

Part 4 Faculty of Engineering and Information Technology

Faculty of Engineering and Information Technology

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Faculty of Engineering and Information Technology

Dean: Professor John Baird, BSc ANU, PhD ANU

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 (Communication Systems)	4
Bachelor of Engineering (Mechatronic Systems)	4
Bachelor of Engineering (Manufacturing and Mechanical Systems)	4
Bachelor of Engineering (Materials and Mechanical Systems)	4
Bachelor of Engineering (Semiconductor Electronics)	4
Bachelor of Engineering (Sustainable Energy Systems)	4
Bachelor of Engineering (Photonic Systems)	4
Bachelor of Engineering (Environmental 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 Commerce/Bachelor of Information Technology	4
Bachelor of Economics/Bachelor of Information Technology	4
Bachelor of Information Technology/Bachelor of Science (Forestry)	5

Course Prerequisites

Bachelor of Engineering

ACT

(a) Advanced Mathematics Extended major/minor and Physics major or

(b) Advanced Mathematics Extended double major and Physics minor

NSW

(a) 3 unit Mathematics; and 2 unit Physics or 4 unit Science or

(b) 4 unit Mathematics and 3 unit Science

Bachelor of Information Technology

ACT

Satisfactory performance in a major in Advanced Mathematics

NSW

Satisfactory performance in 2 unit Mathematics

Bachelor of Software Engineering

ACT

Advanced Mathematics Extended major/minor

NSW

3 unit Mathematics

Bachelor of Engineering

(course code 4700)

The ANU Bachelor of Engineering degree programs are four-year, 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 which 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.

Building on a foundation of basic science and engineering fundamentals, the four-year BE degree programs focuses on the following major disciplines:

- communication systems
- robotics and computer vision
- manufacturing and management systems
- materials and mechanical systems
- semiconductor electronics
- sustainable energy 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 above, 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 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 the choice of Engineering majors and electives, other University electives and named degrees

Practical Experience

The Institution of 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 ENGN4005 Practical Experience.

Bachelor of Engineering — program requirements

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

- 48 units of the following professional development courses:
 ENGN1211 Discovering Engineering (6 units)
 ENGN2225 Systems Design (6 units)
 ENGN3211 Investment Decisions & Financial Systems (6 units)
 (or specified equivalent: BUSN1002 or ASHI2021 or ASHY2041 or ASHI2023 or POLS1004 or ECHI1105 or ECHI1106)
 ENGN3221 Project & Operations Management (6 units)
 ENGN4200 Individual Project (12 units)
 ENGN4221 Systems Engineering Project (6 units)
 ENGN4611 Engineering Law (6 units)
 (or specified equivalent: BUSN1101 or ASHI2268 or POLS1002 or ECHI1105 or ECHI1106) (6 units)
 ENGN4005 Practical Experience (0 units)
- 78 units of engineering discipline courses listed in Schedule 1, including ENGN1221 Electromechanical Technologies (6 units), ENGN1215 Introduction to Materials (6 units) and at least one engineering discipline major (42 units)
- 12 units of mathematics, being
 MATH1013 Mathematics & Applications 1 (or MATH1115) (6 units)
 MATH1014 Mathematics & Applications 2 (or MATH1116) (6 units)
- 12 units of computing, being
 COMP1100 Intro to Programming & Algorithms (6 units)
 COMP1110 Foundations of Software Engineering (6 units)
- 6 units of physics, being
 PHYS1101 Advanced Physics I (6 units)
- 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.

<i>Communication Systems</i>		
ENGN1221	Electromechanical Technologies	6 units
ENGN2211	Electronic Circuits & Devices	6 units
ENGN2223	Signals & Systems	6 units
ENGN3214	Telecommunication Systems	6 units
ENGN3226	Digital Communications	6 units
ENGN4535	Communication Networks	6 units
ENGN4536	Mobile Communications	6 units
TOTAL		42 units

<i>Electronics and Semiconductors</i>		
ENGN1221	Electromechanical Technologies	6 units
ENGN2211	Electronic Circuits & Devices	6 units
ENGN2224	Electronics	6 units
ENGN3213	Digital Systems and Microprocessors	6 units
ENGN3225	Power Electronics	6 units
ENGN4519	Semiconductor Materials and Devices	6 units
ENGN4507	Semiconductor Technology	6 units
TOTAL		42 units

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

<i>Manufacturing and Management Systems</i>		
ENGN1215	Introduction to Materials	6 units
ENGN2214	Mechanics of Materials	6 units
ENGN2221	Systems Dynamics	6 units
ENGN3212	Manufacturing Technologies	6 units
ENGN3222	Manufacturing Systems	6 units
ENGN4615	Finite Element Analysis	6 units
ENGN4532 or ENGN4530 or ENGN4528	Logistics and Operational Systems OR Engineering and Public Policy OR Computer Vision	6 units
TOTAL		42 units

<i>Materials and Mechanical Systems</i>		
ENGN1215	Introduction to Materials	6 units
ENGN2214	Mechanics of Materials	6 units
ENGN2221	Systems Dynamics	6 units
ENGN2222	Thermal Energy Systems	6 units
ENGN3224	Energy Systems Engineering	6 units
ENGN4601	Engineering Materials	6 units
ENGN4511	Composite Materials	6 units
TOTAL		42 units

<i>Sustainable Energy Systems</i>		
ENGN1221	Electromechanical Technologies	6 units
ENGN2211	Electronic Circuits and Devices	6 units
ENGN2224	Electronics	6 units
ENGN2222	Thermal Energy Systems	6 units
ENGN3224	Energy Systems Engineering	6 units
ENGN4524	Solar Energy Technologies	6 units
ENGN4516	Sustainable Energy Systems	6 units
TOTAL		42 units

Note: Subject to student enrolment the above listed courses may not be offered each year.

Science 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 and in environmental systems by incorporating non-engineering majors offered by the Faculty of Science in fulfillment of the requirements under Items 5 and 6 of the BE program requirements. These are the Photonic Systems major and the Environmental Systems major. Note that these majors cannot be counted towards Item 2 of the BE program requirements.

Note that the corresponding named degrees BE (Photonic Systems) and BE (Environmental Systems) may only be taken as a single degree, not as a combined degree.

<i>Photonic Systems</i>		
PHYS1101 and PHYS1201	Advanced Physics I and II	12 units
PHYS2013	Quantum Mechanics	6 units
PHYS2017	Laser and Photonic Fundamentals	6 units
PHYS2016	Electromagnetism and Continuum Mechanics	6 units
PHYS3031	Light and Matter Interaction	3 units
PHYS3050	Optical Fibre and Waveguide Transmission	3 units
PHYS3051	Devices for Optical Systems and Networks	3 units
PHYS3052	Electro-Optics	3 units
TOTAL		42 units

<i>Environmental Systems</i>		
PHYS1101	Advanced Physics I	6 units
GEOG2106	Introduction to Greenhouse	6 units
	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 units
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.

Named Bachelor of Engineering Degrees

In addition to the interdisciplinary Bachelor of Engineering degree, students may be eligible to enroll in one the following named degrees. The specification of a named degree is optional.

