ANU College of Engineering & Computer Science

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Introduction

The ANU College of Engineering and Computer Science (CECS) is comprised of the Research School of Engineering and the Research School of Computer Science, each responsible for degrees in the engineering and computing disciplines. The College has over 1,400 students enrolled including about 1,000 undergraduate students. Our degrees draw upon the extensive expertise and cutting-edge research activities of our staff and take advantage of the interdisciplinary nature of the University's research strengths in information and computing science, engineering, and related mathematical and physical sciences. In addition to the internationally renowned staff in the College, students have access to world class laboratories and computing facilities.

College Student Office

The College Student Services Office can be found on Level 2, N202 of the CSIT Building (Bldg No 108). Opening hours are 9am to 5pm Monday to Friday. A Student Advisor is available to provide information and assistance in person or you can email Student Services at: www.student.services@cecs.anu.edu.au

In addition to this support, each Research School has an Associate Director (Education) and Program Advisers to provide advice on academic matters. Appointments with theses staff can be made at the relevant School office:

Research School of Engineering
Level 2, Ian Ross Building (Bldg 31)

Research School of Computer Science
Level 3, Computer Science Building (Bldg 108)

Programs for outstanding students

The College offers the following programs for outstanding students:

> Bachelor of Advanced Computing (Research and Development)

> Bachelor of Engineering (Research and Development)

Further information is available from: www.cecs.anu.edu.au/rdprograms

Women in Technology

The College is committed to encouraging more women to enrol in its programs and to ensuring its programs are conducted in a manner that respects and values women's interest, experience and learning styles. The College operates a women's network and offers a number of scholarships to female students. Further information is available from the College Student Office.

Combined degrees

In addition to the programs listed within the College handbook entry, combined degree programs are available in a number of areas. These are listed in the table below and more information can be found in the Combined Program section at the end of the Handbook. Approximately 40 per cent of students in the College study combined programs.

Accreditation

The Bachelor of Engineering and the Bachelor of Software Engineering programs are accredited to the appropriate level with Engineers Australia. The Bachelor of Engineering (Research and Development) received provisional accreditation in 2010. The Bachelor of Software Engineering and the Bachelor of Information Technology program are accredited with the Australian Computer Society. It is intended to apply for accreditation of the Bachelor of Advanced Computing (Research and Development) and Bachelor of Advanced Computing in the near future.

Status

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

Undergraduate programs offered:

Program	Usual program duration (yrs)
Bachelor of Advanced Computing (Research and Development)	4
Bachelor of Engineering (Research and Development)	4
Bachelor of Engineering	4
Bachelor of Advanced Computing	4
Bachelor of Software Engineering	4
Bachelor of Information Technology	3
Bachelor of Engineering (Research and Development)/Bachelor of Science	5
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 Advanced Computing (Research and Development)/Bachelor of Science	5
Bachelor of Advanced Computing/Bachelor of Science	5
Bachelor of Arts/ Bachelor of Information Technology	4
Bachelor of Business Administration/Bachelor of Information Technology	4
Bachelor of Commerce/Bachelor of Information Technology	4
Bachelor of Economics/Bachelor of Information Technology	4
Bachelor of Information Technology/Bachelor of Laws	5
Bachelor of Software Engineering/Bachelor of Science	5
Bachelor of Software Engineering/Bachelor of Commerce	5

Engineering

Associate ProfessorThushara Abhayapala,
BEng (Hons), PhD, *ANU*
Director, Research School of Engineering

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. Engineering is also vital to wealth creation and the economic well-being of nations and has a responsibility to consider sustainability and solve our environmental problems. These issues are addressed throughout the Bachelor of Engineering (BE) degree program.

A strength of the degree programs offered by the Research School of Engineering is its research areas, which are reflected in the majors and minors offered in the BE program. One of the forefront areas is renewable energy research, with a particular interest in photovoltaic solar cells, semiconductor and solar thermal technology. The ANU 'Big Dish' is the largest of its kind in the world. The School's solar academic groups hold several world records for solar cell efficiency. It is also developing a unique thermochemical solar energy system. The School has strong links with industry and several technologies are being commercialised.

The School's materials and manufacturing group conducts research in specialised areas of advanced materials, such as fibre-reinforced composites and composite-metal hybrid materials, nanofibres, piezoelectric materials, bulk amorphous metals and theory of materials. Materials research is integrated with manufacturing in order to understand and improve advanced processing technologies for these materials. Many projects are industrially focused with major elements of the work carried out at the collaborating company's site. This provides a healthy cross fertilisation between the School and some of Australia's largest manufacturing companies.

Mechatronic engineering is associated with the analysis and design of electro-mechanical devices that typically include a computer system to provide a level of programmability or `intelligence'. The systems based focus of the Research School of Engineering provides a strong foundation for a discipline that involves integration of skills in electronics, mechanical and computer engineering tied together by dynamical and control systems analysis.

Electronics and Communication Systems major is closely aligned to the School's research groups in Signal Processing, Computer Vision and Systems and Control. These groups are developing methods to solve problems in application areas such as wireless communications, biomedical engineering including medical image analysis, multimedia, surveillance, bio-security, swarms and multi-agent systems and quantum control systems.

The Research School of Engineering offers a four-year, Engineers Australia accredited Bachelor of Engineering degree program, a four-year Bachelor of Engineering degree program with a Research and Development emphasis (currently being accredited), one-year and two-year Masters of Engineering (see the College of Engineering and Computer Science entry), as well as Master of Philosophy and PhD degree programs. The School has active collaborations with a wide range of other ANU Schools and Colleges including the College of Physical and Mathematical Sciences, College of Business and Economics, the Fenner School of Environment and Society, as well as CSIRO, NICTA and DSTO. The School has strategic collaborative research relationships with organisations including Ford Australia, Canon, Origin Energy, Rheem, Toll Logistics, and Microsoft. The School also undertakes research as a partner in the Automotive Cooperative Research Centre (AutoCRC). Graduates are employed in a wide range of organisations and companies both in Australia and overseas. Undergraduate scholarship support from ANU Enterprise is gratefully acknowledged. The School engages in a number of activities with Engineers Without Borders (EWB).

The Research School of Engineering spans across three buildings which 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 School's website at http://eng.anu.edu.au

Bachelor of Engineering (Research and Development)

(Academic Program: 4714 | Academic Plan: 4714HBENG)
Duration: 4 years full-time
Minimum: 192 units
CRICOS Code: 060542F

This program is specifically designed for students who have an interest in undertaking research and development in either industry or an academic environment. The program combines the unique systems engineering focus of the ANU Bachelor of Engineering degree with a more project based, research intensive study mode, also unique to ANU. Students undertake a number of research projects in different research groups at ANU or an associated industry partner in order to obtain a flavour of research in the discipline areas and develop independent research skills.

Students also complete an engineering specialisation which will complement the R&D specialisation. Thus this program produces Professional Engineering graduates who have the skills, knowledge and capability to go onto advanced research programs.

The ANU BE (R&D) program produces graduates that will demonstrate the following generic attributes, as required for professional accreditation by Engineers Australia (EA). The attributes are mapped to the EA stage 1 competencies that must be demonstrated for accreditation.

- a sound and broad knowledge of basic science and engineering; (Competencies PE1 and PE2)
- the ability to communicate effectively with engineers and the general public; (PE1-PE3)
- in-depth discipline knowledge; (PE1)
- common sense, scientific and engineering knowledge to identify, formulate and solve problems; (PE1-PE3)
- a systems approach to engineering analysis, design, operation and management; (PE1-PE3)
- the ability to contribute to a multidisciplinary and multicultural team; (PE1-PE3)
- awareness of the social, cultural, global, environmental, legal and business aspects of engineering, including a commitment to the principles of sustainable development; (PE3)
- an understanding of the responsibilities of an inclusive and socially aware engineering professional, including a commitment to the Engineers Australia Code of Ethics, life-long learning and continuing professional development. (PE3)

In particular, The BE (R&D) program articulates and emphasises creativity and innovation attributes (PE3.3), as follows:

- a higher level of cognitive and creative development than in standard degree programs;
- an understanding of the approaches required for higher degree research.

Program requirements

The Bachelor of Engineering (Research and Development) requires completion of 192 units of which:

- A maximum of 60 units from completion of 1000 level courses;
- A minimum of 132 units from completion of 2000, 3000 or 4000 level courses.

The 192 units must include:

- 66 units from completion of compulsory courses:
  - ENGN1211 Discovering Engineering
  - ENGN1215 Engineering Science
  - ENGN1217 Introduction to Mechanics
  - ENGN1218 Introduction to Electronics
  - ENGN2217 Mechanical Systems and Design
  - ENGN2218 Electronic Systems and Design
  - ENGN2225 Systems Engineering Design
  - ENGN2226 Systems Engineering Analysis
  - ENGN3100 Practical Experience (0 unit)
  - ENGN3211 Investment Decision and Financial Systems
  - ENGN3221 Engineering Management
  - ENGN4611 Engineering Law
- 24 units from completion of core courses from the following list:
  - COMP1730 Programming for Scientists or COMP1100Introduction to Programming and Algorithms
  - MATH1115 Mathematics and Applications 1(Honours) and
  - MATH1116 Mathematics and Applications 2(Honours)
  - PHYS1101 Advanced Physics 1
- 36 units from completion of Research and Development project based courses:
  - ENGN2706 R&D Project (Methods)
  - ENGN3712 R&D Project (12 unit)
  - ENGN4718 R&D Project (18 unit)
- 36 units from completion of one of the following Engineering majors;
- (Note - Majors are 48 units with12 units accounted for in the compulsory requirements above)
- 30 units from completion of elective courses which may be offered by the ANU College of Engineering and Computer Science or by another ANU College.

Major List:

Electronic and Communication Systems
Mechanical and Material Systems
Mechatronic Systems
Photonic Systems
Renewable Energy Systems

Minor List:

Electronic and Communication Systems
Mechanical and Material Systems
Mechatronic Systems
Photonic Systems
Renewable Energy Systems

To remain enrolled in the degree, students must maintain an average mark of 80 percent in ENGN courses each semester with the understanding that the School can waive this at its discretion. Students deemed not to be performing at an appropriate level will be able to transfer to the Bachelor of Engineering program, with appropriate status granted for courses successfully completed.

The Degree with Honours

Students must formally enrol in ENGN4100 Engineering Honours, at the commencement of their intended final semester. Graduation from the Bachelor of Engineering (Research and Development) program will require award at 1st class honours level:

H1 80–100 per cent.

Combined degrees

The BE (Research and Development) can be combined with the Bachelor of Science. This is a 5 year program comprising 240 units.

Degree Structure

Courses	
Year 1 48 units	ENGN1211 ENGN1215 MATH1115 PHYS1101
	COMP1730 ENGN1217 ENGN1218 MATH1116
Year 2 48 units	ENGN2217 ENGN2218 ENGN2225 Elective Course (6u)
	ENGN2226 ENGN2706 Major Course (6u) Elective Course (6u)
Year 3 48 units	ENGN3211 R&D Project (12u) Major Course (6u)
	ENGN3221 Major Course (6u) Major Course (6u) Elective Course (6u)
Year 4 48 units	R&D Project (18u) Elective Course (6u)
	ENGN4611 Major Course (6u) Major Course (6u) Elective Course (6u)

Bachelor of Engineering

(Academic Program: 4700 | Academic Plan: 4700XBENG)
Duration: 4 years full-time
Minimum: 192 units
CRICOS Code: 001691D

The ANU Bachelor of Engineering (BE) degree is a four-year undergraduate program accredited by the national professional body, Engineers Australia. Its main aim is to prepare students for successful careers as professional engineering managers, designers, analysts, educators and researchers.

The BE program is characterised by an interdisciplinary systems approach to engineering that will enable graduate engineers to solve the engineering problems of the future. The traditional areas of electrical and mechanical engineering provide the foundations to this approach, and a compulsory core of courses in engineering systems provides the skills and techniques for complex problem solving. This is supplemented by project work on real-life engineering problems. Courses in engineering management, finance and law are also included to produce well-rounded and multi-skilled engineering professionals.

The ANU Engineering program is also underscored by technological trends that cut across the boundaries that typically exist between the traditional disciplines of engineering. These trends are reflected by the engineering majors and minors. They provide students with an opportunity to specialise in an area of strength or interest. The majors and minors also reflect the research activity in the Research School of Engineering and are, therefore, an opportunity to engage with the cutting-edge areas that contribute to the University's reputation for research-intensive education. The engineering majors and minors currently offered are in the areas of:

> electronic and communication systems
> mechanical and material systems
> mechatronic systems
> photonic systems
> renewable energy systems

A major or minor in sustainable systems is also possible through selection of engineering courses along with specified courses from the ANU Fenner School of Environment and Society .

The ANU BE program produces graduates that will demonstrate the following generic attributes, as required for professional accreditation by Engineers Australia (EA). The attributes are mapped to the EA stage 1 competencies that must be demonstrated for accreditation.

> a sound and broad knowledge of basic science and engineering; (Competencies PE1 and PE2)
> the ability to communicate effectively with engineers and the general public; (PE1-PE3)
> in-depth discipline knowledge; (PE1)
> common sense, scientific and engineering knowledge to identify, formulate and solve problems; (PE1-PE3)
> a systems approach to engineering analysis, design, operation and management; (PE1-PE3)
> the ability to contribute to a multidisciplinary and multicultural team; (PE1-PE3)
> awareness of the social, cultural, global, environmental, legal and business aspects of engineering, including a commitment to the principles of sustainable development; (PE3)
> an understanding of the responsibilities of an inclusive and socially aware engineering professional, including a commitment to the Engineers Australia Code of Ethics, life-long learning and continuing professional development (PE3).

These attributes are engendered by the program structure that includes compulsory courses in basic science, engineering fundamentals, systems engineering, management, finance and law. The program of study is the same for all students in the first year, with specialisation starting in year 2 through the selection of courses from the list of engineering electives towards one or more of the majors and minors. The teaching and assessment processes throughout the program also serve to develop the attributes listed above. There is a significant amount of project and design work, small-group teaching that encourages collaborative learning and problem solving, and practical laboratory work. The importance of written and oral communication is also emphasised.

