Engineering.

Special Topics in Engineering 4 — ENGN4523 (6 units)

Later Year Course

Prerequisites: Written approval of the Head of Engineering
Syllabus: Within this course, topics may be offered from time to time to take advantage of the expertise of visitors to the University and academic staff in the IAS. Admission to the course is at the discretion of the Head of Engineering.

Solar Energy Technologies — ENGN4524 (6 units)

Later Year Course
Second semester

Coordinator: Prof. A. Cuevas

Prerequisites: ENGN2224, ENGN3224

Syllabus: Photovoltaic and solar thermal electric systems have become an important area of engineering and are a major research area in FEIT. They are an example of interdisciplinary systems engineering, where basic electronic materials science or thermodynamics and heat transfer are combined with power electronics, mechanical design, control systems and economic optimisation. The course will give an overview of the solar energy resource and examine two different approaches to conversion to electricity in detail. The physics and fabrication of silicon solar cells, including a discussion of the trade offs between cost, fabrication complexity and performance will be discussed. Computer modelling of solar cell operation using the program PC1D will be used to reinforce the physical understanding and as a tool for device design. The presentation of solar thermal systems will look at alternative approaches to concentration and conversion of energy, focal region flux prediction and measurement, plus modelling of steady state and dynamic thermal behaviour.

Proposed Assessment: Laboratories and Final Exam

Computer Vision — ENGN4528 (6 units)

Later Year Course
First semester

Coordinator: Dr. R. Mahony

Prerequisites: ENGN2223

Syllabus: This subject introduces the problems of computer vision and means for their solution. Topics include: image acquisition, sampling and quantisation; image segmentation, point, line and edge detection, and thresholding; geometric frameworks for vision, single view and two views; camera calibration; stereopsis, the correspondence problem and epipolar geometry; motion and optical flow; recognition, invariants, appearance and geometric-based identification; pose estimation in perspective images.

Proposed Assessment: Laboratories (10%); Assignments (40%); Final Examination (50%)

Engineering and Public Policy — ENGN4530 (6 units)

Later Year Course
First semester
Not Offered in 2004

Coordinator: Staff

Prerequisites: ENGN3221 and ENGN1211

Syllabus: The subject considers contemporary public policy issues as they relate to engineering and technology. Students are expected to complete a report and give a seminar on an appropriate engineering and public policy issue. Issues include: technology and social change, sustainable development, risk, deregulation and privatisation, occupational health and safety, privacy and censorship, gender and technology, globalisation, professionalism, and ethics. Technologies include: telecommunications, information technology, energy, manufacturing, materials, and aerospace.

Proposed Assessment: Coursework and Final Examination

Logistics and Operational Systems — ENGN4532 (6 units)

Later Year Course
First semester

Coordinator: Dr. N. Hastings

Prerequisites: ENGN3221

Syllabus: This subject aims to develop an understanding of the factors that affect the performance of human-activity systems and their management. The impact of variation, in external conditions and internal operations, will be a particular focus. The subject involves hands-on work using computer-based simulations. Case studies are taken from production, manufacturing and service industries and from natural resource management. Specific topics covered include: probability and distributions, queuing theory, discrete event simulation, system dynamics, task networks and work flow, and the impact of variation.

Proposed Assessment: Assignment (40%); Final Examination (60%)

Biomedical Engineering — ENGN4533 (6 units)

Later Year Course
First semester
May not be offered in 2004

Twenty lectures, nine tutorials and eight hours of laboratory.
Coordinator: Dr. M. Dwyer and Mr. M. Flood

Prerequisites: ENGN3223

Syllabus: This course aims to place biomedical engineering in a systems context and to introduce anatomy, physiology, biocompatibility, biological signal analysis, biomaterials, medical radiation, patient safety and medical device regulation using a case-study approach.

Proposed Assessment: Laboratories, Essays and Final Examination

Telecommunication Networks — ENGN4535 (6 units)

Later Year Course
First semester
Coordinator: Mr R. Edwards

Prerequisites: ENGN3226

Incompatible: COMP3310

Syllabus: The aim of this course is to provide an introduction to communication networks and systems. Topics include: communication network principles, network topologies and circuits, switching. Network architectures and protocols. Multiplexing schemes. Elementary queuing theory. Network standards and management. ISDN and ATM architectures. Communications regulations and standards.