<i>Degree Program</i>	<i>Requirements</i>
Bachelor of Engineering (BE)	No major specified, although at least one must be completed.
BE (Communication Systems)	Must include the Communication Systems major.
BE (Mechatronic Systems)	Must include both the Robotics and Computer Vision major and the Manufacturing and Management Systems major.
BE (Semiconductor Electronics)	Must include the Electronics and Semiconductors major.
BE (Manufacturing and Management Systems)	Must include the Manufacturing and Management Systems major.
BE (Materials and Mechanical Systems)	Must include the Materials and Mechanical Systems major.
BE (Sustainable Energy Systems)	Must include the Sustainable Energy Systems major.
BE (Photonic Systems)*	Must include both the Communication Systems major and the Photonic Systems major
BE (Environmental Systems)*	Must include both the Sustainable Energy Systems major and the Environmental Systems major.

* Not available as part of a combined degree program.

Schedule 1: Engineering Discipline Courses

ENGN1215 Introduction to Materials 6 units
 ENGN1221 Electromechanical Technologies 6 units
 ENGN2211 Electronic Circuits and Devices 6 units
 ENGN2214 Mechanics of Materials 6 units
 ENGN2221 System Dynamics 6 units
 ENGN2222 Thermal Energy Systems 6 units
 ENGN2223 Signals and Systems 6 units
 ENGN2224 Electronics 6 units
 ENGN3212 Manufacturing Technologies 6 units
 ENGN3213 Digital System and Microprocessors 6 units
 ENGN3214 Telecommunications 6 units
 ENGN3222 Manufacturing Systems 6 units
 ENGN3223 Control Systems 6 units
 ENGN3224 Energy Systems Engineering 6 units
 ENGN3225 Power Electronics 6 units
 ENGN3226 Digital Communications 6 units
 ENGN4535 Communication Networks 6 units
 ENGN4536 Mobile Communications 6 units
 ENGN4627 Robotics 6 units
 ENGN4528 Computer Vision 6 units
 ENGN4507 Semiconductor Technology 6 units
 ENGN4519 Semiconductor Materials and Devices 6 units
 ENGN4615 Finite Element Analysis 6 units
 ENGN4532 Logistics and Operational Systems 6 units
 ENGN4601 Engineering Materials 6 units
 ENGN4511 Composite Materials 6 units
 ENGN4524 Solar Energy Technologies 6 units
 ENGN4516 Sustainable Energy Systems 6 units
 ENGN4526 Optimal Filtering and Control 6 units
 ENGN4512 Digital Signal Processing 6 units
 ENGN4530 Engineering and Public Policy 6 units
 ENGN4533 Biomedical Engineering 6 units

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 is based on the calculation of an average percentage mark (APM). The APM for Years 1, 2, 3 and 4 is the average, weighted according to unit value, of each ENGN1xxx, ENGN2xxx, ENGN3xxx and ENGN4xxx course respectively. The APM for Year 4 is the average mark awarded in ENGN4611, ENGN4221 and in each completed course unit from the engineering professional electives list.

The weighting factors 0.1, 0.2, 0.35 and 0.35 respectively, are used for the Years 1, 2, 3 and 4 APMs to give the overall APM.

Standard Bachelor of Engineering program pattern

	<i>First semester</i>		<i>Second semester</i>	
Year 1 48 units	ENGN1211 Discovering Engineering	6 units	ENGN1221 Electromechanical Technologies	6 units
	MATH1013 Mathematics & Applications 1	6 units	MATH1014 Mathematics & Applications 2	6 units
	PHYS1101 Advanced Physics I	6 units	ENGN1215 Introduction to Materials	6 units
	COMP1100 Introduction to Programming OR University elective	6 units	COMP1110 Foundations of Software Engineering OR ENGN1225 Chemistry Fundamentals (3 units) and ENGN1226 Modern Physics (3 units) OR University elective	6 units
Year 2 48 units	MATH2305 Calculus and Differential Equations OR University elective	6 units	ENGN2225 System Design	6 units
	Engineering major	6 units	Engineering major	6 units
	Engineering elective	6 units	Engineering elective	6 units
	University elective OR COMP1100 Introduction to Programming	6 units	University elective OR COMP1110 Foundations Software Engineering	6 units
Year 3 48 units	ENGN3211 Investment Decisions (or equivalent)	6 units	ENGN3221 Project Operations and Management	6 units
	Engineering major	6 units	Engineering major	6 units
	Engineering elective	6 units	Engineering elective	6 units
	University elective	6 units	University elective	6 units
Year 4 48 units	ENGN4200 Individual Project	12 units	ENGN4221 Systems Engineering Project	6 units
			ENGN4611 Engineering Law (or equivalent)	6 units
	Engineering major	6 units	Engineering major	6 units
	Engineering elective	6 units	University elective	6 units

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>

Combined degrees

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

BE		Bachelor of Science
BE (Communication Systems)		Bachelor of Information Technology
BE (Mechatronic Systems)		Bachelor of Commerce
BE (Semiconductor Electronics)	may be combined with one of	Bachelor of Economics
BE (Manufacturing and Management Systems)		Bachelor of Asian Studies
BE (Materials and Mechanical Systems)		Bachelor of Arts
BE (Sustainable Energy Systems)		

The named degrees BE (Photonic Systems) and BE (Environmental Systems) are not available as combined degrees.

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 very 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 BInfTech degree is organised to allow a flexible choice between an Information Systems stream and a Software Development stream. Both streams 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. Both also require at least 18 units of mathematics, which is a means of developing the ability to work with abstractions, a fundamental requirement for understanding and applying ideas in computing.

In later years of the course, students can choose the Software Development stream, to develop the conceptual and practical skills for software development and the technology of computer systems, or the Information Systems stream to develop understanding of organisations, the management of computer systems applications in them, and the accompanying systems analysis and design.

Course requirements

The degree requires the completion of 144 units of courses offered, or approved by, the Faculty of Engineering and Information Technology, including:

- completion of 90 units of IT courses (including the IT courses from Schedule 1 and the IT courses from a major chosen from Schedule 2), comprising a total of:
 - 18 units of 1000-series IT courses, and
 - 24 units of 2000-series IT courses, and
 - 42 units of 3000/4000-series IT courses, and
 - 36 units of 3000-series IT courses, and
 - a further 12 units of IT courses;
- completion of MATH1005 or alternatives as listed in Schedule 1;
- completion of MATH1003 or alternatives as listed in Schedule 1 and 6 units of 2000-series mathematics courses;
- completion of a further 12 units of 2000/3000/4000-series IT courses;
- completion of a further 24 units of courses offered within the university, including the non-IT courses listed under the chosen major from Schedule 2;
- no more than 60 units of 1000-series courses may be included.

IT courses are:

COMP courses

INFS courses

ENGN1211 Discovering Engineering

ENGN225 System Design

ENGN3213 Digital Systems and Microprocessors

ENGN3214 Telecommunications

ENGN3226 Digital Communications

ENGN4512 Digital Signal Processing

ENGN4528 Computer Vision

Schedule 1

COMP1100 Introduction to Programming and Algorithms
 COMP1200 Perspectives on Computing or ENGN1211 Discovering Engineering
 COMP1110 Foundations of Software Engineering
 COMP2300 Introduction to Computer Systems
 COMP2600 Formal Methods in software Engineering
 COMP3110 Software Analysis and Design
 MATH1003 Mathematical Modelling 1 or MATH1013 Mathematics and Applications 1 or MATH1115 Mathematics and Applications 1 Honours
 MATH1005 Mathematical Modelling 2 or MATH1014 Mathematics and Applications 2 or MATH1116 Mathematics and Applications 2 Honours

Schedule 2*Information Systems*

COMP2400 Relational Databases

INFS2024 Information Systems Analysis

INFS3024 Information Systems Management

BUSN1101 Introduction to Commercial Law

12 units from:

- BUSN1001 Business Reporting and Analysis and BUSN1002 Accounting Processes and Systems
- ECON1101 Microeconomics 1 and ECON1102 Macroeconomics 1
- ECHI1005 Business and Economy in the Asia-Pacific Region and ECHI1006 Australian Economy

Software Development

COMP2100 Software Construction

COMP2110 Software Design

COMP3100 Software Engineering Group Project

BUSN1001 Business Reporting and Analysis or ENGN3211 Investment Decisions and Financial Systems

The BInfTech with Honours

The BInfTech degree with honours requires an additional year of study after the pass degree of BInfTech. 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.