The final year of the program is characterised by a systems engineering group project and an individual project. The systems engineering group project is a capstone course that addresses a problem relevant to industry. It is an opportunity for students to apply the knowledge gained throughout their BE program and simulates as far as possible the experience of functioning as an engineer after graduation. The individual project is an opportunity for in-depth study in an area of interest with a research supervisor, and will foster individual attributes such as creativity, innovation and the ability to personally manage an engineering project.

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

An Engineering Internship program is also available for selected students. This is an opportunity to spend 3 or 6 months full-time in industry and gain real-life experience as an engineer. It is viewed by the School as an increasingly important part of professional engineering education. A flexible curriculum and assessment scheme has been designed for the internship program so that it can be integrated into the BE program. This means students can receive full credit for their internship and gain valuable experience without delaying their graduation.

For more details please visit the Bachelor of Engineering Homepage: http://cecs.anu.edu.au/students/future/undergrad/BEng

Program requirements

The Bachelor of Engineering requires the completion of 192 units of which:

> A maximum of 60 units from completion of 1000 level courses;
> A minimum of 132 units from completion of 2000, 3000 or 4000 level courses.

The 192 units must include:

> 90 units from completion of compulsory courses:
  - ENGN1211 Discovering Engineering
  - ENGN1215 Engineering Science
  - ENGN1217 Introduction to Mechanics
  - ENGN1218 Introduction to Electronics
  - ENGN2217 Mechanical Systems and Design
  - ENGN2218 Electronic Systems and Design
  - ENGN2219 Computing for Engineering Simulation
  - ENGN2225 Systems Engineering Design
  - ENGN2226 Systems Engineering Analysis
  - ENGN3100 Practical Experience (0 unit)
  - ENGN3211 Investment Decision and Financial Systems
  - ENGN3221 Engineering Management
  - ENGN4200 Individual Project (12 units)
  - ENGN4221 Systems Engineering Project
  - ENGN4611 Engineering Law

> 24 units from completion of core courses from the following list:
  - COMP1730 Programming for Scientists or COMP1100 Introduction to Programming and Algorithms
  - MATH1013 Mathematics and Applications 1 or MATH1115 Mathematics and Applications I Honours
  - MATH1014 Mathematics and Applications 2 or MATH1116 Mathematics and Applications II Honours
  - PHYS1101 Advanced Physics I

> 36 units from completion of one of the following Engineering Majors:
> Note - Majors are 48 units with12 units accounted for in the compulsory requirements above
> 6 units from completion of an Engineering elective course offered by the Research School of Engineering;
> 36 units from completion of elective courses which may be offered by the ANU College of Engineering and Computer Science or by another ANU College.

Engineering Majors

The Research School of Engineering offers five engineering majors requiring 48 units of specified courses. Students must complete at least one engineering major. Students should note that all completed majors will be listed on their academic transcript.

Major List:

Electronic and Communication Systems
Mechanical and Material Systems
Mechatronic Systems
Photonic Systems
Renewable Energy Systems

Minor List:

Electronic and Communication Systems
Mechanical and Material Systems
Mechatronic Systems
Photonic Systems
Renewable Energy Systems

Elective courses

The 36 units of elective courses may be used to study another Engineering major or minor or, elective courses offered by another ANU College. In collaboration with the ANU Fenner School of Environment and Society, a Science major and minor, *Sustainable Systems* is offered for students with a keen interest in sustainable engineering.

Practical experience

Engineers Australia 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 the entry for ENGN3100 Practical Experience.

The Bachelor of Engineering degree with Honours

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

The awarding of honours in engineering is based on meritorious performance over the entire four-year program. The assessment of meritorious performance includes the calculation of an average percentage mark (APM), together with the consideration of the overall academic progress of the student and the ENGN4200 Individual Project result. To determine the global APM, the first year average mark is weighted by a factor of 0.1, and the combined average of years 2, 3 and 4 by a factor of 0.9.

The first year average mark is the average of the marks awarded in the following courses: ENGN1211 Discovering Engineering, ENGN1215 Engineering Science, ENGN1217 Introduction to Mechanics, ENGN1218 Introduction to Electronics, MATH1013 Mathematics and Applications 1 (or MATH1115), MATH1014 Mathematics and Applications 2 (or MATH1116), PHYS1101 Advanced Physics I, and COMP1100 Introduction to Programming and Algorithms.

The average mark for the remaining years is the average mark awarded in all the additional engineering courses (that is, having an ENGNxxxx code number) completed by the student, excluding ENGN4200 Individual Project, which is considered separately.

ENGN4100 Engineering Honours

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

Combined degrees

All Bachelor of Engineering combined degrees are 5 year programs comprising 240 units. The Bachelor of Engineering may be combined with:

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

Degree Structure

Courses	
Year 1 48 units	ENGN1211 ENGN1215 MATH1013[1] PHYS1101[2]
	COMP1730 ENGN1217 ENGN1218 MATH11014[1]
Year 2 48 units	ENGN2217 ENGN2218 ENGN2225 Elective Course (6u)
	ENGN2219 ENGN2226 Major Course (6u) Elective Course (6u)
Year 3 48 units	ENGN3211 Major Course (6u) Major Course (6u) Elective Course (6u)
	ENGN3221 Major Course (6u) Major Course (6u) Elective Course (6u)
Year 4 48 units	ENGN4200 ENGN4221 Major Course (6u) Elective Course (6u)
	ENGN4200 ENGN4611 Engineering Elective Courses (6u) Elective Course (6u)

[1] Students who have studied ACT Maths Methods or equivalent in Year 11/12 are advised to study MATH1003 prior to studying MATH1013 in S2 and MATH1014 in S1 the following year

[2] Students who have not studied Physics in Year 11/12 are advised to study PHYS1001.

Engineering Majors

Electronic and Communication Systems Major

This major requires the completion of 48 units which must include:

- ENGN1218 Introduction to Electronics
- ENGN2218 Electronic Systems and Design
- ENGN2228 Signal Processing
- ENGN3213 Digital Systems and Microprocessors
- ENGN3226 Digital Communications
- ENGN4536 Wireless Communications
- ENGN4537 Discrete Time Signal Processing
- ENGN4625 Power Electronics

Mechanical and Material Systems Major

This major requires the completion of 48 units which must include:

- ENGN1217 Introduction to Mechanics
- ENGN2217 Mechanical Systems and Design
- ENGN2222 Thermal Energy Systems
- ENGN3212 Manufacturing Technologies
- ENGN3601 Engineering Materials
- ENGN4420 Sustainable Product Development
- ENGN4511 Composite Materials
- ENGN4615 Finite Element Analysis

Mechatronic Systems Major

This major requires the completion of 48 units which must include:

- ENGN1218 Introduction to Electronics
- ENGN2218 Electronic Systems and Design
- ENGN3213 Digital Systems and Microprocessors
- ENGN3223 Control Systems
- ENGN3331 System Dynamics
- ENGN4528 Computer Vision
- ENGN4627 Robotics
- MATH2305 Differential Equations and Applications

Photonic Systems Major

This major requires the completion of 48 units which must include:

- PHYS1101 Advanced Physics I
- PHYS1201 Advanced Physics II
- PHYS2017 Waves and Optics
- ENGN3334 Semiconductors
- ENGN3512 Optical Physics
- ENGN4513 Fibre Optic Communication Systems
- ENGN4524 Photovoltaic Technologies
- ENGN4613 Micro, Bio and Nanophotonics

Renewable Energy Systems Major

This major requires the completion of 48 units which must include:

- ENGN1218 Introduction to Electronics
- ENGN2218 Electronic Systems and Design
- ENGN2222 Thermal Energy Systems
- ENGN3224 Energy Systems Engineering
- ENGN3334 Semiconductors
- ENGN4516 Energy Resources and Renewable Technologies
- ENGN4524 Photovoltaic Technologies
- ENGN4525 Solar Thermal Technologies

Sustainable Systems Major

This major may be taken by Bachelor of Engineering students in addition to an Engineering major.

This major requires completion of 48 units which must include:

- ENVS2011 Human Ecology
- ENVS2015 GIS and Spatial Analysis
- ENVS2012 Sustainable Systems: Urban OR ENVS3020 Climate Change Science and Policy
- ENVS3040 Solving Complex Environmental Problems
- ENGN3224 Energy Systems Engineering
- ENGN3410 Engineering Sustainable Systems
- ENGN4420 Sustainable Product Development
- ENGN4516 Energy Resources and Renewable Technologies

Engineering Science Major

This major may not be taken by Bachelor of Engineering or Bachelor of Engineering (Research and Development) students.

This major requires the completion of 48 units which must include:

> 24 units from completion of one of the following courses:
  - PHYS1101 Advanced Physics I
  - ENGN1215 Engineering Science
  - ENGN1217 Introduction to Mechanics
  - ENGN1218 Introduction to Electronics

> 6 units from completion of one of the following courses:
  - ENGN2217 Mechanical Systems and Design
  - ENGN2218 Electronic Systems and Design

> 6 units from completion of 2000 level courses in the subject area of ENGN

> 12 units from completion of 3000 or 4000 level courses in the subject area of ENGN

Engineering Minors

Electronic and Communication Systems Minor

This minor requires the completion of 24 units which must include:

> 12 units from completion of the following compulsory courses:
  - ENGN2228 Signal Processing
  - ENGN3213 Digital Systems and Microprocessors

> 12 units from completion of core courses from the following list:
  - ENGN3226 Digital Communications
  - ENGN4536 Wireless Communications
  - ENGN4625 Power Electronics
  - ENGN4537 Discrete Time Signal Processing

Mechanical and Material Systems Minor

This minor requires the completion of 24 units which must include:

> 12 units from completion of the following compulsory courses:
  - ENGN2222 Thermal Energy Systems
  - ENGN3601 Engineering Materials

> 12 units from completion of core courses from the following list:
  - ENGN3212 Manufacturing Technologies
  - ENGN4420 Sustainable Product Development
  - ENGN4511 Composite Materials
  - ENGN4615 Finite Element Analysis

Mechatronic Systems Minor

This minor requires the completion of 24 units which must include:

> 12 units from completion of the following compulsory courses:
  - ENGN3213 Digital Systems and Microprocessors
  - ENGN3223 Control Systems

> 12 units from completion of courses from the following list:
  - ENGN3331 System Dynamics
  - ENGN4528 Computer Vision
  - ENGN4627 Robotics
  - MATH2305 Differential Equations and Applications

Photonic Systems Minor

This minor requires the completion of 24 units which must include:

> 12 units from completion of the following compulsory courses:
  - PHYS2017 Waves and Optics
  - ENGN3512 Optical Physics

> 12 units from completion of core courses from the following list:
  - PHYS2016 Electromagnetism
  - ENGN3334 Semiconductors
  - ENGN4513 Fibre Optic Communication Systems
  - ENGN4524 Solar Energy Technology
  - ENGN4613 Micro, Bio and Nanophotonics

Renewable Energy Systems Minor

This minor requires the completion of 24 units which must include:

> 12 units from completion of the following compulsory courses:
  - ENGN2222 Thermal Energy Systems
  - ENGN3334 Semiconductors

> 12 units from completion of core courses from the following list:
  - ENGN3224 Energy Systems Engineering
  - ENGN4524 Solar Energy Technologies
  - ENGN4516 Energy Resources and Renewable Technologies
  - ENGN4525 Solar Thermal Technologies

Sustainable Systems Minor

This minor requires the completion of 24 units which must include:

> 12 units from completion of the following compulsory courses:
  - ENGN3410 Engineering Sustainable Systems
  - ENVS3040 Solving Complex Environmental Problems

> 12 units from completion of core courses from the following list:
  - ENGN4420 Sustainable Product Development
  - ENGN4516 Energy Resources and Renewable Technologies ENVS2011 Human Ecology
  - ENVS2015 GIS and Spatial Analysis
  - ENVS2012 Sustainable Systems: Urban
  - ENVS3020 Climate Change Science and Policy

Engineering Science Minor

This minor may not be taken by Bachelor of Engineering or Bachelor of Engineering (Research and Development) students.

This minor requires the completion of 24 units which must include:

> 6 units from completion of one of the following courses:
  - PHYS1101 Advanced Physics
  - ENGN1215 Engineering Science

> 6 units from completion of one of the following courses:
  - ENGN1217 Introduction to Mechanics
  - ENGN1218 Introduction to Electronics

> 6 units from completion of one of the following courses:
  - ENGN2217 Mechanical Systems and Design
  - ENGN2218 Electronic Systems and Design

> 6 units from completion of 2000 level courses in the subject area of ENGN

Associate Degree in Engineering

(Academic Program: 2700 | Academic Plan: 2700XADENG)
Duration: 2 years full-time
Minimum: 96 units
Articulation: To the Bachelor of Engineering
Coordinator: Douglas Lang, CIT; Dr Adrian Lowe, ANU
CRICOS Code: 056477M

This program will provide students with a strong practical base as well as the theoretical foundation required for studying engineering at university level. Two fields of engineering will be offered; mechanical and electronic. Students study university-type subjects while at CIT which provide graduates with the potential to progress to a Bachelor of Engineering degree at ANU with up to 72 units of status/advanced standing.

Entry Requirements

> An ACT Year 12 Certificate (or equivalent) with ACT Year 12 Mathematical Methods or Mathematical Applications, or

> Mature Age (turn at least 20 in first year of study). Refer to www.cit.act.edu.au/future/mature_age

and have relevant work or other practical experience and a demonstrated level of general education, which provides a reasonable chance of successfully completing the program.

NOTE: International students who have an IELTS rating of less than 6.5 who will be studying at ANU in the first year of the program, will be required to undertake additional English language study concurrently with their first semester of study.

Preference will be given to applicants who have an ACT Year 12 T-Major in physics or equivalent, and one or more of:

> other studies in chemistry and/or general science;

> related work experience, or are involved in recreational activities which demonstrate an interest in electronic or mechanical engineering.