Proposed Assessment: Laboratories (12%); Quizzes (8%); Assignment (10%); Programming Assignment (20%); Final Examination (50%)

Mobile and Wireless Communications — ENGN4536 (6 units)

Later Year Course
Second semester

Coordinator: Dr. H. Jones

Prerequisites: ENGN3226

Syllabus: The purpose of this course is to provide an introduction to modern digital mobile communication systems. Topics include: Overview of digital cellular mobile communication network architecture and design. Mobile radio channel, channel modelling and effects; mobile fading channel. Coding and modulation schemes. GSM standards, CDMA cellular systems. System performance, traffic issues, handover techniques.

Proposed Assessment: Assignments (20%); Quiz (5%); Laboratories (5%); Final Exam (70%)

Engineering Materials — ENGN4601 (6 units)

Later Year Course
First semester
Not offered in 2004

Coordinator: Dr. Z. Stachurski

Prerequisites: ENGN2214

Syllabus: This subject develops a knowledge of the variety of engineering materials, their properties and characteristics. Equilibrium phase diagrams and kinetic TTT diagrams for predicting microstructure in materials. Properties of alloys (steels, aluminium, magnesium, titanium, and other non-ferrous metals). Ceramic materials: ceramics and glasses; forming of ceramics; structure and defects in ceramics. Characterisation, structure and properties of polymers; polymer processing. Rubber elasticity. Strengthening and toughening mechanisms for materials. Fracture mechanics. Characterisation methods (mechanical and microstructural). Biomaterials and nano-materials.Stereoscopy, surfaces and spatial distributions, analytical and visualisation software. Focal plane, Fraunhofer diffraction, Fourier transform. Reflected optical microscopy, SEM, AFM. Phase identification. Transmission optical microscopy, TEM, EP

Proposed Assessment: Essay (35%); Laboratories (30%); Final Examination (35%)

Engineering Law — ENGN4611 (6 units)

Later Year Course
Second semester

Coordinator: Mr G. Tamsitt

Prerequisites: ENGN1211

Incompatible: ENGN4211, ENGN4534, BUSN1101, ASHI2268, POLS1002, ECHI1105, ECHI1106

Syllabus: Sources and classification of law; professional engineering legislation, code of ethics, registration and discipline; negligence; contract law; employment law; patent law and submission; environmental law. Introduction to intellectual property. What is intellectual property? Enforcement of rights. Copyright, trademarks, designs and patents. Intellectual property management. Commercialising intellectual property. University policy and practice and students' rights. Legal aspects of the Internet and electronic commerce.

Proposed Assessment: Coursework and Final Examination

Digital Signal Processing and Control — ENGN4612 (6 units)

Later Year Course
Second Semester
Not Offered in 2004

Coordinator: Prof. M.James

Prerequisites: ENGN2223

Syllabus: This course aims to develop an understanding of discrete time signal processing algorithms, technology and applications. Specification and properties of frequency-selective filters (low-pass, high-pass and band-pass filters, group delay, generalised linear phase, minimum phase). Fast Fourier transform. Finite impulse response filter design techniques, computer-aided filter design. Implementation of digital filters, analog-to-digital and digital-to-analog converters and DSP chips. Applications areas discussed include digital audio and video signal processing.

Proposed Assessment: Laboratories (20%); Quizzes (40%); Research Report (40%)

Power Electronics **ENGN4625 (6 units)**

Later Year Course
Second semester
Coordinator: Dr. B. Blackwell

Prerequisites: ENGN2211

Syllabus: This course covers the important aspects of power electronic circuits, components and design. Topics include device characteristics, heat dissipation, failure modes and discrete transistor circuits. Power magnetic devices are examined, together with their associated drive circuitry and snubbers. Techniques for designing DC-power supplies, static power inverters and universal power supplies, DC-DC converters, and switch-mode power supplies are discussed.

Proposed Assessment: Assignments and Presentation (15%); Laboratories (35%); Quiz (10%); Final Examination (40%)

Robotics **ENGN4627 (6 units)**

Later Year Course
Second semester
Not Offered in 2004

Coordinator: Dr. R.Mahony

Prerequisites: ENGN2221

Syllabus: This course provides an introduction to the mechanics of robots and spatial mechanics. The theoretical focus is on kinematics and dynamics of robotic manipulators and control design for non-linear mechanical systems. Topics covered include: homogeneous coordinate transformations, representation of spatial orientation, Denavit-Hartenberg link descriptions, forward and inverse kinematics, Jacobian rate and static force relations, singularities, recursive Newton-Euler iteration and Euler-Lagrange derivations of manipulator dynamics, trajectory planning, linear control, computed torque control, passivity based control. The applied component of the course includes experimental work with robotic manipulators and a mechatronic design and build project.

Proposed Assessment: Laboratories (50%); Final Examination (50%)