BInfTech (3701:SD) possible enrolment pattern

	<i>First semester</i>	<i>Second semester</i>
<i>Year 1</i>	COMP1100 Introduction to Programming and Algorithms COMP1200 Perspectives on Computing MATH1003 Mathematical Modelling 1 COMM1010 Financial Accounting Fundamentals	COMP1110 Foundations of Software Engineering COMP2400 Relational Databases MATH1005 Mathematical Modelling 2 1000-elective (6 units)
<i>Year 2</i>	COMP2100 Software Construction COMP2300 Intro to Computer Systems 2000-series MATH 1000-elective (6 units)	COMP2110 Software Design 2000/3000/4000-series IT (12 units) 2000-elective (6 units) COMP2600 Formal Methods in Software Engineering
<i>Year 3</i>	COMP3100 SE Group Project COMP3110 Software Analysis and Design 3000/4000-series IT (12 units) [1] IT elective (6 units)	COMP3100 SE Group Project 3000/4000-series IT (12 units) [1] 2000/3000/4000-series IT (6 units)

[1] Some 3000/4000-series IT electives may have specific prerequisites that are not covered by the units specified in the table.

BInfTech (3701: IS) possible enrolment pattern

	<i>First semester</i>	<i>Second semester</i>
<i>Year 1</i>	COMP1100 Introduction to Programming and Algorithms COMP1200 Perspectives on Computing MATH1003 Mathematical Modelling 1 1000-elective (6 units) [1]	COMP1110 Foundations of Software Engineering COMP2400 Relational Databases MATH1005 Mathematical Modelling 2 1000-elective (6 units) [1]
<i>Year 2</i>	INFS2024 Information Systems Analysis COMP2300 Intro to Computer Systems 2000-series MATH 2000-elective (6 units)	COMM1101 Intro to Commercial Law 2000/3000/4000-series IT (12 units) COMP2600 Formal Methods in Software Engineering
<i>Year 3</i>	INFS3024 Information Systems Management COMP3110 Software Analysis and Design 3000/4000-series IT (12 units) [2] IT elective (6 units)	3000/4000-series IT (18 units) [2] IT elective (6 units)

[1] 1000-electives to be chosen from one of the following 12 units options: COMM1010/1020 or ECON1001 or ECHI1005/1006.

[2] Some 3000/4000-series IT electives may have specific prerequisites that are not covered by the units specified in the table.

Bachelor of Software Engineering

(course code 4708)

The Bachelor of Software Engineering is a four year degree which will be accredited by the Institution of Engineers, Australia. 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 very 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 teamworking 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.

Course requirements

The BSEng degree requires completion of 192 units including

(a) completion of 114 units of core BSEng courses as follows:

COMP1100 Introduction to Programming and Algorithms
 COMP1110 Foundations of Software Engineering
 COMP2100 Software Construction
 COMP2200 Technical Communication and Professional Context
 or ENGN1211 Discovering Engineering
 COMP2300 Introduction to Computer Systems
 COMP2310 Concurrent and Distributed Systems
 COMP2400 Relational Databases
 COMP2600 Formal Methods in Software Engineering
 COMP3500 Software Engineering Individual Project
 COMP3110 Software Analysis and Design
 COMP3600 Algorithms
 COMP4510 Software Engineering Team Project Part I
 COMP4520 Software Engineering Team Project Part II and
 ENGN4221 Systems Engineering Project OR COMP4530
 Software Engineering Team Project
 COMP1800, COMP2800, COMP3800 Art and Science of Computing I, II, III
 COMP4800 Industrial Experience

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 30 units of Information Technology courses, with at least 15 units of 4000-series courses, selected from Tables A, B and C as follows:

- 18 units from Table A
- 6 units from Table B
- 6 units from Table C;

(c) completion of 2000-series mathematics units to the value of 6 units;

(d) completion of further Science or Engineering units to the value of 12 units, excluding those offered by Computer Science;

(e) completion of a further 30 units, including at least 6 units of 3000- or 4000-series courses and not more than 12 units of 1000-series courses, from anywhere in the university.

(f) no more than 60 units of 1000-series courses may be included.

IT units are COMP and INFS courses, ENGN3213, ENGN3214.

Table A refers to Software Engineering units, Table B refers to Foundation units, Table C refers to Design units. The contents of Tables A, B and C may be changed from time to time.

Table A

COMP3120 Managing Software Development

COMP4100 Software Quality Management

COMP4110 Software Process

Table B

COMP3300 Operating Systems Implementation

COMP3310 Computer Networks

COMP3320 High Performance Scientific Computation

COMP3400 Internet, Intranet and Document Systems

COMP3410 Information Technology in Electronic Commerce

COMP3420 Database Systems

COMP3610 Principles of Programming Languages

COMP3700 Topics in Software Engineering I

COMP3710 Topics in Computer Science

COMP4120 Component-based Software Development

COMP4200 Milestone Papers in Computing

COMP4210 Usability and Design of the Human-Computer Interface

COMP4300 Parallel Systems

COMP4320 Network Security

COMP4400 Advanced Databases

COMP4410 Document Technologies

COMP4420 Networked Scientific Data Analysis and Presentation

COMP4600 Advanced Algorithms

COMP4610 Computer Graphics

COMP4620 Machine Learning and Data Mining

COMP4630 Applications of Logic in Computing

COMP4700 Topics in Software Engineering II

COMP4710 Topics in Software Engineering III

Table C

COMP2110 Software Design

Bachelor of Software Engineering with Honours

Honours grades in the BSEng will be awarded on the basis of merit.

BSEng (4708) possible enrolment pattern

	<i>First semester</i>	<i>Second semester</i>
<i>Year 1</i>	COMP1100 Introduction to Programming and Algorithms MATH1013 Mathematics and Applications 1 ENGN1211 Discovering Engineering COMP1800 Art and Science of Computing I 1000-elective	COMP1110 Foundations of Software Engineering MATH1014 Mathematics and Applications 2 COMP2400 Relational Databases COMP1800 Art and Science of Computing I 1000-elective
<i>Year 2</i>	COMP2100 Software Construction COMP2300 Introduction to Computer Systems COMP2800 Art and Science of Computing II 2000-series MATH 2000-elective	COMP2110 Software Design COMP2310 Concurrent and Distributed Systems COMP2800 Art and Science of Computing II COMP2600 Formal Methods in Software Engineering 2000-elective
<i>Year 3</i>	COMP3100 SE Group Project COMP3110 Software Analysis and Design ENGN3211 Investment Decisions and Financial Systems COMP3800 Art and Science of Computing III Science/Engn elective	COMP3100 SE Group Project COMP3120 Managing Software Development COMP3600 Algorithms COMP3800 Art and Science of Computing III Science/Engn elective
<i>Year 4</i>	COMP4510 Individual Project Part I (6 units) COMP4100 Software Quality Management ENGN4211 Engineering Law 3000/4000-series IT (3 units) [1] 3000-elective (6 units)	COMP4520 Individual Project Part II (12 units) COMP4110 Software Process 3000/4000-series IT (6 units) [1]

[1] units to be selected from Table B. Please note that some 3000/4000-series IT electives may have specific prerequisites that are not covered by the units specified in the table.