Program Structure

For detailed program structure refer to the ANU website: http://studyat.anu.edu.au/programs/2700XADENG;overview.html

For program and course information about the CIT component please contact:

CIT Science, Forensic and Engineering Centre

Bruce Campus, Haydon Drive
Bruce
ACT 2601
CIT Student Services HUB

T 02 6207 3188
E douglas.lang@cit.act.edu.au

Further information requests about the ANU component should be directed to:

ANU College of Engineering and Computer Science
CSIT Building 108, North Road, ANU
ACT 0200

T 02 6125 4450
E student.services@cecs.anu.edu.au

Computer Science

Associate Professor Henry Gardner, BSc(Hons) Melbourne, Dip Comp Stud Melbourne, PhD ANU,
Reader and Director of School

How do people understand and use computers, computer networks, and the information they help us to manage? 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, general-purpose commodity computing of today, to the ubiquitous embedded computing and communication devices of the near future. The computing discipline has broadened to include the ways in which its professional graduates apply computing to the information needs and creative expression of people and organisations.

Information and Communications 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 ICT industry is now reckoned to be the world's largest. Although our School's name continues to refer to "Computer Science," it is a centre for the study of wider aspects of ICT: software engineering, which is the profession of designing and constructing large and complex software systems; information systems, which involves the ways in which computer systems are meshed with organisations; human-centred computing, which involves understanding and applying technology to human needs of creative expression; computer systems, the creative engineering and science of the support layers of computer technologies; artificial intelligence, the science and engineering of making intelligent machines, and computer science, the systematic study of the fundamental algorithms and processes underlying computing. The School provides professional and technical courses in these areas and introductory computing courses for students in other areas of the university.

School aims and objectives - programs offered

The School aims to produce graduates with technical, professional and fundamental scientific education via a number of programs, in the Bachelor of Information Technology, the Bachelor of Software Engineering, the Bachelor of Advanced Computing, the Bachelor of Advanced Computing (Research and Development), the Bachelor of Science majoring in Computer Science, and the Bachelor of Philosophy.

The Bachelor of Advanced Computing emphasises the development of knowledge and skills to prepare future leaders of the Information Communication Technology (ICT) revolution. It will produce graduates with technical knowledge honed by the study of a selection of advanced computing topics. Professional and practical skills in software development will be gained through a series of courses in software analysis, design and construction, capped off with a group software project. With professional skills developed in the areas of entrepreneurship and management, the graduate will be in a position to apply their in-depth technical knowledge to become innovators in industry.

The Bachelor of Advanced Computing (Research and Development) incorporates a Research and Development Major for intellectually ambitious students. Students learn the methodologies of research, undertake software engineering projects in the context of advanced computing and internships with leading-edge industry, and culminate their studies by a full research project. Both variants of the Bachelor of Advanced Computing may be combined with Science for a five-year degree of a truly interdisciplinary nature.

The Bachelor of Software Engineering program offers the technical and professional education, communications skills, and individual and group project work supported by a solid basis of computer science necessary to construct large complex software systems. Later-year courses and capstone projects in this program have a substantial component which is sourced from industry. A pass degree or a degree with Honours can be awarded after four years of study in this program. The program is accredited with both Engineers Australia and the Australian Computer Society, and can be combined with a Bachelor of Commerce or Bachelor of Science for a five-year combined program.

The School offers a three-year technical and professional program, the Bachelor of Information Technology. This program is accredited with the Australian Computer Society and B Inf Tech students can choose to major in software development or information systems. The B Inf Tech can also be combined with programs in Commerce, Economics or Business Administration for a four-year combined program that aims to provide a professional, business-oriented education. It can be combined with the Bachelor of Engineering for five years of study that includes substantial computing within a full, multidisciplinary Engineering program. It is also possible to combine the B Inf Tech with the Bachelor of Arts and the Bachelor of Laws.

The School aims to produce graduates with a fundamental scientific education via the Bachelor of Science majoring in Computer Science. Students taking this program can combine a study of a Science subject with as much computing as they wish or take combined Science programs such as Science and Law. Like the Bachelor of Advanced Computing (Research and Development), the Bachelor of Philosophy (Honours) is an innovative, research-focused program but is offered through the Colleges of Science. This program is extremely flexible in its structure and allows students to specialise in many areas of science, including computer science. For more details on these programs see the College of Science entry in the Handbook.

A fourth year of Honours study can be added to the B Inf Tech or BSc and first-class Honours graduates from these programs, and from the other four-year programs offered by the School, are eligible to enter postgraduate research studies at ANU and other leading computer-science departments worldwide.

The School offers three coursework Masters programs, the Master of Information Technology Studies, the Master of Computing and the Masters of Computing (Honours). These programs are accredited with the Australian Computing Society.

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

Introductory courses

The School offers several courses that can be taken by students with no previous background in computing or information technology. COMP1710 and COMP1720 are courses that introduce students to the development and generalised use of IT tools in new media. COMP1710 studies tools used for new media and the web, while COMP1720 deals with script-level programming in the context of new media. COMP1730 offers an introductory programming course for students from the sciences.

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, with a focus on the construction of 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 course can be used as part of a major in Commerce as well as contributing to Information Technology and Software Engineering programs.

Further information

Further information on the courses offered and the structures of the courses is available from the School's website at http://cs.anu.edu.au

Bachelor of Advanced Computing (Research and Development)

(Academic Program: 4717 | Academic Plan: 4717HBAC)
Duration: 4 years full-time
Minimum: 192 units
CRICOS Code: 074325M

The Bachelor of Advanced Computing (Research and Development) is four year program that will be accredited by the Australian Computing Society. It is specifically designed for exceptional students who have an interest in undertaking research and development in either industry or an academic environment. The program combines a strong foundation in computer science and mathematics, a specialty advanced computing curricula unique to ANU, and a project based, research intensive course of study, also unique to ANU. It provides ample scope for the student to pursue research in individual areas of interest, working with researchers of international distinction in the areas of computer science, engineering and mathematics.

A graduate of the program will have a solid grounding in the fundamentals of computing and relevant mathematics, expertise in the software development process, a a familiarity with business aspects of the ICT industry including product innovation and development, technical knowledge in a selection of contemporary and advanced ICT topics, and a solid experience in research methods in the ICT area.

A graduate of the program will have the skills, knowledge and capability to go onto advanced research programs in Computer Science and related areas, and have the potential to become innovators and leaders in the Information Communication Technology (ICT) discipline.

Program requirements

The Bachelor of Advanced Computing (Research and Development) requires the completion of 192 units of courses of which:

> A maximum of 48 units from completion of 1000 level courses;

> A minimum of 144 units from completion of 2000, 3000 or 4000 level courses.

The 192 units must include:

> 72 units from completion of compulsory courses from the following list:
  - COMP1130 Introduction to Advanced Computing I
  - COMP1140 Introduction to Advanced Computing II
  - COMP2100 Software Construction
  - COMP2130 Software Design and Analysis
  - COMP2300 Introduction to Computer Systems
  - COMP2310 Concurrent and Distributed Systems
  - COMP2600 Formal Methods in Software Engineering
  - COMP3120 Managing Software Development
  - COMP3530 Systems Engineering for Software Engineers
  - COMP3600 Algorithms
  - COMP3630 Theory of Computation
  - MGMT3027 Entrepreneurship and Innovation

> 18 units from completion of core courses from the following list:
  - MATH1115 Mathematics and Applications 1 Honours
  - MATH1116 Mathematics and Applications 2 Honours
  - STAT1003 Statistical Techniques

> 48 units from completion of the Research and Development major;
  - COMP2550 R&D Project Methods
  - COMP2560 Studies in Advanced Computing R&D
  - COMP3550 Advanced Computing R&D Project (12 units)
  - COMP3560 Advanced Computing R&D Internship (0 unit)
  - COMP4550 Advanced Computing Research Project (24 units)

> 18 units from completion of 3000 or 4000 level COMP courses;

> 36 units from completion of elective courses which may be offered by the ANU College of Engineering and Computer Science or from another ANU College.

Students may complete one of the following 48 units Advanced Computing majors or 24 units Specialisations.

Major List:

Computational Foundations
Computer Engineering
Human-Centric Computing
Information-Intensive Computing
Intelligent Systems

Specialisation List:

Algorithms and Data
Artificial Intelligence
Computer Systems
Human-Centric Computing

To remain enrolled in the degree, students must maintain an average mark of 80 percent in computing courses each semester with the understanding that the School can waive this at its discretion. Students deemed not to be performing at an appropriate level will be able to transfer to the Bachelor of Advanced Computing program, with appropriate status granted for courses successfully completed.

The Degree with Honours

Graduation from the Bachelor of Advanced Computing (Research and Development) program will require award at 1st class honours level:

H1 80–100 per cent.

Combined Degrees

The Bachelor of Advanced Computing (Research and Development) may be combined with a Bachelor of Science.

Degree Structure

	Courses
Year 1 48 units	COMP1130 COMP2300 MATH1115 STAT1003
	COMP1140 COMP2600 MATH1116 Elective Course (6u)
Year 2 48 units	COMP2100 COMP2550 2 x Elective Courses (6u each)
	COMP2130 COMP2310 COMP2560 Elective Course (6u)
Year 3 48 units	COMP3120 COMP3530 COMP3550 Elective Course (6u)
	COMP3550 COMP3600 MGMT3027 Elective Course (6u)s
Year 4 48 units	COMP3630 COMP4550 (12u) Core Course 3000/4000 (6u)
	COMP4550 (12u) 2 x Core Courses 3000/4000 (6u each)

Bachelor of Advanced Computing

(Academic Program: 4716 | Academic Plan: 4716XBAC)
Duration: 4 years full-time
Minimum: 192 units
CRICOS Code: 071360K

The Bachelor of Advanced Computing is a four year program that will be accredited by the Australian Computing Society. The program emphasizes the development of knowledge and skills to prepare future leaders of the Information Communication Technology (ICT) revolution. It will produce graduates with a knowledge and skills base that endures, has breadth, and keeps career options open.

The computing industry has grown very rapidly in the last 40 years, with various specialized areas requiring advanced computational techniques emerging. The pervasiveness of computers and computer-enabled devices is rapidly becoming established in modern society. Humans are interacting with computers in ever more profound and sophisticated ways. Allied with this, computers are having to act more intelligently in many different contexts. As the scale and complexity of these computer systems increases, so too do challenges in their engineering. As the amount of data increases exponentially, new challenges in the mining and warehousing of information emerge. In all areas of computing, increasingly sophisticated algorithms underpin all of the resulting technologies. The resulting hardware and software systems in these areas are complex; hence a systems engineering perspective on their design and construction is valuable.

In these areas of computing, another emerging trend is linkages with other disciplines. Valuable perspectives on artificial intelligence are emerging from the study of natural intelligence and biological systems. Psychology is a central element in human-computer interaction. The explosion in the volume and utility of information from bioinformatics is a key driver of large-scale data systems. An engineering approach, with emphasis on both hardware and software, is needed for the design of embedded computing technology. In all cases, reliable and systematic software development remains as a key element.

The Bachelor of Advanced Computing graduate will posses technical knowledge of programming, With these as a foundation, their technical knowledge will have been honed by the study of a selection of advanced computing topics. Professional and practical skills in software development will be gained through a series of courses in software analysis, design and construction, capped off with a group software project, With professional skills developed in the areas of entrepreneurship and management, the graduate will be in a position to apply their in-depth technical knowledge to become innovators in industry.

The best computing professionals are informed by knowledge of a wider field than computing alone. Graduates fulfilling a Major in an area of advanced computing and a cognate interdisciplinary area will be ideally positioned to shape the respective sector of the computing industry as it evolves over the near future. This will also imbue a capacity for lifelong learning by exposure to a broader range of perspectives and of ways of studying.

The degree also offers a research pathway for graduates wishing to pursue careers with a high emphasis on research.

Program requirements

The Bachelor of Advanced Computing requires the completion of 192 units of courses of which:

> A maximum of 60 units from completion of 1000 level courses;

> A minimum of 132 units from completion of 2000, 3000 or 4000 level courses.

The 192 units must include:

> 90 units from completion of compulsory courses from the following list:

- COMP1130 Introduction to Advanced Computing I
- COMP1140 Introduction to Advanced Computing II
- COMP2100 Software Construction|
- COMP2130 Software Design and Analysis
- COMP2300 Introduction to Computer Systems
- COMP2310 Concurrent and Distributed Systems
- COMP2600 Formal Methods in Software Engineering
- COMP3100 Software Project (12 units)
- COMP3120 Managing Software Development
- COMP3530 Systems Engineering for Software Engineers
- COMP3600 Algorithms
- COMP3630 Theory of Computation
- ENGN1211 Discovering Engineering
- MGMT3027 Entrepreneurship and Innovation

> 18 units from completion of core courses from the following list:

- MATH1013 Mathematics and Applications 1 (or MATH1115)

   - MATH1014 Mathematics and Applications 2 (or MATH1116)
   - STAT1003 Statistical Techniques
- 24 units from completion of COMP4550 Advanced Computing Research Project or 12 units from completion of COMP4560 Advanced Computintg Project and 12 units of 4000 level COMP courses;
- 12 units from completion of COMP courses;
- 48 units from completion of elective courses which may be offered by the ANU College of Engineering and Computer Science or by another ANU College.

Students may complete one of the following 48 units Advanced Computing majors or 24 units Specialisations.

Major List:

Computational Foundations
Computer Engineering
Human-Centric Computing
Information-Intensive Computing
Intelligent Systems

Specialisation List:

Algorithms and Data
Artificial Intelligence
Computer Systems
Human-Centric Computing

The Degree with Honours

The awarding of honours in advanced computing is based on meritorious performance in the third and fourth year components of the program. The assessment of meritorious performance is based on the marks and grades obtained for all 3000-level and 4000-level courses that the student has undertaken. Students who qualify may be awarded a grade of first class honours; or second class honours, division A.

The Bachelor of Advanced Computing may be combined with a Bachelor of Science.

Degree Structure

Courses	
Year 1 48 units	COMP1130 ENGN1211 MATH1013 STAT1003
	COMP1140 MATH1014 Core Course (6u) Elective Course (6u)
Year 2 48 units	COMP2100 COMP2300 2 x Elective Courses (6u each)
	COMP2130 COMP2310 COMP2600 Elective Course (6u)
Year 3 48 units	COMP3100 COMP3120 COMP3530 Elective Course (6u)
	COMP3100 COMP3600 MGMT3027 Elective Course (6u)
Year 4 48 units	COMP3630 COMP4550 (12u) Elective Course (6u)
	COMP4550 (12u) Core Course (6u) Elective Course (6u)

Bachelor of Software Engineering

(Academic Program: 4708 | Academic Plan: 4708XBSENG)
Duration: 4 years full-time
Minimum: 192 units
CRICOS Code: 029273C

The Bachelor of Software Engineering (BSEng) is a four-year program accredited by Engineers Australia and the Australian Computer Society. 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 program in 1999 meets 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 courses combining theoretical study and practical laboratory exercises, individual projects, and group projects. Of no less importance is an introduction to the professional skills of a competent engineer: management, communication with others and teamwork in particular, and ethical and other responsibilities. Graduates will also build their own skills of individual software development in university studies and in practical work experience which is required during the course, and will learn a systems approach developed and exemplified in individual and group project work.

Mathematics is an essential component of the program for developing the 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.

The Bachelor of Software Engineering degree is accredited by Engineers Australia and the Australian Computer Society.

The Bachelor of Software Engineering Homepage: http://cecs.anu.edu.au/future_students/computing#SE

Program requirements

The Bachelor of Software Engineering degree requires the completion of 192 units of which:

> A maximum of 60 units from completion of 1000 level courses;
> A minimum of 132 units from completion of 2000, 3000 and 4000 level courses.

The 192 units must include:

> 114 units from completion of compulsory courses:
  – COMP1100 Introduction to Programming and Algorithms or COMP1730 Programming for Scientists
  – COMP1510 Introduction to Software Engineering
  – COMP2130 Software Analysis and Design
  – COMP2300 Introduction to Computer Systems
  – COMP2310 Concurrent and Distributed Systems
  – COMP2400 Relational Databases
  – COMP2500 Software Construction for Software Engineers
  – COMP2600 Formal Methods in Software Engineering
  – COMP3120 Managing Software Development
  – COMP3500 Software Engineering Project (12 units)
  – COMP3530 System Engineering for Software Engineers
  – COMP3600 Algorithms
  – COMP4130 Managing Software Quality and Process
  – COMP4500 Software Engineering Practice (12 units) or COMP450 Software Engineering Research Project (12 units)
  – COMP4800 Industrial Experience (0 unit)
  – ENGN1211 Discovering Engineering
  – ENGN3211 Investment Decisions and Financial Systems
  – ENGN4611 Engineering Law
> 12 units from completion of core courses from the following list:
  – MATH1013 Mathematics and Applications 1 (or MATH1115 Mathematics and Applications 1 Honours)
  – MATH1014 Mathematics and Applications 2 (or MATH1116 Mathematics and Applications 2 Honours)
> 18 units from completion of 3000 or 4000 level COMP courses;
> 12 units from completion of ENGN courses offered by the ANU College of Engineering and Computer Science or 12 units from completion of courses offered by ANU College of Medicine, Biology and Environment or ANU College of Physical and Mathematical Sciences;
> 36 units from completion of elective courses which may be offered by the ANU College of Engineering and Computer Science or by another ANU College.

Elective courses

The Bachelor of Software Engineering (BSEng) program provides for students to choose: (a) 12 units Science or Engineering; (b) 36 units of courses (which must include at least 12 units at 1000-series level). The following suggestions are highlighted for BSEng students who want to consider engineering-related areas:

Electronic and Communication Systems
Mechanical and Material Systems
Mechatronic Systems
Photonic Systems
Renewable Energy Systems

Industrial Experience

Engineers Australia specify that students are required to complete at least 60 days of industrial experience during their program of study through approved professional employment taken

in the vacation period. For details see entry for COMP4800 Industrial Experience.

The Degree with Honours

The awarding of honours in software engineering is based on meritorious performance in the third and fourth year components of the program. The assessment of meritorious performance is based on the marks and grades obtained for all 3000-level and 4000-level courses that the student has undertaken. Students who qualify may be awarded a grade of first class honours; or second class honours, division A.

ENGN4801 Software Engineering Honours

The Research School of Computer Science will calculate student's averages and arrange for enrolment in ENGN4801 if required.

Combined degrees

All BSEng combined degrees are 5 year programs comprising 240 units:

Bachelor of Science
Bachelor of Commerce.

Degree Structure

Courses	
Year 1 48 units	COMP1100 ENGN1211 MATH1013[1] Elective Course Engn/Sc (6u)
	COMP1510 COMP2400 MATH11014 Elective Course Engn/Sc (6u)
Year 2 48 units	COMP2300 COMP2500 ENGN3211 Elective Course (6u)
	COMP2130 COMP2310 COMP2600 Elective Course (6u)
Year 3 48 units	COMP3120 COMP3500 COMP3530 Elective Course (6u)
	COMP3500 COMP3600 Core Course 3000/4000 level (6u) Elective Course (6u)
Year 4 48 units	COMP4130 COMP4500 Core Course 3000/4000 level (6u) Elective Course (6u)
	COMP4500 ENGN4611 Core Course 3000/4000 level (6u) Elective Course (6u)

[1] Students who have studied ACT Maths Methods or equivalent in Year 11/12 are advised to study MATH1003 prior to studying MATH1013 in S2 and MATH1014 in S1 the following year.

Bachelor of Information Technology

(Academic Program: 3701 | Academic Plan: 3701XBINFT)
Duration: 3 years full-time
Minimum: 144 units
CRICOS Code: 029996A

The Bachelor of Information Technology (BInfTech) is a three-year program 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 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 program allows students to approach information technology from either a technical, constructive angle, starting with courses in programming, or from a conceptual, critical or information and organisational management angle. It widens the approach to computing to include the creative and conceptual touch, starting by applying scripting to the application area of new media (video and audio), rather than from learning traditional general purpose programming languages applied to algorithms. The technically oriented student can major in Software Development; whereas the more conceptually oriented student can major in Information Systems.

The Software Development major aims to develop the conceptual and practical skills for software development and the technology of computer systems; the Information Systems major focuses on developing an understanding of organisations, the management of computer systems applications in them, and the accompanying systems analysis and design.

All of the majors are founded on an introduction to the principles of programming, a broad perspective on the computing discipline and profession, and an introduction to the functional structure of computers. They also require a grounding in mathematics and theoretical computer science, which is a means of developing the ability to work with abstractions, a fundamental requirement for understanding and applying ideas in computing.

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

The Bachelor of Information Technology Homepage: http://cecs.anu.edu.au/future_students/computing#BIT

Program requirements

The Bachelor of Information Technology program requires the completion of 144 units of which:

> A maximum of 60 units from completion of 1000 level courses;

> A minimum of 84 units from completion of 2000, 3000 or 4000 level courses.

The 144 units must include:

> 36 units from completion of compulsory courses from the following list:
  - COMP1100 Introduction to Programming and Algorithms
  - COMP1110 Introduction to Software Systems
  - COMP1710 Web Development and Design
  - COMP2400 Relational Databases
  - COMP2600 Formal Methods in Software Engineering
  - COMP3120 Managing Software Development

> 6 units from completion of core courses from the following:
  - MATH1005 Discrete Mathematical Models or MATH1014 Mathematics and Applications 2 or MATH1116 Mathematics and Applications 2 Honours;

> 30 units from completion of 3000 or 4000 level computing courses offered or approved by the ANU College of Engineering and Computer Science;

> 24 units from completion of additional computing courses offered or approved by the ANU College of Engineering and Computer Science;

> 48 units from completion of elective courses from the ANU College of Engineering and Computer Science or from another ANU College.

Major List:

Information Systems
Software Development

Minor List:

Information Systems
IT in New Media
Software Development

Computing courses are:

COMP as the prefix to their course code
INFS courses named in the Information Systems major/minor
MATH courses in the compulsory requirement of the BIT degree program
ENGN1211 Discovering Engineering

Combined degrees

The Bachelor of Information Technology may be combined with:

Bachelor of Arts
Bachelor of Business Administration
Bachelor of Commerce
Bachelor of Economics
Bachelor of Engineering
Bachelor of Law

Degree Structure

Courses	
Year 1 48 units	COMP1100 COMP1700 2 x Elective Courses (6u each)
	COMP1110 COMP2400 MATH1005 Elective Course (6u)
Year 2 48 units	Core Course (6u) Core Course (6u) 2 x Elective Courses (6u each)
	COMP2600 Core Course (6u) Core Course (6u) Elective Course (6u)
Year 3 48 units	COMP3120 Core Course 3000/4000 level (6u) Core Course 3000/4000 level (6u) Elective Course (6u)
	Core Course3000/4000 level (6u) Core Course 3000/4000 level (6u) Core Course 3000/4000 level (6u) Elective Course (6u)

Bachelor of Information Technology (Honours)

(Academic Program: 3701 | Academic Plan: 3701HBINFT)
Duration: 3 years full-time
Minimum: 144 units
CRICOS Code: 036677B

The BInfTech program with honours requires an additional year of study after the pass degree of Bachelor of Information Technology. Admission is by invitation based on performance in the best 48 units of 2000 and 3000 series Information Technology and Mathematics courses and generally requires an average performance at better than Credit level. The honours program includes advanced coursework and a major individual project worth 50 per cent of the year. Honours grades are awarded on the result of the whole year's work. For more details refer to http://cs.anu.edu.au/honours

Summary of courses offered in the Bachelor of Information Technology (Honours) Program in 2012

First Semester, 2012
COMP4670 - Introduction to Statistical Machine Learning
Second Semester, 2012
COMP4600 - Advanced Algorithms COMP4620 - Advanced Topics in Artificial Intelligence COMP4630 - Overview of Logic and Computation COMP4650 - Document Analysis

Courses that count towards this Program

COMP4300 - Parallel Systems
COMP4330 - Real-Time and Embedded Systems
COMP4600 - Advanced Algorithms
COMP4620 - Advanced Topics in Artificial Intelligence
COMP4630 - Overview of Logic and Computation
COMP4650 - Document Analysis
COMP4670 - Introduction to Statistical Machine Learning

Computer Science Majors

Computational Foundations Major

This major requires the completion of 48 units of courses which must include:

> 30 units from completion of the following courses:
  - COMP2610 Information Theory
  - COMP2620 Logic
  - COMP3600 Algorithms
  - COMP3630 Theory of Computation
  - MATH2301 Games, Graphs and Machines

> 18 units from completion of courses from the following list:
  - COMP3610 Principles of Programming Languages
  - COMP4600 Advanced Algorithms
  - COMP4630 Overview of Logic and Computation
  - MATH3301 Number Theory and Cryptography
  - MATH3343 Foundations of Mathematics Honours

Computer Engineering Major

This major requires the completion of 48 units of courses which must include:

> 24 units from completion of the following courses:
  - COMP2300 Introduction to Computer Systems
  - COMP2310 Concurrent and Distributed Systems
  - COMP3310 Computer Networks
  - ENGN3213 Digital Systems and Microprocessors

> 24 units from completion of courses from the following list:
  - COMP3300 Operating Systems Implementation
  - COMP3320 High Performance Scientific Computation
  - COMP3610 Principles of Programming Languages
  - COMP4300 Parallel Systems
  - COMP4330 Real-Time and Embedded Systems
  - COMP4340 Multicore Computing: Principles and Practice
  - ENGN2218 Electronic Systems and Design
  - ENGN3226 Digital Communications
  - ENGN4536 Wireless Communications

Human-Centric Computing Major

This major requires the completion of 48 units of courses which must include:

> 18 units from completion of the following courses:
  - ARTV2100 Complementary Studies I
  - COMP1720 Art and Interaction in New Media
  - COMP3900 Human Computer Interface Design and Evaluation

> 30 units from completion of courses from the following list:
  - COMP1710 Web Development and Design
  - COMP3650 System Architectural Understanding and the Human Brain
  - COMP4610 Computer Graphics
  - COMP4660 Bio-inspired Computing: Applications and Interfaces
  - ENGN4528 Computer Vision
  - PSYC1003 Understanding Mind, Brain and Behaviour
  - PSYC2008 Visual Perception and Cognition
  - PSYC3011 Perception

Information Systems Major

This major requires 48 units from completion of the following courses:

  - INFS1001 - Business Information Systems
  - INFS2024 - Information Systems Analysis
  - COMP2310 - Concurrent and Distributed Systems
  - COMP2410 - Networked Information Systems
  - COMP3410 - Information Technology in Electronic Commerce
  - COMP3420 - Advanced Databases and Data Mining
  - INFS3024 - Information Systems Management
  - INFS3059 - Project Management and Information Systems

Information-Intensive Computing Major

This major requires the completion of 48 units of courses which must include:

> 18 units from completion of the following courses:
  - COMP2400 Relational Databases
  - COMP3420 Advanced Databases and Data Mining
  - MATH2307 Bioinformatics and Biological Modelling

> 30 units from completion of courses from the following list:
  - BIOL2151 Introductory Genetics
  - BIOL3157 Advanced Genetics and Bioinformatics
  - COMP2310 Concurrent and Distributed Systems
  - COMP2410 Networked Information Systems
  - COMP3410 Information Technology in Electronic Commerce
  - COMP4650 Document Analysis

- ENVS2015 Introduction to Remote Sensing and Geographic Information Systems
- MATH3346 Data Mining Honours
- MATH3353 Topics in Bioinformatics Honours

Intelligent Systems Major

This major requires the completion of 48 units of courses which must include:

> 18 units from completion of the following compulsory courses:

- COMP2600 Formal Methods in Software Engineering
- COMP3620 Artificial Intelligence
- PSYC1003 Understanding Mind, Brain and Behaviour

> 30 units from completion of courses from the following list:

- COMP2610 Information Theory
- COMP3650 System Architectural Understanding and the Human Brain
- COMP4620 Advanced Topics in Artificial Intelligence
- COMP4650 Document Analysis
- COMP4660 Bio-inspired Computing: Applications and Interface
- COMP4670 Introduction to Statistical Machine Learning
- COMP4680 Advanced Topics in Statistical Machine Learning
- PSYC2007 Biological Basis of Behaviour
- PSYC3016 Issues in Behavioural Neuroscience

Research and Development Major

This major requires the completion of 48 units of courses which must include:

- COMP2550 R&D Project Methods
- COMP2560 Studies in Advanced Computing R&D
- COMP3550 Advanced Computing R&D Project (12 units)
- COMP3560 Advanced Computing R&D Internship (0 unit)
- COMP4550 Advanced Computing Research Project (24 units)

Software Development Major

This major may not be taken by Bachelor of Software Engineering or Bachelor of Advanced Computing (Research and Development) or Bachelor of Advanced Computing students.