BSEng engineering elective options

The Bachelor of Software Engineering (BSEng) program provides for students to choose: (a) 12 units Science or Engineering; (b) 30 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

ENGN1214, ENGN1221, ENGN2211, ENGN2223, ENGN3214, ENGN4504, ENGN4512, ENGN4542, ENGN4543, ENGN4513

Robotics and Computer Vision

ENGN1214, ENGN1221, ENGN2211, ENGN2223, ENGN3213, ENGN3223, and choose 6 units from ENGN4509, ENGN4527, ENGN4528

Manufacturing and Computational Engineering

ENGN1214, ENGN1221, ENGN2214, ENGN2221, ENGN3212, ENGN3222, ENGN4515, ENGN4518 (or, with permission, ENGN4520)

Electronics and Semiconductors

ENGN1214, ENGN1221, ENGN2211, ENGN2224, ENGN3213, ENGN4506, ENGN4507, ENGN4519, and, with permission, ENGN4520.

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.

Accreditation

The Bachelor of Engineering degree is accredited to the appropriate level by the Institution of Engineers, Australia (IEAust). The Bachelor of Software Engineering degree has been submitted for accreditation with IEAust and the Australian Computer Society.

All students who complete the BInfTech degree are eligible for associate membership of the Australian Computer Society.

Combined Courses

Detailed information about courses 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 courses with the Bachelor of Software Engineering.

Status

Status towards undergraduate degree courses of the Faculty may be granted for studies completed elsewhere. Requests for status are assessed individually.

Computer Science

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Senior Lecturer and 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; as well as 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 a four year professional Software Engineering degree course has been offered since 1999. This includes technical, professional, communications skills, 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. The Faculty has submitted this course to the Institution of Engineers, Australia, for professional accreditation as an engineering degree.

The Faculty also offers a three-year technical and professional degree course, the Bachelor of Information Technology, in combination with the Faculty of Economics and Commerce. BInfTech students can choose to specialise in a software development stream or an information systems stream. The BInfTech course can also be combined with courses in Commerce or with Economics for a four year combined degree program which aims to provide a professional, business-oriented education. It can be combined with the Bachelor of Engineering course for five years of study that includes more computing within a full multidisciplinary Engineering degree. It is also possible to combine the BInfTech course with the BSc (Forestry) degree.

Many of the same computer science and software development units 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. The specialised Bachelor of Computational Science degree combines several of these units with mathematics.

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 with little computing background is also available.

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

Introductory units

The Department offers several units that can be taken by students with no previous background in computing or information technology. COMP1900 is an information technology service unit 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. COMP2200 introduces the communication skills and other professional background for the Software Engineering degree.

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.

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 unit 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 units offered and the structures of the courses is available from the Department's World Wide Web site, at <http://cs.anu.edu.au>.

UNIT DETAILS

Introduction to Programming and Algorithms

COMP1100
(6 units) Group A

First semester

Thirty one-hour lectures. Twelve two-hour tutorial/laboratory sessions.

Assumed prior knowledge: ACT Advanced maths major or NSW 2 unit maths or equivalent.

Incompatible with COMP1011, ENGN1002, ENGN1213

Syllabus: This unit 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 unit has a strong practical emphasis, with required attendance at laboratory sessions.

Foundations of Software Engineering

COMP1110
(6 units) Group A

Second semester

Twenty-six one-hour lectures and twelve two-hour tutorial/laboratory sessions

Prerequisites: COMP1100 or COMP1011

Incompatible with COMP2031, ENGN2003, ENGN1223

Syllabus: This unit introduces students to the tools and techniques for developing software systems of a size and quality of an industrially relevant nature. The unit 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 unit will cover: 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 unit will also introduce some of the theoretical fundamentals that underpin software engineering, including: logic and its application to specifications, and finite state automata.

Perspectives on Computing **COMP1200** **(6 units) Group A**

First semester

Thirty one-hour lectures, twelve two-hour tutorial and laboratory sessions.

Prerequisites: none

Syllabus: This unit 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, 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, professional ethics. Educational issues: curriculum issues, the ANU experience.

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

Full Year

About eight sessions of occasional seminars.

Prerequisites: Enrolment in BEng 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) Group A**

First semester (may be offered in second semester also)

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 BEng. Cannot be taken after successful completion of COMP1011, COMP1100 or INFS1014.

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

Software Construction **COMP2100** **(6 units) Group B**

First semester

Twenty-six one-hour lectures and twelve two-hour tutorial and laboratory sessions

Prerequisites: COMP1110 or COMP2031, and 12 units of 1000-level mathematics or mathematical statistics courses including MATH1014 or MATH1005

Syllabus: This unit 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 build 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 part (or all) of the Personal Software Process, learning time-management, planning, and quality control.

The following topics are covered: programming to precise specifications; the implementation milieu (configuration control, programming standards, documentation standards, literate programming, use of integrated programming environments); code review and inspections; test planning and procedures (derived from specification and design documents); object-oriented (Eiffel), procedural (C), and scripting (Bash) languages; GUI interfaces; the Personal Software Process.

Software Design **COMP2110** **(6 units) Group B**

Second semester

Thirty one-hour lectures and twelve two-hour tutorial and laboratory sessions.

Prerequisites: COMP1110 or COMP2031, and 12 units of 1000-level mathematics or mathematical statistics courses including MATH1014 or MATH1005.

Incompatible with COMP2038

Syllabus: This unit is one of three units (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. Designing to specifications (ab initio design) and design recovery from source code (reverse engineering). The design milieu (notations, documentation standards, configuration control). Design techniques (structured, object-oriented, software architectures, design patterns). Design review and inspections. Design in the context of requirements change. Design metrics.

Technical Communication and Professional Context **COMP2200** **(6 units) [Not grouped for BSc]**

First semester (will not be offered in 2001)

Twenty four lectures, twelve two hour design classes, and twelve tutorials

Prerequisites: Enrolment in BEng or permission of Head of Department.

Incompatible with ENGN1211, SCOM1001

Syllabus: About one third of this unit is dedicated to technical communication (verbal and written) for computing professionals. The purpose is to equip students with the necessary skills to communicate technical information to customers and colleagues with the necessary clarity and simplicity.

The unit will also cover the various social and ethical responsibilities of the computing professional. These include professional ethics, concern for information security and privacy, whistle-blowing, the role of professional societies, social responsibilities, knowing one's own limitations, the continuity of professional advancement, the role of the professional in educating society, and technical consultancy in public policy issues.

Legal issues will form a third focus of the unit, including risks and liabilities and intellectual property.

Introduction to Computer Systems **COMP2300** **(6 units) Group B**

First semester

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

Prerequisites: COMP1110 or COMP1011; and 6 units of 1000-level MATH, STAT, EMET courses.

Incompatible with COMP1012.

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 unit 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 organisation, the assembly and linking process and software libraries.

Concurrent and Distributed Systems **COMP2310** **(6 units) Group B**

Second semester

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

Prerequisites: COMP2100 or COMP2300 or COMP2031; 12 units of 1000-level mathematics or mathematical statistics courses.

Incompatible with COMP2029, COMP2032

Syllabus: This unit 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.

Relational Databases **COMP2400** **(6 units) Group B**

Second semester

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

Prerequisites: COMP1100 or COMP1011; and 6 units of 1000-level mathematics or mathematical statistics or microeconomic courses.