This major requires the completion of 48 units of courses which must include:

- COMP2100 Software Construction
- COMP2130 Software Analysis and Design
- COMP2300 Introduction to Computer Systems
- COMP2310 Concurrent and Distributed Systems
- COMP3100 Software Engineering Group Project (12 units)
- COMP3600 Algorithms
- COMP3300 Operating Systems Implementation or COMP3310 Computer Networks or COMP3610 Principles of Programming Languages

Computer Science Minors

IT in New Media Minor

This minor requires the completion of 24 units which must include:

> 12 units from completion of the following compulsory courses:

- COMP1710 - Web Development and Design
- COMP1720 - Art and Interaction in New Media

> 12 units from completion of courses from the following list:

- ARTV2100 - Complementary Studies
- COMP3900 - Human Computer Interface Design and Evaluation
- COMP4610 - Computer Graphics

Information Systems Minor

This minor requires the completion of 24 units which must include:

> 12 units from completion of the following compulsory courses:

- INFS2024 - Information Systems Analysis
- INFS3024 - Information Systems Management

> 12 units from completion of courses from the following list:

- COMP2400 - Relational Databases
- COMP2410 - Networked Information Systems
- COMP3120 - Project Management
- COMP3410 - Information Technology in Electronic Commerce

Software Development Minor

This minor may not be taken by Bachelor of Software Engineering or Bachelor of Advanced Computing (Research and Development) or Bachelor of Advanced Computing students.

This minor requires the completion of 24 units from completion of courses from the following list:

- COMP2100 - Software Construction
- COMP2130 - Software Analysis and Design
- COMP2300 - Introduction to Computer Systems
- COMP2310 - Concurrent and Distributed Systems
- COMP3100 - Software Engineering Group Project (12 units)
- COMP3600 - Algorithms
- COMP3300 - Operating Systems Implementation
- COMP3310 - Computer Networks
- COMP3610 - Principles of Programming Languages

Computer Science Specialisations

Algorithms and Data Specialisation

24 units from completion of advanced courses from the following list:

- COMP3420 - Advanced Databases and Data Mining
- COMP3600 - Algorithms
- COMP3630 - Theory of Computation
- COMP4610 - Computer Graphics
- COMP4650 - Document Analysis

Artificial Intelligence Specialisation

24 units from completion of advanced courses from the following list:

- COMP3620 - Artificial Intelligence
- COMP3650 - System Architectural Understanding and the Human Brain
- COMP4620 - Advanced Topics in Artificial Intelligence
- COMP4650 - Document Analysis
- COMP4660 - Bio-inspired Computing: Applications and Interfaces
- COMP4670 - Introduction to Statistical Machine Learning
- COMP4680 - Advanced Topics in Statistical Machine Learning

Computer Systems Specialisation

24 units from completion of advanced courses from the following list:

- COMP3300 - Operating Systems Implementation
- COMP3310 - Computer Networks
- COMP3320 - High Performance Scientific Computation
- COMP3610 - Principles of Programming Languages
- COMP4300 - Parallel Systems
- COMP4330 - Real-Time and Embedded Systems
- COMP4340 - Multicore Computing: Principles and Practice

Human-Centric Computing Specialisation

24 units from completion of advanced courses from the following list:

- COMP3650 - System Architectural Understanding and the Human Brain
- COMP3900 - Human Computer Interface Design and Evaluation
- COMP4660 - Bio-inspired Computing: Applications and Interfaces
- COMP4610 - Computer Graphics

Course descriptions

Introduction to Programming and Algorithms COMP1100 (6 units) A

First Year Course

First Semester, 2012

Workload: Thirty one-hour lectures, ten two-hour tutorial/ laboratory sessions.

Assumed Knowledge and Required Skills: Students are assumed to have achieved a level of knowledge of mathematics comparable to at least ACT Maths Methods major or NSW 2 unit maths or equivalent.

Course Description: In general terms, an algorithm is a precise computational process for producing a specific result from some given input data. A program is a formal definition of an algorithm, in a notation that can be mechanically translated and then executed by a modern computer.

The core unifying theme of the course is data-directed design. The course introduces fundamental algorithmic structures such as composition (sequence), choice and repetition, predominantly using a functional programming language as the vehicle of expression. The course introduces fundamental data types and structures such as products (tuples), lists, and unions. A key aim is to illustrate the interdependancy of algorithms and data structures - significantly, that data structures largely determine algorithms, for example, that products are processed by projections, unions by alternatives, and that recursive data structures such as lists are processed by recursive algorithms.

For all but the simplest programs, some means of abstraction and structuring is required to manage the complexities faced by programmers, as individuals and as groups. The course introduces modularisation techniques such as libraries and abstract data types, as a means of managing such complexity. Good modular design is of fundamental and practical importance for program development - adhering to the theme of data-directed design adopted in this course leads to elegant and maintainable programs.

The final section of the course revisits the most important aspects covered in the course, but now in the context of an object-oriented programming language. The aim is to thereby emphasise the concepts, rather than any particular implementation, and to provide a springboard to subsequent programming courses.

Indicative Assessment: Continuous Assessment (40 per cent); Examinations (60 per cent)

Introduction to Software Systems COMP1110 (6 units) A

First Year Course

Second Semester, 2012

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

Prerequisites: COMP1100 or COMP1730

Incompatibility: COMP1510 and COMP2750

Course Description: This course introduces students to the tools and techniques for developing software systems of a size and quality of an industrially relevant nature. The course teaches the fundamental strategies of abstraction, decomposition and reuse as methods for constructing such systems. Verification and validation techniques, with an emphasis on testing, are taught as a means to ensure that students are able to deliver software products of the quality required.

In particular, the course will cover: recursive data structures and algorithms; structured data types, abstract data types and their applications; object-oriented programming; and software life-cycle. The course will also introduce some of the theoretical fundamentals that underpins software engineering, including: reasoning about software and its application to specifications, and verification and validation

Indicative Assessment: Assignment (30 per cent); Lab Tests (20 per cent); Final Exam (50 per cent)

Introduction to Advanced Computing I COMP1130 (6 units) A

First Year Course

First Semester, 2012

Workload: Forty two one-hour lectures, ten two-hour tutorial/laboratory sessions.

Prerequisites: Enrolment in the Bachelor of Advanced Computing, or permission from the Head of Computer Science.

Course Description: This course includes COMP1100 and extends it with 12 one-hour lecture/tutorial/laboratory sessions. It introduces students to various areas of research in computer science, especially those research areas represented in the School of Computer Science. A number of research groups in the School will be responsible for various parts of the course. Each part will consist of some introductory lectures on the data structures and algorithms most relevant to the research area and an overview lecture on the research problems, techniques, and applications of the area. Specific technical material to be covered includes lists, trees, induction, recursion, the Big-Oh notation, and the running time of programs.

Indicative Assessment: Assignments (40 per cent); Final exam (60 per cent)

Introduction to Advanced Computing II
COMP1140 (6 units) A

First Year Course

Second Semester, 2012

Workload: Forty two one-hour lectures, ten two-hour tutorial/laboratory sessions.

Prerequisites:

Enrolment in the Bachelor of Advanced Computing, or permission from the Head of Computer Science.

Course Description: This course includes COMP1110 and extends it with 12 one-hour lecture/tutorial/laboratory sessions. It introduces students to various areas of research in computer science, especially those research areas represented in the School of Computer Science, other than those covered in COMP1130. A number of research groups in the School will be responsible for various parts of the course. Each part will consist of some introductory lectures on the data structures and algorithms most relevant to the research area and an overview lecture on the research problems, techniques, and applications of the area. These topics will include graphs, sets, probability and propositional logic.

Indicative Assessment: Assignments (40 per cent); Final exam (60 per cent)

Introduction to Software Engineering
COMP1510 (6 units)

First Year Course

Second Semester, 2012

Workload: Thirty one-hour lectures, nine two-hour tutorial/laboratory sessions and three two-hour seminars.

Prerequisites: Enrolment in BSEng; COMP1100

Incompatibility: COMP1110 and COMP2750

Course Description: This course introduces students to the tools and techniques for developing software systems of a size and quality of an industrially relevant nature. The course teaches the fundamental strategies of abstraction, decomposition and reuse as methods for constructing such systems. Verification and validation techniques, with an emphasis on testing, are taught as a means to ensure that students are able to deliver software products of the quality required. It also introduces students to the principles and practices of software engineering.

In particular, the course will cover: recursive data structures and algorithms; structured data types, abstract data types and their applications; object-oriented programming; and software life-cycle. The course will also introduce some of the theoretical fundamentals that underpins software engineering, including: reasoning about software and its application to specifications, and verification and validation.

Indicative Assessment: Assignment (30 per cent); Lab Tests (20 per cent); Final Exam (50 per cent)

Web Development and Design
COMP1710 (6 units)

First Year Course

First Semester, 2012

Workload: Thirty one-hour lectures and nine two-hour laboratory sessions

Course Description: This course introduces the construction of web sites and web interface/interaction design. There is a key focus on the on new media / multimedia and its delivery on the world wide web. The course introduces multimedia as a combination of text, graphics, video, animation and sound for the purposes of information access, storage and dissemination. Topics such as the nature and types of multimedia objects, components of a multimedia system, Web authoring, delivery tools, multimedia applications, spam, podcasts, RSS, web spam and societal implications of the web. Students will create multimedia applications using some or all of HTML, XHTML, JavaScript, Flash, animation, sound, video and 3D. The course provides an introduction to the latest web technologies.

Indicative Assessment: Laboratories (25 per cent); Assignment (35 per cent); Final Exam (40 per cent)

Art and Interaction in New Media
COMP1720 (6 units)

First Year Course

Second Semester, 2012

Workload: Thirty one-hour lectures and ten two-hour laboratory sessions

Prerequisites: Incompatability: COMP2720

Course Description: This course will introduce coding in the context of New Media. Topics covered may include the nature of New Media applications, New Media data formats and data manipulation, program organisation, control structures, writing and debugging New Media programs.

In terms of the modern art world, the computer is not just another medium, it is a whole other range of media. Students will experience and experiment with a large suite of programming components which have been used to construct interactive works of New Media art. They will learn how to conceptualise, brainstorm, plan and realise an original and creative New Media work of their own and to embed that work in a web page.

In modern times, the boundary between data visualisation and artistic practice is porus. That is, the techniques used by computer professionals to visualise and present data are heavily influenced by techniques invented by artists and vice versa. Students will gain an appreciation of the techniques and impact of good visual design.

Indicative Assessment: Assignments (80 per cent); Final Exam (20 per cent)

Programming for Scientists
COMP1730 (6 units) A

First Year Course

Second Semester, 2012

Prerequisites: MATH1003 or MATH1013 or MATH1115

Assumed Knowledge and Required Skills: Solid mathematical background on the high-school level.

Incompatibility: COMP1100

Course Description: This course teaches introductory programming within a problem solving framework applicable to the sciences. The course emphasises technical programming, the simulation of scientific systems and the processing of scientific data. There is an emphasis on designing and writing correct code. Testing and debugging are seen as integral to the programming enterprise. Both top-down and object oriented design are taught. There will be an introduction to widely-used computer science algorithms and to machine architecture. The course will be taught using one or more programming languages which are widely applicable to scientific work.

Indicative Assessment: Assignments (30 per cent); Lab Work (15 per cent); Exam (55 per cent)

Software Construction
COMP2100 (6 units) B

Later Year Course

First Semester, 2012

Workload: Thirty one-hour lectures and five two-hour tutorial/laboratory sessions

Prerequisites: COMP1110 or COMP1510 or COMP1140 and MATH1005 or MATH1014 or MATH1116

Assumed Knowledge and Required Skills: Introductory programming, preferably in an object-oriented language, to design and implement programs with several classes, with simple inheritance.

Incompatibility: COMP2500

Course Description: This course is about the implementation (construction) phase and test phase of the software development process. It develops students' skills in programming at the pragmatic level and at an increased level of abstraction. Students will create individual practical assignments on the small scale, and read, critique, and modify medium scale software systems, in part through two major assignments over the whole semester. The system is closely specified and designed around a strong architectural structure, exemplifying abstraction and design patterns, and a graphical user interface. During the semester students learn to improve their own software development practices by following the Personal Software Process to learn time management, planning, and quality control.

The following topics are covered: working with larger software systems; introduction to code review and inspections; test planning and unit testing (derived from specification and design documents); object-oriented (Java), and scripting (Bash) languages; recursive data structures; graphical user interfaces; the Personal Software Process; build tools (Make and Ant) and version control (Subversion); introductory software design patterns.

Indicative Assessment: Assignments (35 per cent); Mid Semester Exam (15 per cent); Final Exam (50 per cent practical 25 per cent, theory 25 per cent)

Software Analysis and Design
COMP2130 (6 units) B

Later Year Course

Second Semester, 2012

Workload: Thirteen two-hour lectures and seven two-hour workshop sessions.

Academic Contact: shayne.flint@anu.edu.au

Prerequisites: COMP2100 or COMP2500 or INFS2024, and 6 units of 1000-level MATH courses.

Recommended: see requisite statement

Incompatibility: Incompatible with COMP3110.

Course Description: This course builds upon COMP2100 / COMP2500 by addressing the requirements, architecture and design phases of the software development life-cycle. It has a primary focus on modeling and its central role in eliciting, understanding, analysing and communicating software requirements, architecture and design. Students will learn to use several different modeling approaches to describe complex subject matters typically involved in developing, analysing and specifying requirements, architecture and design. While most of the approaches will seem straight forward and even conceptually simple, students will discover that a good deal of effort and diligence is required to produce useful, accurate, meaningful, understandable and easily maintainable models. Through a series of practical workshops, students will develop an appreciation for the characteristics and capabilities of each approach, and will learn to make decisions as to the best approach to use for a given purpose. Students will then learn how to integrate several modeling approaches to form software requirements, architecture and design specifications that are unambiguous, consistent and understandable. At the end of the course, students will be introduced to various approaches for automating the translation of specifications (models) into operational software systems. This will include topics such as model translation, code generation and an overview of active research in the area of model-driven engineering.

Indicative Assessment: Workshops (30 per cent), Mid-Semester Exam (30 per cent); Final Exam (40 per cent).

Introduction to Computer Systems
COMP2300 (6 units) B

Later Year Course

First Semester, 2012

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

Prerequisites: COMP1100 or COMP1730, and 6 units of 1000-level MATH courses or enrollment in the BCS.

Course Description: An introduction to the hardware and software components of a modern computer system. Introduction to procedural and assembly languages typically used for low-level programming of computer systems. Representation of data on computers. Comparisons of different types of instruction sets and corresponding addressing modes. Emphasis on the relationships among instruction sets, fetch and execute operations, and the underlying architecture. Consideration of the physical implementation of large memory systems, together with the techniques of data storage and checking. Overall concepts of virtual memory, operating system functions, file systems and networks. Virtual machines and the levels of machine organization, the assembly and linking process and software libraries.

Indicative Assessment: Assignments/Labs/Tutorials (40 per cent); Exam (60 per cent)

Concurrent and Distributed Systems
COMP2310 (6 units) B

Later Year Course

Second Semester, 2012

Workload: 26 one and a half hour lectures, 6 two hour pre-formulated laboratory sessions, 5 two hour

laboratory sessions plus “in your own time” programming for assignments.

Prerequisites: COMP1110 or COMP1140 or COMP1510 and COMP2100 or COMP2500 or COMP2300

Course Description: This course is concerned with aspects of computation beyond sequential programs. Concurrency occurs naturally in most real-world applications and is also strongly suggested by any modern computer architecture. Working professionally in computing today thus means to be able to handle those

challenges and to employ the available hardware to the fullest. The course introduces all basic mechanisms to analyse, design, and manage single

computer as well as distributed applications. Topics addresses include: Basics of concurrency, Mutual exclusion, Condition synchronization, Non-determinism, Scheduling, Safety and liveness, Architectures for concurrent and distributed systems, and Distributed systems.

Indicative Assessment: 2 Assignments (35 per cent combined), Mid-term exam (5 per cent), Final exam (60 per cent)

Relational Databases COMP2400 (6 units) B

Later Year Course

Second Semester, 2012

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

Prerequisites:

Assumed Knowledge and Required Skills: COMP1100 or COMP1710 or INFS1001

Recommended: COMP1100 or COMP1130 or COMP1730 or COMP1710 or INFS1001

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

Indicative Assessment: Continuous Assessment (30 per cent); Mid Semester Exam (20 per cent); Final Exam (50 per cent)

Networked Information Systems COMP2410 (6 units)

Later Year Course

First Semester, 2012

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

Prerequisites: COMP1100 or COMP1730 or COMP1710; and 6 units of 1000-level MATH/STAT courses

Incompatibility: COMP3400

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

Indicative Assessment: Assignments (30 per cent); Quizzes(10 per cent); Final Exam (60 per cent)

Software Construction for Software Engineers COMP2500 (6 units)

Later Year Course

First Semester, 2012

Workload: Thirty one-hour lectures, five two-hour tutorial/ laboratory sessions and three one to two-hour seminars

Prerequisites: Enrolment in BSEng 4708 or 4711 or 4712 and COMP1510 or COMP1110 and MATH1005 or MATH1014 or MATH1116

Assumed Knowledge and Required Skills: Introductory programming, preferably in an object-oriented language

Incompatibility: COMP2100

Course Description: This course is about the implementation and test phases of the software construction process. It is based around creating individual practical assignments on the small scale, and modifying a medium scale project in two major assignments over the whole semester. In this project, students work on a substantial application, relevant to their experience as computer users. The project is closely specified and designed around a strong architectural structure as an exemplar, and may involve a graphical user interface. During the semester students learn to improve their own software development practices by following the Personal Software Process, learning time-management, planning, and quality control. The course also studies aspects of the principles and practices of software engineering.

The following topics are covered: working with software larger systems; code review and inspections; test planning and unit testing (derived from specification and design documents); object-oriented (Java), and scripting (Bash) languages; recursive data structures; graphical user interfaces; the Personal Software Process; build tools (Make and Ant) and version control (Subversion); use of external code libraries.

Indicative Assessment: Assignments (20 per cent); Mid Semester Exam (20 per cent); Presentation (5 per cent); Report (5 per cent); Final Exam (50 per cent: practical 25 per cent, theory 25 per cent)

Formal Methods in Software Engineering COMP2600 (6 units) B

Later Year Course

Second Semester, 2012

Workload: Thirty one-hour lectures and nine one-hour tutorials.

Prerequisites: COMP1110 or COMP1510 or COMP2750 and MATH1005 or MATH1014 or MATH1116 or enrolment in Bachelor of Computer Science Honours

Course Description: This course presents some formal notations that are commonly used for the description of computation and of computing systems, for the specification of software and for mathematically rigorous arguments about program properties.

The following areas of study constitute the backbone of the course. Predicate calculus and natural deduction, inductive definitions of data types as a basis for recursive functions and structural induction, formal language theory (particularly regular expressions, finite state machines and context free grammars), specification languages, propositional programming language semantics, partial correctness and proofs of termination.

Indicative Assessment: Assignments (36 per cent); Tutorials (4 per cent); Quiz (10 per cent); Final Exam (50 per cent)

Information Theory
COMP2610 (6 units) B

Later Year Course

Second Semester, 2012

Workload: Twenty six one-hour lectures and five two-hour tutorial sessions.

Academic Contact: mark.reid@anu.edu.au

Prerequisites: See Assumed Knowledge

Recommended: Some background in elementary statistics and probabilities and programming experience.

Course Description: Information theory studies the fundamental limits of the representation and transmission of information. This course provides an introduction to information theory, studying fundamental concepts such as probability, information, and entropy and examining their applications in the areas of data compression, coding, communications, pattern recognition and probabilistic inference.

Indicative Assessment: Two written assignments (30 per cent); Final exam (70 per cent).

Prescribed Text:

Information Theory, Inference, and Learning Algorithms by David MacKay, Cambridge University Press, 2003.

Additional reading: Elements of Information Theory by Cover and Thomas, 2nd Edition, New York, Wiley, 2006.

Logic
COMP2620 (6 units) B

Later Year Course

First Semester, 2012

Workload: 35 hours of lectures and 12 hours of tutorials

Academic Contact: john.slaney@anu.edu.au

Prerequisites: Completion of 12 units of MATH or COMP courses.

Course Description: An introductory course in formal logic, dealing with propositional and predicate logic. Techniques of formal deduction and tests for the validity of arguments will be studied. Basic semantic concepts will be discussed.

Indicative Assessment: Assignments (40 per cent); Two 2-hour tests (30 per cent each).

Computer Science Research Project
COMP3006 (6 units)

Later Year Course

Second Semester, 2012

Workload: As many hours as necessary for meetings with supervisors and a nominal 10 hours per week

Prerequisites: Enrolment in BCS(H) of PhB or BE(R&D); 12 units of 3000-series COMP courses

Course Description: Students will conduct a small research project, under supervision. This will give them experience in research in an area of interest in computer science. The activities in the course will normally include some combination of reading, writing, project work and presentation as appropriate to the topic. The learning objectives, project overview and assessment arrangements will be specified at the outset using the Department of Computer Science form 'Independent Study Contract'.

Indicative Assessment: The assessment arrangements will be specified at the outset using the Department of Computer Science form 'Independent Study Contract'.

Software Engineering Group Project
COMP3100 (6 units) C

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload:

Annual course. Students must enroll in Semester 1 and Semester 2

Twenty five two-hour lectures and 300 hours of group project work

Prerequisites: COMP2100 and COMP2110; or COMP2500 and COMP2510; and 12 units of courses from COMP2300, COMP2310, COMP2400 and COMP2600

Corequisites: COMP3110

Incompatibility: COMP3500

Course Description: This course provides the student with project experience to complement the studies of the software development process in courses COMP2100, COMP2130 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.

Indicative Assessment: Reflective learning journal (25 per cent); Project reviews (45 per cent); Project artefact submission (20 per cent); Project poster and presentation (10 per cent)

Managing Software Development
COMP3120 (6 units) C

Later Year Course

First Semester, 2012

Workload: Seventeen two-hour lectures and five three-hour workshop sessions.

Prerequisites: COMP3110 or COMP2130 or INFS2024.

Course Description: This course introduces students to a range of technically-orientated issues in business, engineering and software management. Students are provided with concrete strategies for addressing important issues within practical, relevant and contemporary contexts.

The course comprises selections from one or more of the following topic areas:

> Project Management. This is a major topic for the course. Tools and techniques appropriate to management of both generic and software-specific projects are introduced.
> Business Environments - a systems-thinking approach to understanding the internal and external environments for

an organisation will be used to set the stage for work in business planning and management.

> Business Planning - students will gain practical experience of new venture planning
> Ethics and Corporate Responsibility - individual ethics and ethical culture - structured approach to arrive a a normative conclusion
> Planning and Strategic management - management decision-making; risk management
> Organisational Design - alignment with corporate goals; staffing and people management
> Leadership - motivating, influencing, communicating, managing groups and teams
> Control in Organisations and change management
> Quality - definition, value and scope. Quality management techniques
> Understanding Variation - the truth behind the management report, statistical process control (SPC) for managers
> Software specific issues - 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.

Indicative Assessment: Written assignment 20 per cent; Oral presentation 20 per cent; Written examination 60 per cent; Progressive exercises

Computer Science Group Project
COMP3130 (6 units)

Later Year Course

First Semester, 2012

Workload: As many hours as necessary for meetings with supervisors and a nominal 10 hours per week

Prerequisites: Enrolment in BCS(Hons) or PhB or BE (R&D); 12 units of 3000-series COMP courses.

Course Description: This course provides the students with research experience. It exposes the students to team work, problem solving skills, research skills and project management. Students will work in small groups on a synergistic project that covers at least two of the areas in computer science, such as the following: Applications, Programming Languages and Systems and Theory. This will promote depth of study in at least two different areas of computer science for the students.

Indicative Assessment: Project (90 per cent); Presentation (10 per cent)

Operating Systems Implementation
COMP3300 (6 units) C

Later Year Course

Second Semester, 2012

Workload: Thirty one-hour lectures and twelve two-hour tutorials/laboratory sessions.

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

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

Indicative Assessment: Assignments (20 per cent); Tutorials and Laboratories (10 per cent); Final Exam (70 per cent)

Computer Networks
COMP3310 (6 units) C

Later Year Course

First Semester, 2012

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

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

Incompatibility: ENGN 4535

Course Description: This course studies the standard models for the layered approach to communication between autonomous machines in a network and the main characteristics of data communication (transmission protocols) for the lower layers. It introduces several application layer protocols from a distributed systems viewpoint, and considers alternative lower layer methods such as ATM, and problem areas in the Internet protocol suite.

The following topics are included: introduction to communication network architectures (protocol hierarchies, layered services, the OSI model); the physical layer (transmission media, signal representation, limits to data capacity); the data link layer (error detection and recovery, point-to-point protocols); the medium access layer (protocols for Local Area Networks and satellite communication); the network layer (routing algorithms, congestion control); internetworking (addressing, internetwork routing and protocols, quality of service); the transport layer (connection-oriented transport layer services and protocols); application protocols for distributed systems.

Indicative Assessment: Assignments (30 per cent); Quizzes (5 per cent); Final Exam (65 per cent)

High Performance Scientific Computation
COMP3320 (6 units) C

Later Year Course

First Semester, 2012

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

Prerequisites: 12 units of 2000-level COMP courses including COMP2100 or COMP2500 or COMP2300; and 6 units of 2000-level MATH courses or COMP2600

Course Description: This course provides an introduction to High Performance Computing with an orientation towards applications in science and engineering. Aspects of numerical computing and the design and construction of sophisticated scientific software will be considered. The focus will be on the C and C++ programming languages, although reflecting the reality of modern scientific computation this course will also touch on other languages such as Python, Java and FORTRAN95. The course will study high performance computer architectures, including modern parallel processors, and will describe how an algorithm interacts with these architectures. It will also look at practical methods of estimating and measuring algorithm/ architecture performance.

The following topics will be addressed: the C++ programming language; basic numerical computing from aspects of floating point error analysis to algorithms for solving differential equations; the engineering of scientific software; general high performance computing concepts and architectural principles; modern scalar architectures and their memory structure; performance and programmability issues, and program analysis techniques for high performance computing; parallel computing paradigms and programming using the OpenMP standard; trends in HPC systems.

Indicative Assessment: Assignment (40 per cent); Mid-Semester exam (10 per cent); Final Exam (50 per cent)

Information Technology in Electronic Commerce COMP3410 (6 units) C

Later Year Course

Second Semester, 2012

Workload: Thirty one-hour lectures and seven two-hour tutorial/laboratory sessions

Prerequisites: COMP1100 or COMP1130 or COMP1720 or COMP1730; 12 units of 2000-series IT courses; and 6 units of MATH/STAT courses

Course Description: This course is an introduction to the information technologies required for secure, practical information systems for electronic commerce.

Topics will be chosen from areas such as:

> document representation (XML, DTDs, XML Schema, XSLT, CSS)
> security (encryption, public key, symmetric key, PKI, authentication); kinds of attack and vulnerabilities
> electronic trading (spontaneous, deliberative, auctions)
> electronic document management (metadata, search, digital libraries, management and processing)
> recent developments and maturation of the area, such as web application frameworks, web services, the semantic web , mobile commerce

Case studies will be used where appropriate.