Incompatible with INFS2051, INFS3055

Syllabus: Introduction to the basic goals, functions, models, components, applications, and social impact of database systems applications. The unit introduces the relational 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 schema requires some appreciation of role of integrity constraints, and the impact of DBMS access schemes and query optimisation techniques.

Formal Methods in Software Engineering **COMP2600** **(6 units) Group B**

Second semester

Thirty one-hour lectures, eight one-hour tutorials and four two-hour laboratory sessions.

Prerequisites: COMP1110 and 12 units of 1000-level mathematics or mathematical statistics including MATH1005 or MATH1014.

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 unit. 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), propositional programming language semantics and partial correctness, weakest preconditions and total correctness.

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

Annual

About eight sessions of occasional seminars.

Prerequisites: COMP1800 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.

Software Engineering Group Project **COMP3100** **(12 units) Group C**

Annual

Fifty one-hour lectures and 300 hours of group project work.

Prerequisites: 24 units of 2000-level COMP courses including COMP2100, and COMP2110, and 6 units of 2000-level MATH or STAT or EMET courses.

Incompatible with COMP3018.

Co-requisites: COMP3110.

Syllabus: This unit provides the student with project experience to complement the studies of the software development process in units 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.

Software Analysis and Design **COMP3110** **(6 units) Group C**

First semester

Thirty one-hour lectures and four or five two-hour laboratory sessions.

Prerequisites: 12 units of 2000-level COMP or INFS courses including at least one of COMP2110, COMP2038, COMP2400, INFS2051 and INFS3055, and 12 units of 1000-level MATH or STAT courses.

Incompatible with INFS2047, INFS2048, INFS3047, INFS3048.

Syllabus: This unit is one of three units (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 unit 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 modeling tools will be used to reinforce the various concepts that are covered theoretically.

Managing Software Development **COMP3120** **(6 units) Group C**

Second semester

Thirty one-hour lectures and five two-hour laboratory sessions.

Prerequisites: COMP3110, INFS2047 or INFS3047, and 6 units of 2000-level MATH or STAT or EMET courses.

Incompatible with ENGN3221

Syllabus: This unit addresses the control of the software development process. It is a companion unit to COMP2100, COMP2110 and COMP3110, which address constructive 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 units 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.

Operating Systems Implementation **COMP3300** **(6 units) Group C**

Second semester

Twenty-six one-hour lectures and six one-hour tutorials and six three-hour laboratory sessions.

Prerequisites: COMP2300 and COMP2310, or COMP2030, and 6 units of 2000-level mathematics or mathematical statistics or econometrics courses.

Incompatible with COMP3037.

Syllabus: This unit 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.

Computer Networks **COMP3310** **(6 units) Group C**

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 or both COMP2031 and COMP1012, and 6 units of 2000-level mathematics or mathematical statistics or econometrics.

Incompatible with ENGN4514, COMP3036

Syllabus: This unit 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.

High Performance Scientific Computation **COMP3320** **(6 units) Group C**

First semester

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

Prerequisites: 12 units of 2000-level COMP courses including COMP2100 or COMP2300 or COMP2031 or ENGN2003, and 6 units of 2000-level MATH, STAT or EMET courses.

Incompatible with COMP3061, COMP3067.

Syllabus: This unit provides an introduction to High Performance Computing with an orientation towards applications in science and engineering. The dominant programming language in this application domain, FORTRAN95, will be taught within the context of numerical computing and the design and construction of sophisticated scientific software. The unit will study high performance computer architectures, including vector and 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 FORTRAN95 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; scalar and vector 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.

Internet, Intranet and Document Systems **COMP3400** **(6 units) Group C**

First semester

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

Prerequisites: COMP1100 or COMP1011; 12 units of 2000-level IT courses; and 12 units of 1000-level MATH/STAT/EMET courses.

Incompatible with INFS2052, INFS3056.

Syllabus: This unit 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.

Information Technology in Electronic Commerce

COMP3410
(6 units) Group C

Second semester

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

Prerequisites: COMP1100 or COMP1011; 12 units of 2000-series IT courses; 12 units of 1000-series MATH/STAT/EMET courses

Syllabus: This unit 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 (search engines, 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.

Database Systems

COMP3420
(6 units) Group C

First semester

Thirty one-hour lectures and twelve one-hour tutorials three two-hour laboratory sessions

Prerequisites: COMP2400 or INFS2012 or INFS1014

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

Software Engineering Individual Project

COMP3500
(12 units)

Annual

Fifty one-hour lectures and 300 hours of project work.

Prerequisites: Enrolment in BSEng; and completion of 24 units of 2000-series COMP courses including COMP2100 and COMP2110, and 6 units of 2000-series MATH or STAT or EMET courses.

Incompatible with COMP3100.

Co-requisites: COMP3110.

Syllabus: This unit provides the student with a substantial individual project experience. In this project the student participates 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.

Algorithms

COMP3600
(6 units) Group C

Second semester

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

Prerequisites: 12 units of 2000-level COMP courses including COMP2100 or both COMP2031 and COMP2033; and 6 units of 2000-level MATH/STAT/EMET courses.

Incompatible with COMP3064.

Syllabus: This unit 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.

Principles of Programming Languages

COMP3610
(6 units) Group C

First semester (may not be offered in 2002)

Thirty one-hour lectures, five one-hour tutorials and four two-hour laboratory sessions.

Prerequisites: COMP2600 or COMP1013; COMP2100 or COMP2031; 6 units of 2000-level mathematics, statistics or econometrics.

Incompatible with COMP3065, COMP3039, COMP3040.

Syllabus: The unit 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 unit 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 unit 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 unit 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.

Topics in Software Engineering I

COMP3700
(6 units) Group C

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/STAT/EMET courses.

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 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.

Topics in Computer Science

COMP3710
(6 units) Group C

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 6 units of 2000 series MATH/STAT/EMET courses.

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.

Art and Science of Computing III **COMP3800** (0 units)

Annual

About eight sessions of occasional seminars.

Prerequisites: COMP2800 and enrolment in BEng or approval of Head of Department.

Syllabus: Same as for COMP2800 except that events in Art and Science of Computing III will be targeted to those students in their final years.

Computer Science Honours **COMP4001** Full Year

Prerequisites: Enrolment in the BSc Honours degree, with specialisation in computer science.

Syllabus: The program consists of a coursework component and a project component, of equal weight. The coursework component involves units 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, 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.

Information Technology Honours **INFT4001**

Full Year

Prerequisites: Enrolment in the BInfTech Honours degree.

The 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 coordinator.

The coursework component involves units 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 COMP4001 unit 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.

Software Quality Management **COMP4100** (6 units) [Not grouped for BSc]

First semester

Thirty one-hour lectures and five two-hour laboratory sessions

Prerequisites: Enrolment in BEng; COMP2600, COMP3100 and COMP3120

Syllabus: This unit 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.

Software Process **COMP4110** (6 units) [Not grouped for BSc]

Second semester

Thirty one-hour lectures and five two-hour laboratory sessions

Prerequisites: Enrolment in BEng; COMP3100 and COMP3120

Syllabus: This unit 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.

Component-Based Software Development **COMP4120** (6 units) (Group C)

Not offered in 2002

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) Group C

First semester

Thirteen one-hour lectures

Prerequisites: 30 units of 3000/4000-series IT courses

Syllabus: Each week, students in this unit 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.

Usability and Design of the Human-Computer Interface **COMP4210** (3 units) Group C

Second semester (may not be offered in 2002)

Fifteen one-hour lectures

Prerequisites: 12 units of 2000-level COMP or INFS courses, including COMP2100 or COMP2300; and 6 units of 2000-level mathematics, statistics, or econometrics

Incompatible with COMP3043

Syllabus: This unit 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; software internationalisation and localisation; user interface programming (graphical interfaces and software systems, the X Window System, interaction toolkits); user interface design tools; interface and application integration.

Parallel Systems **COMP4300**
(6 units) Group C

First semester
Twenty-six one-hour lectures, four one-hour laboratory/tutorials
Prerequisites: COMP2310; and 24 units of 3000-level COMP courses, including either COMP3320 or COMP3600
Syllabus: A practically-oriented introduction to programming paradigms for parallel computers. Considers definitions of program efficiency on parallel computers, addresses the modeling, analysis and measurement of program performance. Description, implementation and use of parallel programming languages, parallel features of operating systems, library routines and applications.

Network Security **COMP4320**
(3 units) Group C

First semester
Fifteen one-hour lectures, three tutorials.
Prerequisites: 12 units of 3000-level COMP courses including COMP3310
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).

Advanced Databases **COMP4400**
(6 units) Group C

Not offered in 2002
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
Incompatible with COMP3062
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) Group C

Second semester
Fifteen one-hour lectures and four two-hour laboratory sessions
Prerequisites: 24 units of 3000-level COMP courses including COMP3400 and COMP3410
Syllabus: This unit 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 unit has a strong practical component, exposing students to the computer science and software engineering aspects of building search systems and other document technologies.

Networked Scientific Data Analysis and Presentation **COMP4420**
(6 units) Group C

First semester

Twenty-six one-hour lectures and six two-hour laboratory sessions
Prerequisites: 24 units of 3000-level COMP courses, including COMP3320; and either COMP3400 or COMP3310

Syllabus: Modern 'big' science and engineering projects often make use of computing systems which combine components of networking, real-time control, data management, data analysis and visualisation. The interface to all of the above is increasingly via a Web-based workbench. This unit adopts a case study approach to describing some of these systems. Sample applications include remote experimentation, scientific co-laboratories, graphical information systems (GIS), planning and management of industrial processes and financial information systems.

Software Engineering Team Project I **COMP4510**
(6 units)

To be done as the first part of the combination COMP4510 and COMP4530, or the combination COMP4510, COMP4520 and ENGN4221 which represent two alternative ways to satisfy the goals for the Software Engineering fourth year project.
First Semester
As many hours as necessary for reviews and a nominal 12 hours per week

Prerequisites: Enrolment in BEng and 24 units of 3000-level COMP courses including COMP3500 and COMP3120

Incompatible with COMP3100
Syllabus: The courses COMP4510 and COMP4520 together form a team software project requirement whilst ENGN4221 provides an opportunity for students to participate in a systems type project run within the Department of Engineering; COMP4510 and COMP4530 together form a complete software engineering project of similar scale overall.

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 including (monitoring, measuring, tracking, managing change) and ultimately close out the project, will be achieved during COMP4520 or COMP4530. 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 for the COMP4510/COMP4520 combination, and 1500–2500 person hours for the COMP4510/COMP4530 combination.

Software Engineering Team Project II **COMP4520**
(6 units)

To be done as part of the combination COMP4510, COMP4520 and ENGN4221 which together represent an alternative to the more software-oriented combination of COMP4510 and COMP4530.
Second Semester
As many review meetings as required plus a nominal allocation of 12 hours per week

Prerequisites: Enrolment in BEng, and completion of COMP4510.

Incompatible with COMP3100, COMP4530
Syllabus: This project course completes the second part of the requirements for a software engineering team of 3–5 students to undertake a self-contained software project supervised by an academic. The work of this course is to be an enactment of the project plans de-

veloped by the team as part of COMP4510. The ultimate completion of the COMP4510-COMP4520 pair will be a software product developed according to a customer's requirements. The type of customer that may be involved is described within the COMP4510 handbook entry.

Much of the work associated with this course parallels that of COMP4530. However, COMP4520 project work will typically be limited to 1000–1600 person hours.

Software Engineering Team Project **COMP4530** **(12 units)**

To be done as part of the combination COMP4510 and COMP4530 which together represent an alternative to the combination of COMP4510, COMP4520 and ENGN4221.

Second Semester

As many review meetings as required plus a nominal allocation 24 hours per week

Prerequisites: Enrolment in BEng, and completion of COMP4510.

Incompatible with COMP3100, COMP4520, ENGN4221.

Syllabus: In combination with COMP4510, this course represents the capstone for the BEng degree and as such, is intended to provide students the opportunity to apply the knowledge and skills that they have learned in the previous three years concerning all aspects of the software development lifecycle.

At the commencement of COMP4510, students will have been 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. 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 1500–2500 person hours in terms of effort.

Advanced Algorithms **COMP4600** **(6 units) Group C**

Second semester

Twenty-six one-hour lectures, together with occasional seminars

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

Syllabus: This unit 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.

Computer Graphics **COMP4610** **(6 units) Group C**

First semester

Twenty-six one-hour lectures and six two-hour laboratory classes

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 familiarise 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 unit will include some practical experience of graphical software environments such as OpenGL, VRML and Java3D.

Machine Learning and Data Mining **COMP4620** **(3 units) Group C**

Second semester

Fourteen one-hour lectures

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

Syllabus: This unit 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.

Applications of Logic in Computing **COMP4630** **(6 units) Group C**

Not offered in 2002

Thirty one-hour lectures, five one-hour tutorials and five two-hour laboratory sessions

Prerequisites: 24 units of 3000-level COMP courses including COMP3610 and 6 units of 2000-level Mathematics or Mathematical Statistics courses

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 unit 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 unit 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

Topics in Software Engineering II **COMP4700** **(3 units) [Not grouped for BSc]**

First and second semesters

Contact hours as appropriate

Prerequisites: Written approval of Head of Department of Computer Science. Enrolment in Bachelor of Software Engineering, and a minimum of 24 units of 3000-series COMP, INFS or ENGN courses.

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 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.

Topics in Software Engineering III **COMP4710** **(6 units) [Not grouped for BSc]**

First and second semesters

Contact hours as appropriate

Prerequisites: Written approval of Head of Department of Computer Science. Enrolment in Bachelor of Software Engineering, and a minimum of 24 units of 3000 or 4000-series COMP, INFS or ENGN courses.

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 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.

Industrial Experience

COMP4800
(0 units)

First and second semesters

Prerequisites: Enrolment in BSEng and COMP3100.

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 December in order to graduate at the ceremony the following April.)

Engineering

M. Green, BSc (Hons) *NSW*, PhD *ANU*
Senior Lecturer and 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 which 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 which are currently the world's 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 rubber-toughened polymer alloys in collaboration with researchers in Japan.

The volatile environment faced by organisations today presents managers with continual challenges. Yet few managers understand the nature and impact of variation. The Department's Variation and Management Group carries out research, development work with industry and educational programs aimed at enhancing the capacity of organisations to understand variation and to achieve organisational goals under variable conditions. Industry-based Masters students form a significant part of the research effort.

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, 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 Web site at <http://engn.anu.edu.au>

Course Descriptions

Discovering Engineering

ENGN1211
(6 units)

First semester
 12 discovery/design classes (2 hours), 24 lectures and 12 tutorials

Convener: Dr Green

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

Incompatible: COMP2200, ENGN1021

Syllabus: The course introduces engineering using a discovery/design project supported by tutorial discussions, readings, lectures and seminars, which are directed towards beginning the process of developing in students a range of graduate attributes relevant to contemporary professional engineering practice. These include: communication; teamwork; problem identification and formulation; systems design; an understanding of the social, cultural and environmental responsibilities of engineering practice; and an awareness of reflective and ethical professional practice.