Indicative Assessment: Quizzes 5 per cent; Assignments (25 per cent); Final Exam (70 per cent)

Advanced Databases and Data Mining COMP3420 (6 units) C

Later Year Course

First Semester, 2012

Workload: Thirty one-hour lectures and six two-hour tutorials

Prerequisites: COMP1100 or COMP1130 or COMP1720 or COMP1730; COMP2400; 6 units of 2000-level IT courses; and 6 units of 1000-level MATH/STAT courses.

Course Description: This course examines the design of databases and data warehouses and their use for data mining; and investigates associated issues. Topics may include: relational theory and conceptual modelling; privacy and security; statistical databases; distributed databases; data warehousing; data cleaning and integration; and data mining concepts and techniques.

Indicative Assessment: Two assignments (40 marks); Final Exam (60 marks)

Software Engineering Project COMP3500 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload:

Annual course. Student enrols in Semester 1 and Semester 2

Twenty five two-hour lectures and 300 hours of group project work

Prerequisites: Enrolment in BSEng; COMP2500 and COMP2510; or COMP2100 and COMP2110; and 12 units of courses from COMP2300, COMP2310, COMP2400 and COMP2600

Corequisites: COMP3110

Incompatibility: COMP3100

Course Description: This course provides the student with project experience to complement the studies of the software development process in courses COMP2500, COMP2130, COMP3530 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. Students will also study relevant aspects of the software engineering milieux.

Indicative Assessment: Reflective learning journal 25 per cent; Project reviews 45 per cent; Project artefact submission 20 per cent; Project poster and presentation 10 per cent.

Systems Engineering for Software Engineers COMP3530 (6 units) C

Later Year Course

First Semester, 2012

Workload: Thirteen two-hour lectures and seven two-hour workshop sessions.

Academic Contact: shayne.flint@anu.edu.au

Prerequisites: ENGN1211 and COMP2130

Incompatibility: ENGN2225

Course Description: Society relies on many complex systems of interacting technology, people, processes, laws and other elements. Examples of such systems include air transport, telecommunications and energy supply. Systems Engineering is a holistic, multi-disciplinary and well established approach to the engineering of these complex systems. Because software is a critical component of such systems, Software Engineers will often work in Systems Engineering teams. This course prepares students for such roles by covering the following topics:

> Systems concepts
> The Systems Engineering life-cycle and processes
> Conceptual system design: including problem definition, technical performance measures, quality function deployment (QFD), trade-off analyses, and system specification.
> Preliminary system design: subsystem design requirements, design review.
> Detailed design and development: Detailed design requirements and design engineering activities; review and feedback, and incorporation of design changes
> Design testing, evaluation and validation
> Design for sustainability: approaches that integrate sustainability principles into the design process
> Integration of Systems Engineering and Software Engineering activities

Indicative Assessment: Problem sets (25 per cent); Quiz (25 per cent); Individual design exercise (25 per cent); Group Design Project (25 per cent)

Algorithms
COMP3600 (6 units) C

Later Year Course

Second Semester, 2012

Workload: Thirty one-hour lectures and four two-hour tutorial/laboratory sessions.

Prerequisites: COMP1110 or COMP1140 or COMP1510; 6 units of 2000-level COMP courses or enrollment in BComptlSci; and 6 units of 2000-level MATH courses or COMP2600.

Course Description: This course deals with the study of algorithms for solving practical problems, and of the data structures used in their implementation. Detailed analysis of the resource requirements of algorithms will be an important issue.

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

Indicative Assessment: Assignments (40 per cent); Final Exam (60 per cent)

Artificial Intelligence
COMP3620 (6 units) C

Later Year Course

First Semester, 2012

Workload: Thirty one-hour lectures, six tutorials and six laboratory sessions.

Prerequisites: COMP2100 or COMP2300 or COMP2500; and COMP2600.

Course Description: Artificial intelligence is the science that studies and develops methods of making computers more / intelligent/. The focus of this course is on core AI techniques for knowledge representation, search, reasoning, learning and designing intelligent agents. The course also aims to give an overview of other topics within AI, such as for example robotics, and of the historical, philosophical, and logical foundations of AI.

Indicative Assessment: Assignments (50 per cent); Final Exam (50 per cent)

Theory of Computation
COMP3630 (6 units) C

Later Year Course

First Semester, 2012

Prerequisites: COMP1140 or a mark of 70 or more in COMP2600

Course Description: This course covers the theoretical computer science areas of formal languages and automata, computability and complexity. Topics covered include: regular and context-free languages; finite automata and pushdown automata; Turing machines; Church's thesis; computability - halting problem, solvable and unsolvable problems; space and time complexity; classes P, NP and PSPACE; NP-Completeness.

Indicative Assessment: Assignments (30 per cent); Final Exam (70 per cent)

System Architectural Understanding and the Human Brain
COMP3650 (6 units) C

Later Year Course

Autumn Session, 2012

Prerequisites: 12 units of 2000-series COMP or 12 units of 2000-series PSYC

Course Description: This course will teach how to understand the behaviours of complex functional systems in terms of their components, using as an example the problem of relating psychology to physiology for the human brain.Students will learn how to approach understanding of complex functional systems by means of descriptions on many different levels of detail which can be mapped into each other. This is one of the basic skills needed to understand, design and modify complex functional systems. The course will be relevant to students interested in designing or maintaining complex functional systems. Using the human brain as the example will make the course relevant to students interested in research on the mammal brain, and students interested in medical studies of the human brain.

Indicative Assessment: Assignments (30 per cent); Exam (70 per cent)

Topics in Software Engineering I
COMP3700 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Contact hours as appropriate

Prerequisites: Written approval of Head of Department of Computer Science.

Minimal background is 18 units of 2000 series COMP courses including COMP2500 and COMP2510; and 6 units of 2000-level MATH courses or COMP2600.

Course Description: This course is available so that senior students can pursue, under supervision, topics that are not covered in the regular curriculum or to execute a project that will significantly increase their knowledge of software engineering theory or practice.

The activities in the course will be some combination of lectures, reading, writing and project work, as appropriate to the topic.

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

Topics in Computer Science COMP3710 (6 units) C

Later Year Course

First Semester, 2012, Second Semester, 2012, and Spring Session, 2012

Workload: Students are expected to spend 10-12 hours each week on this course. Contact hours will be determined for each individual student and recorded in an 'Independent Study Contract' at the beginning of the course.

Prerequisites: Written approval of Head of Department of Computer Science.

Recommended: Minimal background is 18 units of 2000-level COMP courses including COMP2100 or COMP2500; and 6 units of 2000-level MATH courses or COMP2600.

Course Description: This course is available so that senior students can pursue, under supervision, topics that are not covered in the regular curriculum 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. These activities will be specified, for each enrolled student, using a Research School of Computer Science `Independent Study Contract'.

Indicative Assessment: An appropriate combination of written report, exercises, examination and seminar presentations. This will be set out in the 'Independent Study Contract' for each student at the start of each course.

Project Work in Computing COMP3740 (6 units) C

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: No formal contact is required in this course. Students will meet regularly with their supervisor througout the semester.

Academic Contact: uwe.zimmer@anu.edu.au

Prerequisites: Written approval of the Head of Computer Science. Minimal background is 24 units of 2000-level IT courses.

Recommended: see requisite statement

Course Description: Students will conduct a small project, under supervision, that in area of computing of mutual interest to the student and their supervisor. The project will involve applying and increasing the depth of the student's knowledge in some aspect of computing. The activities in the course will normally include some combination of reading, writing, project work and presentation, as appropriate to the topic. The specific learning objectives, project overview and assessment arrangements will be specified at the outset using the Department of Computer Science form 'Independent Study Contract'.

Indicative Assessment: An appropriate combination of written report, project documentation and presentation, which may include a demonstration of the project.

Project Work in Computer Systems COMP3750 (6 units) C

Later Year Course

First Semester, 2012 and Second Semester, 2012

Prerequisites: Written approval of Head of Computer Science. Minimal background is 24 units of 2000-level IT courses.

Course Description: Students will conduct a small project, under supervision, that will act as a capstone to the Computer Systems major by applying and increasing the depth of the student's knowledge in this area.

The activities in the course will normally include some combination of reading, writing, project work and presentation as appropriate to the topic. The learning objectives, project overview and assessment arrangements will be specified at the outset using the Department of Computer Science form 'Independent Student Contract'.

Indicative Assessment: An appropriate combination of written report, project documentation and presentation, which may include a demonstration of the project.

Project Work in Information Systems COMP3760 (6 units) C

Later Year Course

First Semester, 2012 and Second Semester, 2012

Prerequisites: Written approval of Head of Computer Science. Minimal background is 24 units of 2000-level IT courses.

Course Description: Students will conduct a small project, under supervision, that will act as a capstone to the Information Systems major by applying and increasing the depth of the student's knowledge in this area.

The activities in the course will normally include some combination of reading, writing, project work and presentation as appropriate to the topic. The learning objectives, project overview and assessment arrangements will be specified at the outset using the Department of Computer Science form 'Independent Student Contract'.

Indicative Assessment: An appropriate combination of written report, project documentation and presentation, which may include a demonstration of the project.

Software Engineering Internship COMP3820 (24 units)

Later Year Course

Second Semester, 2012

Workload: There is no formal contact for this course.

Academic Contact: shayne.flint@anu.edu.au

Prerequisites: Completion of COMP3500 (6 units). Departmental consent required.

Recommended: see requisite statement

Course Description: The aim of this course is to use the internship experience to enable students to develop their software engineering skills and practice. Students will be placed in industry, working full-time and assessed for academic credit. The internships will be aligned with the aims of the software engineering program. Students will experience a real-life engineering workplace and understand how their software engineering and professional skills and knowledge can be utilised in industry. They will also be able to demonstrate functioning software engineering knowledge, both new and existing, and identify areas of further development for Students who successfully complete this course will be given status for COMP3500 in Semester 2 and COMP4800.

Indicative Assessment: Internship e-Portfolio (20 per cent); Internship Report (50 per cent); Industry Supervisor Report (20 per cent); Internship interview and response to feedback (10 per cent)

Human Computer Interface Design and Evaluation COMP3900 (6 units) C

Later Year Course

Second Semester, 2012

Workload: Two two-hour lecture blocks each week and a group assignment

Prerequisites: (COMP 1110 or COMP 1510 or COMP 2750) + 12 units of COMP 2000

Course Description: This course will provide an introduction to the field of Human Computer Interaction and will introduce students to behavioural research methods and techniques used in usability testing. The course will give students the essential theoretical background to approaches, methods and techniques followed by practical experience in conducting usability studies for interactive systems.

Indicative Assessment: Group project Stage 1 (15 per cent);

Group project Stage 2 (20 per cent); Group project Stage 3 (10 per cent); Group project Stage 4 (5 per cent); Final exam (50 per cent)

Computer Science IV Honours COMP4005F (12 units to 24 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Full Year

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

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

Indicative Assessment: Courses (50 per cent); Project (50 per cent)

Computer Science IV Honours COMP4005P (12 units to 24 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Full Year

Part-Time Intensity

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

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

Indicative Assessment: Courses (50 per cent); Project (50 per cent)

Computer Science Honours COMP4006 (24 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: 24 units of honours level courses and 24 units of thesis

Prerequisites: Enrolment in the Bachelor of Computer Science (Honours) program 4710HBCSCI

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

Indicative Assessment: The coursework and project components carry equal weight, because it is felt that are of equal importance. The individual courses studied have their own assessment rationale. The research project is assessed on the thesis and the seminar. The seminar tests objective 1; and the thesis objectives 2, 3 and 4; as listed above.

Managing Software Quality and Process COMP4130 (6 units)

Later Year Course

First Semester, 2012

Workload: Thirty one hour lectures and five two hour laboratory sessions

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

Incompatibility: Incompatible:COMP4100 and COMP4110

Course Description: This course introduces students to advanced topics on managing the quality of products to be delivered as part of the progression within a software development project, and managing the development process itself through software process improvement frameworks and standards.

Several causal aspects of (bad) software quality will be introduced and discussed so that students can understand the context for undertaking risk and bad quality avoidance.

There will be a focus on practical techniques for identifying and removing defects as well as for implementing procedures to track the success or failure of resk and kefect resolutions.

There are several Software Process Improvement (SPI) frameworks and 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. This course 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.

Indicative Assessment: Assignments (50 per cent); Final Exam (50 per cent)

Software Engineering Practice
COMP4500 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload:

Annual course. Student enrols in Semester 1 and Semester 2.

Twenty five two-hour lectures and 300 hours of group project work

Prerequisites: Enrolment in BSEng; COMP3110, COMP3120 and COMP3500

Incompatibility: COMP4540

Course Description: This course exposes students to profession software engineering practice through the development of a software system for an industry, government or university based customer. Students will work in small teams with their customer to plan (define, estimate, schedule) and manage an appropriate set of activities to ultimately deliver a software product according to the customer requirements. The implementation part of the project will include monitoring, measuring, tracking, managing change and ultimately close out of the project.

Indicative Assessment: Reflective learning journal 25 per cent; Project reviews 45 per cent; Project artefact submission 20 per cent; Project poster and presentation 10 per cent

Software Engineering Research Project
COMP4540 (12 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Annual course. Student enrols in Semester 1 and Semester 2. As many hours as necessary for meetings with supervisors and a nominal 20 hours per week

Prerequisites: Departmental consent required

Incompatibility: COMP4500

Course Description: Students will conduct an individual research project under the close supervision of one or more academic staff. Projects will, at least in part, require the application of theoretical or experimental research techniques. In particular, students will be expected to conduct and present a survey of the literature relevant to the research topic.

Students will prepare a thesis reporting on the research project and its outcomes. They will also be expected to present a poster and a short seminar describing their work.

Students will be expected to apply their software engineering knowledge and skills in the planning and execution of their research project.