Contemporary issues examined include: theories of technological change; gender and technology; technology, environment and sustainable development; deregulation and privatisation; workplace relations; occupational health and safety; risk; professionalism and ethics.

Technological systems examined include: telecommunications; information technology; energy; manufacturing; and aerospace.

Introduction to Materials

ENGN1215
(6 units)

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

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

Lecturer: Staff

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 pyroelectricity, solar cells. Materials in optical fibres, transparency, dispersion and IR absorption. Environmental degradation and corrosion of materials.

Electromechanical Technologies

ENGN1221
(6 units)

Second semester
 8 laboratory sessions (3 hrs), 24 lectures and 12 tutorials

Lecturer: Staff

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; basic telecommunications (including AM radio); laboratory technique (including notebook keeping); laboratory reporting and written technical communication; writing in a group.

Mechanical topics include: vector mechanics, statics and kinematics of planar and spatial rigid bodies, equivalent force systems, static equilibrium, static indeterminacy, friction, instant centres, and relative motion.

Electro-mechanical topics include: machine elements, linkages, gears, and feedback systems.

Chemistry Fundamentals **ENGN1225**
(3 units)

Second semester
Twenty-four lectures and twelve hours of tutorial/laboratory

Lecturer: Dr Angus

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

Incompatible: CHEM1014, CHEM1015, ENGN1022

Syllabus: Introduction to essential concepts of chemistry. Electronic structure and chemical bonding. Quantum mechanics and atomic spectroscopy. Reaction rates, Arrhenius equation, activation energy of chemical reactions. Chemical equilibrium, equilibrium constants, Le Chateliers Principle. Theories of acids and bases, strong and weak acids and bases, Ka and Kb calculation of pH and extent of hydrolysis. Thermochemistry, enthalpy and the First Law of Thermodynamics. Entropy and Gibbs free energy, the Second Law of Thermodynamics. Electrochemistry, calculation of electrode cell potentials, operation of batteries.

Modern Physics **ENGN1226**
(3 units)

Second semester
Twenty-four lectures and twelve tutorials

Lecturer: Professor Bachor

Prerequisite: ENGN1101

Incompatible: PHYS1001, ENGN1020, PHYS1201

Syllabus: Introduction to modern physics including waves, optics, quantum mechanics and solid state physics.

Electronic Circuits and Devices **ENGN2211**
(6 units)

First semester
Twenty-four lectures and thirty-two hours of laboratory work.

Lecturer: Dr James

Prerequisites: ENGN1221

Syllabus: This course provides an introduction to the analysis and design of electronic systems. 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, canonical

forms, modular components. PSpice computer lab tutorials, hardware labs.

Mechanics of Materials **ENGN2214**
(6 units)

First semester

Lecturer: Dr Stachurski

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 shear 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.

System Dynamics **ENGN2221**
(6 units)

Second semester

Lecturer: Dr Kalyanasundaram

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

Syllabus: This course covers the dynamics of systems. First, we apply Newton's laws to mechanical systems, work-energy and impulse-momentum. Secondly, Lagrange's approach to dynamic equations of motions is developed and applied to a wide variety of practical engineering systems including electrical, electromechanical and vibration systems. An introduction to basic machine elements not covered earlier. Lastly, an introduction to discrete event dynamics, with special attention to their use in logistics, resource management and planning.

Thermal Energy Systems **ENGN2222**
(6 units)

First semester

Lecturer: Dr 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 fluid dynamics. The course also introduces the second law of thermodynamics, the theory of heat transfer, and AC power principles.

Signals and Systems **ENGN2223**
(6 units)

Second semester

Thirty-six lectures, eight tutorials and eight laboratory sessions (2 hours)

Lecturer: Staff

Prerequisite: 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.

Electronics **ENGN2224** **(6 units)**

Second semester

Lecturer: Professor Blakers

Prerequisite: ENGN2211

Syllabus: Design of electronic circuits. Design tradeoffs in simple amplifier design. Field-effect transistors and a miscellany of other electronic devices. Some further device physics and experimental testing of models. Computer aided-analysis of electronic circuits. Theoretical analysis of amplifier frequency response. Basic digital electronics components. Combinatorial circuit design. Flip-flops and simple state machine design.

System Design **ENGN2225** **(6 units)**

Second semester

Prerequisites: ENGN1211, ENGN1221

Convener: Staff

This course aims to introduce methods and techniques required for a systems approach to design. This will require the 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) and FMEA methods. The concepts and techniques covered will be illustrated with example cases, simulation models and applied to an ongoing systems design problem.

Investment Decisions & Financial Systems **ENGN3211** **(6 units)**

First semester

Lecturers: Dr Logan and Dr Shailer

Prerequisite: 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.

Manufacturing Technologies **ENGN3212** **(6 units)**

First semester

Lecturer: Staff

Prerequisite: ENGN2214 (or corequisite)

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.

Digital Systems and Microprocessors **ENGN3213** **(6 units)**

First semester

Twenty-four lectures and thirty-two hours of laboratory work

Lecturer: Dr James.

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.

Telecommunication Systems **ENGN3214** **(6 units)**

First semester

Twenty-six lectures, twelve tutorials and ten hours of laboratory

Lecturer: Dr Abhyapala

Prerequisite: 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:

(a) 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).

(b) Partial digital systems: PAM, PCM, DPCM, Delta Modulation; TDM and TDMA; Frame synchronisation. Telephone systems (TDM); Digital Satellite systems (TDMA).

(c) 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.

(d) Simple network concept: Telephone network, packet switch and circuit switch, simple concept of ISDN, ATM for optical fibre network. How does your telephone work? How does the mobile base-station find moving mobile phone user? (Visit Telstra Tower (Mechanic switch)).

(e) Key problems of all these systems: bandwidth, noise performance, delay, cost, and environment. The key information theoretic limitations.

(f) The role of telecommunications in the discipline of systems engineering and in society more generally.

Project & Operations Management **ENGN3221**
(6 units)

Second semester

Coordinator: Dr Cardew-Hall

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

Syllabus: Introduction to the organisation and management of a business. The techniques covered apply to both ongoing operations and finite length projects.

Topics covered include: business organisation, strategic planning and goals; market research; small business operation and business planning; production management systems including just-in-time techniques; work measurement; total quality management; forecasting; inventory control; materials requirements planning; scheduling and control; facility location; project control; CPM and PERT methods; critical path analysis; staff planning and motivation.

Developing a project plan for the final year individual project will provide a context for students engaging with the subject and applying some of the ideas discussed.

Manufacturing Systems **ENGN3222**
(6 units)

Second semester

Lecturer: Dr Lowe

Prerequisite: 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 technology, 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.

Control Systems **ENGN3223**
(6 units)

Second semester

Lecturer: Dr Mahony

Prerequisites: ENGN2223

Syllabus: Introduction to control system analysis, design and implementation. Laboratory project work involving embedded microprocessor control of an electromechanical system provides a context for students to engage in the subject. The laboratory work will be supported by lectures, resource materials and tutorial discussion. Topics include: History, purpose, applications and classification of control systems; control objectives including stability, regulation, and tracking; root locus design of PI, PD and PID controllers; Bode diagrams and the Nyquist stability criterion; specification of transducers, basic types of transducers and their selection; embedded microprocessors and interfacing them with other systems.

Energy Systems Engineering **ENGN3224**
(6 units)

Second semester

Lecturer: Dr 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 fluid dynamics. It continues with a thorough examination of the second law of thermodynamics, emphasising exergy analysis, and heat transfer. Also included are quantitative economic and environmental analysis of design choices and thermo-economic optimisation (energy systems engineering).

Power Electronics **ENGN3225**
(6 units)

Second semester

Lecturer: To be advised

Prerequisite: 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.

Digital Communications **ENGN3226**
(6 units)

Second semester

Convener: Ms Jones

Prerequisite: ENGN3214

Incompatible: ENGN4504

Syllabus: Random process. Structure and definition of digital communications systems. Complex envelope representation of bandpass signals and systems. Sampling theory and Nyquist criterion. Matched filters and correlator. Basic digital modulation techniques (ASK, MPSK, FSK, and MSK). Performance analysis and power spectra calculation for basic digital modulation techniques. Band-limited channels and equalisation. Fundamentals of information theory. Basics of linear block codes and convolutional codes. Maximum a posteriori detection (MAP), maximum likelihood detection (MLSD) and the Viterbi algorithm (VA).

Practical Experience **ENGN4005**
(0 units)

Second semester

Coordinator: Dr Stachurski

Prerequisites: Completion of Year 3

Syllabus: Twelve weeks of suitable full-time employment, a requirement which 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.

Individual Project **ENGN4200** (12 units)

First semester

Coordinator: Dr Cardew-Hall

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

Incompatible: ENGN4000, ENGN4700

Syllabus ; Students undertake a self-contained engineering project supervised by a member of Faculty. The project is normally based on the project plan developed by the student as part of ENGN3221. This course is the 'project execution' phase. Students are required to (i) give a seminar describing their project and progress; (ii) give a demonstration at the end of semester; and (iii) write a thesis documenting the project.

Engineering Law **ENGN4611** (6 units)

Second semester

Lecturer: Mr Flynn

Prerequisite: 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.

Systems Engineering Project **ENGN4221** (6 units)

Second semester

Coordinator: To be advised

Prerequisite: 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.

Engineering Materials **ENGN4601** (6 units)

Second semester

Prerequisite: ENGN2214

Syllabus: This subject develops a knowledge of the variety, properties and characteristics of engineering materials. Equilibrium phase diagrams and kinetic TTT diagrams for predicting microstructure in

materials. Properties of cast irons, carbon steels, alloy steels, light alloys, other useful non-ferrous metals. Toughening mechanisms for materials. Ceramic materials, glass ceramics and glasses; forming of ceramics; structure and defects in ceramics. Synthesis, characterisation, structure and properties of polymers; polymer processing. Rubber elasticity. Fibre reinforced composites, glass and carbon fibres, fabrication of composites.

Semiconductor Technology **ENGN4507** (6 units)

First semester

Coordinator: Dr Cuevas/Professor Blakers

Prerequisite: 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.

Communication Networks **ENGN4535** (6 units)

Second semester

Prerequisites: ENGN3226

Convener: Staff

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.

Mobile Communications **ENGN4536** (6 units)

First semester

Prerequisites: ENGN3226

Convener: Ms Jones

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.

Robotics **ENGN4627** (6 units)

First semester

Lecturer: Staff

Prerequisite: ENGN2221 and ENGN3223

Syllabus: An introduction to robotics and spatial mechanics including some hands-on laboratory experience. Theory focusses on problems of kinematics and dynamics that are fundamental to the operation, design and control of robot arms: homogeneous coordinate transformations, spatial orientation representations, Denavit-Hartenberg link descriptions, forward and inverse kinematics, Jacobian rate and static force relations, singularities, recursive Newton-Euler and Lagrange dynamics algorithms and trajectory planning.

Composite Materials

ENGN4511
(6 units)

First semester

Lecturer: To be advised

Prerequisite: 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.

Digital Signal Processing

ENGN4512
(6 units)

First semester

Coordinator: Staff

Prerequisite: 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.

Finite Element Analysis

ENGN4615
(6 units)

First semester

Lecturer: Dr Kalyanasundaram

Prerequisite: ENGN2214

Incompatible: ENGN4515, ENGN4527

Syllabus: The subject introduces finite element analysis. Topics covered include principles of virtual work and energy methods for stress analysis; derivation of stiffness matrices for one dimensional problems, plane stress and plane strain problems, axisymmetric problems and general three dimensional continuum elements; solution methods, effect of mesh densities and convergence criteria; variational approach for finite element formulation; use of commercial finite element software; application of finite element analysis to problems in solid mechanics and steady-state field problems.

Sustainable Energy Systems

ENGN4516
(6 units)

First semester

Coordinators: Dr Cuevas.

Syllabus: The subject begins with a summary of Australia's energy usage patterns and then moves on to look at the environmental and social aspects of energy usage. Particular attention is given to greenhouse policy and restructuring of the electricity market. At a more technical level, the combined thermodynamic and economic approach to optimisation introduced in Energy Systems Engineering is reinforced and extended. All these concepts are applied to an examination of a broad range of energy technologies. A field trip to a range of energy system sites is included.

Semiconductor Materials and Devices

ENGN4519
(6 units)

Second semester

Coordinators: Dr Cuevas and Dr Blakers

Prerequisite: ENGN2224 and ENGN2215

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; optoelectronic devices; bipolar devices; field effect devices.

Special Topics in Engineering 1

ENGN4520
(6 units)

Prerequisite: 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. Entry will be at the discretion of the Head of Engineering.

Special Topics in Engineering 2

ENGN4521
(6 units)

Prerequisite: 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. Entry will be at the discretion of the Head of Engineering.

Special Topics in Engineering 3

ENGN4522
(6 units)

Prerequisite: 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. Entry will be at the discretion of the Head of Engineering.

Special Topics in Engineering 4

ENGN4523
(6 units)

Prerequisite: 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. Entry will be at the discretion of the Head of Engineering.

Solar Energy Technologies

ENGN4524
(6 units)

Second semester

Coordinator: Dr Cuevas

Prerequisites: ENGN3224, ENGN2224

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.

Optimal Filtering and Control Systems **ENGN4526**
(6 units)

First semester

Lecturer: To be advised

Prerequisites: ENGN3223

Syllabus: This course provides an introduction to modern state-space and optimal control methods in the setting of discrete-time systems. Topics include: state-space models, controllability, observability and minimality; pole placement by state feedback; the linear quadratic regulator; observers, state-estimation and the Kalman filter; and linear quadratic gaussian (LQG) controller design.

Computer Vision **ENGN4528**
(6 units)

Second semester

Coordinator: Staff

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.

Engineering and Public Policy **ENGN4530**
(6 units)

Second semester

Lecturer: Dr Green

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, aerospace.

Logistics and Operations Research **ENGN4532**
(6 units)

Second semester

Coordinator: Dr Newell

Prerequisite: 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, queueing theory, discrete event simulation, system dynamics, task networks and work flow, and the impact of variation.

Biomedical Engineering **ENGN4533**
(6 units)

First semester

Twenty lectures, nine tutorials and eight hours of laboratory.

Coordinators: Mr Dwyer, Mr Lising and Dr Lowe

Prerequisites: ENGN3223

Syllabus: This course aims to place biomedical engineering in a systems context and to introduce anatomy, physiology, biocompatibil-

ity, biological signal analysis, biomaterials, medical radiation, patient safety and medical device regulation using a case-study approach.