Indicative Assessment: Project (90 per cent); Presentation (10 per cent)

Advanced Computing Research Project
COMP4550 (12 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Annual Course. Student enrols in Semester 1 and Semester 2. No formal contact is required in this course.

Prerequisites: Enrolment in the Bachelor of Advanced Computing, or the Bachelor of Advanced Computing (Research and Development). Incompatible with COMP4560.

Course Description: Students will conduct an individual research project under the close supervision of one or more academic staff. Projects will, at least in part, require the application of theoretical or experimental research techniques. In particular, students will be expected to conduct and present a survey of the literature relevant to the research topic.

Students will prepare a thesis reporting on the research project and its outcomes. They will also be expected to present a poster and a short seminar describing their work. The learning objectives and project overview will be specified at the outset using the Research School of Computer Science form ‘Independent Study Contract’.

Indicative Assessment: Presentation: 10 per cent; Thesis: 90 per cent

Advanced Computing Project
COMP4560 (12 units) C

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: As many hours as necessary for meetings with supervisors and a nominal 20 hours per week

Prerequisites: Enrolment in the Bachelor of Advanced Computing.

Incompatible with COMP4550.

Course Description: Students will conduct a project, under supervision, that will act as a capstone to their studies in Advanced Computing. The activities in the course will normally include some combination of reading, writing, artefact construction and presentation, as appropriate to their project's topic. The learning objectives, project overview and assessment arrangements will be specified at the outset using the Research School of Computer Science form 'Independent Study Contract'.

Indicative Assessment: A typical assessment scheme would be report 60 per cent; artefact 30 per cent; presentation 10 per cent

Advanced Algorithms
COMP4600 (6 units) C

Later Year Course

Second Semester, 2012

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

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

Course Description: This course is concerned with the study of algorithms for solving practical problems efficiently, and the theoretical analysis of their behaviour. There will also be a brief introduction to complexity theory, the formal study of algorithm performance.

A large variety of algorithms are candidates for study. These include, but are not limited to, the following: greedy algorithms, dynamic programming, network flow algorithms, algorithms for string matching, parallel algorithms, graph algorithms and approximation algorithms.

Indicative Assessment: Assignments (50 per cent); Final Exam (50 per cent)

Advanced Topics in Artificial Intelligence
COMP4620 (6 units) C

Later Year Course

Second Semester, 2012

Workload: Thirty one hour lectures

Prerequisites: COMP3620

Course Description: This is an advanced undergraduate course that covers advanced topics in Artificial Intelligence. Topics vary from one offering to the next and are likely to be drawn from the following list: planning, scheduling, games, search reasoning, (constraint based, model-based, spatial, temporal), knowledge representation, decision-making under uncertainty, reinforcement learning, agents, foundations.

Overview of Logic and Computation
COMP4630 (6 units) C

Later Year Course

Second Semester, 2012

Workload: Twenty-six one-hour lectures, ten one-hour tutorials

Prerequisites: 24 units of 3000-level COMP courses including COMP3610 or COMP3630

Course Description: This course covers: essentials of first order logic, up to and including completeness proofs; introductions to proof theory and model theory; elements of modal and temporal logic; introduction to automated reasoning. Students will have the opportunity to read and present material going beyond that in the lectures.

Indicative Assessment: Assignments (100 per cent)

Document Analysis
COMP4650 (6 units) C

Later Year Course

Second Semester, 2012

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

Academic Contact: wray.buntine@nicta.com.au

Prerequisites: 12 units of 3000 series IT courses including COMP3410 or COMP3420 and 6 units of MATH/STAT courses or COMP2600.

Course Description: Processing of semi-structured documents such as internet pages, RSS feeds and their accompanying news items, and PDF brochures is considered from the perspective of interpreting the content. This course considers the " and its various genres as a fundamental object for business, government and community. For this, the course covers four broad areas: (A) information retrieval, (B) natural language processing, (C) machine learning for documents, and (D) relevant tools for the Web. Basic tasks here are covered including content collection and extraction, formal and informal natural language processing, information extraction, information retrieval, classification and analysis. Fundamental probabilistic techniques for performing these tasks, and some common software systems will be covered, though no area will be covered in any depth.

Indicative Assessment: Two written assignments with programming option (40 per cent); written final exam (60 per cent);

Bio-inspired Computing: Applications and Interfaces
COMP4660 (6 units) C

Later Year Course

First Semester, 2012

Workload: The course will be run as three intensive modules. Each module will consiste of two full days of classes.

Prerequisites: 12 units of 3000-level COMP courses.

Note: students with a suitable background, eg in mathematics, biology or psychology may request permission to enrol from the course convenor.

Course Description: Bio-inspired Computing is the combination of computational intelligence and collective intelligence. These computational methods are used to solve complex problems, and modeled after design principles encountered in natural / biological systems, and tend to be adaptive, reactive, and distributed. The goal of bio-inspired computing is to produce computational tools with enhanced robustness, scalability, flexibility and which can interface more effectively with humans. This course introduces the fundamental topics in bio-inspired computing, and build proficiency in the application of various algorithms in real-world problems. The course will also cover applications focused particularly on highly sophisticated interaction with users.

Indicative Assessment: Assignments 20 per cent; Major Project 40 per cent; Final Exam 40 per cent

Introduction to Statistical Machine Learning
COMP4670 (6 units) C

Later Year Course

First Semester, 2012

Workload: Thirty one-hour lectures

Prerequisites: Some background in elementary statistics and probabilities, numerical algorithms, and programming experience.

Course Description: This course provides a broad but thorough introduction to the methods and practice of statistical machine learning. Topics covered will include Bayesian inference and maximum likelihood modeling; regression, classification, density estimation, clustering, principal and independent component analysis; parametric, semi-parametric, and non-parametric models; basis functions, neural networks, kernel methods, and graphical models; deterministic and stochastic optimisation; overfitting, regularisation, and validation.

Indicative Assessment: Assignment 1 (20 per cent); Assignment 2 (20 per cent); Final Oral Exam (60 per cent)

Topics in Software Engineering III
COMP4710 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Contact hours as appropriate

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

Course Description: This course is available so that students can pursue, under supervision, topics that are not covered in the regular curriculum.

The activities in the course will be some combination of lectures, reading, writing and project work, as appropriate to the topic. These activities, and the assessment arrangements, will be specified, for each enrolled student, using a Computer Science Department 'Independent Study Contract'.

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

Industrial Experience
COMP4800 (0 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Prerequisites: Enrolment in BSEng and COMP3500.

Course Description: 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 enrol in COMP4800 in their final year and need to have satisfied the requirements by October in order to graduate at the ceremony the following December.

http://cs.anu.edu.au/student/comp4800

Information Technology IV Honours(S)
INFT4005F (12 units to 24 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Full Year

Prerequisites: Enrolment in the BInfTech Honours degree.

Course Description: The honours program consists of a coursework component and a project component, of equal weight. A student's individual course program is selected in consultation with the BInfTech honours coordinator. The coursework component involves courses in advanced aspects of the computing discipline and information systems. The coursework is drawn from the fourth year honours courses in Computer Science (see the COMP4005 course description), Information Systems (see the entry in College of Business and Economics), 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.

Indicative Assessment: Courses (50 per cent); Project (50 per cent)

Information Technology IV Honours(S)
INFT4005P (12 units to 24 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Full Year

Part-Time Intensity

Prerequisites: Enrolment in the BInfTech Honours degree.

Course Description: The honours program consists of a coursework component and a project component, of equal weight. A student's individual course program is selected in consultation with the BInfTech honours coordinator. The coursework component involves courses in advanced aspects of the computing discipline and information systems. The coursework is drawn from the fourth year honours courses in Computer Science (see the COMP4001 course description), Information Systems (see the entry in College of Business and Economics), 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.

Indicative Assessment: Courses (50 per cent); Project (50 per cent)

Discovering Engineering
ENGN1211 (6 units)

First Year Course

First Semester, 2012

Workload: Twenty seven one-hour lectures, twelve twenty-minute online lectures, ten one-hour tutorials, ten hours of labs, plus ~forty hours outside of class

Prerequisites: Admission to the BE degree course or the BSEng degree course or approval of the Director of the Research School of Engineering.

Course Description: Discovering Engineering engages students in engineering and provides a foundation of skills and knowledge for the rest of their engineering studies. It introduces three aspects of engineering: the disciplines; the practice; and the responsibilities. These three themes are interwoven throughout the course to enhance student learning in problem formulation, systems design, communication, teamwork, research, an understanding of the responsibilities of engineering practice, and an awareness of reflective and ethical professional practice.

The systems approach which encompasses the ANU engineering philosophy and program is introduced. Its relevance and importance to modern engineering is examined through technology projects and guest speaker presentations by practicing engineers and researchers.

The practice of engineering is examined through a group design project focused around the EWB Design Challenge. Students gain an appreciation of the issues involved in taking a design from problem-formation, through concept generation to design, manufacture and proposed implementation during an open-ended, real-world design challenge. The roles and responsibilities of engineers, technologists and scientists are considered through this project and by examining existing professional practice, the engineering profession and its peak professional bodies.

Indicative Assessment: Engineering Technology Report - Initial (5 per cent); EWB Research Report (10 per cent); CAD Assignment (15 per cent); Engineering Technology Report (20 per cent); EWB Presentation (10 per cent); EWB Design Report (40 per cent)

Engineering Sciences
ENGN1215 (6 units) A

First Year Course

First Semester, 2012

Workload: Fifty eight contact hours maximum and thirty hours non-contact

Prerequisites: Admission to the BE degree course, the BSEng degree course or approval of the Director of the Research School of Engineering.

Assumed Knowledge and Required Skills: This course assumes a knowledge of basic physics and some limited chemistry, but has no formal prerequisites.

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

Indicative Assessment: Design eggcersise (20 per cent); Artifacts lab (15 per cent); Problem sets (5 per cent); Quizzes (30 per cent); Final Exam (30 per cent)

Introduction to Mechanics
ENGN1217 (6 units)

First Year Course

Second Semester, 2012

Workload: Nominal load of thirty nine hours of lectures/ tutorials, and additional laboratory classes.

Recommended: Students should be encouraged to take ENGN1218 Introduction to Electonics, concurrently

Incompatibility: ENGN1221

Course Description: This course introduces the fundamental principles in mechanics. Structural design applications of a variety of problems are developed throughout the course using examples that elucidate the theory of mechanics. The primary aim of this course is to provide a solid foundation for students in the field of mechanical engineering. Specific topics include:

> Statics of particles; forces in a plane and in space
> Equivalent systems of forces; cartesian vector and vector operations
> Equilibrium of regid bodies; including free body diagrams
> Simple trusses
> Distributed forces; centroids, centres of gravity and moments of inertia
> Static indeterminacy and friction
> Stress and strain concepts; including Hooke's law
> Mechanical properties of materials
> Axial and torsion loading
> Bending behaviour; including shear and moment diagrams

Indicative Assessment: Online Assignments (20 per cent); Laboratories (10 per cent); Bridge Competition (20 per cent); Final Exam (50 per cent)

Introduction to Electronics
ENGN1218 (6 units)

First Year Course

Second Semester, 2012

Workload: Weekly average contact hours will be five hours and expected non-contact study hours are five hours including three hours of problem sets

Incompatibility: ENGN1221

Course Description: This course introduces the students to the fundamentals of electrical and electronic engineering. It provides the students with an understanding of basic electrical quantities, circuit elements and circuit analysis techniques. It also provides an understanding of the principles and operation of diodes and operational amplifiers. Specific topics include:

> Fundamental electrical quantities (charge, current, voltage) and circuit elements (resistor, capacitor, inductor, voltage and current sources).
> Circuit Analysis Techniques: Kirchhoff's voltage and current laws, Mesh current and Node voltage analysis, Thevenin and Norton Equivalent circuits, Superposition, Maximum power transfer, Wheatstone bridge
> First-order RC and RL Circuits with DC inputs: Time constant, Transient and steady state responses.
> Diodes: Basic diode concepts and diode circuit modes, applications (rectifier and wave shaping circuits), Zener diodes.
> Introduction to Operational Amplifiers: Ideal op-amp, Basic Op-amp configurations, Summing point constraint.

Indicative Assessment: Problem Sets (5 per cent); Quizzes (5 per cent); Hardware laboratories (30 per cent); Mid-semester Exam (20 per cent); Final Exam (50 per cent)

Mechanical Systems and Design
ENGN2217 (6 units)

Later Year Course

First Semester, 2012

Prerequisites: ENGN1217 or ENGN1221

Incompatibility: ENGN2214

Course Description: This course builds on ENGN1217 Introduction to Mechanics. It will focus on the mechanical properties of materials and their importance for the design of structures and mechanical systems. The course will also include approaches to mechanical design, computer-aided design (CAD) and an introduction to stress analysis of mechanical structures. Small design exercises will integrate the main topics and concepts throughout. Specific topics include:

> Transverse shear and combined loadings
> Stress and strain transformations; plane stress, plane strain, material-property relationships
> Design of beams and shafts
> Buckling of columns
> Energy methods; including external work and strain energy

Computer-aided design (CAD) topics such as parts, assembles and drawings, multi-body parts, pattern features, surgaces, stress analysis.

Indicative Assessment: Completion of ANSYS Workshops (5 per cent); Experimental Laboratory report (15 per cent); 3 Problem Sets (15 per cent); Design Problems report (10 per cent); Final Exam (55 per cent)

Electronic Systems and Design
ENGN2218 (6 units)

Later Year Course

First Semester, 2012

Prerequisites: ENGN1218 or ENGN1221

Incompatibility: ENGN2211

Course Description: This course builds on ENGN1218 Introduction to Electronics by developing the students' understanding of the principles and operation of advanced electronic circuits and devices (RLC circuits, operational amplifier, filters, bipolar junction transistor and digital logic gates). It also emphasizes the importance of modelling the behaviour of complex electronic circuits and devices using systematic mathematical techniques. Specific topics include:

> Steady State RLC circuit analysis: complex numbers, phasors, impedances, complex power.
> Introduction to Operational Filter Circuits: Transfer functions, Bode Plots, First order active filters (low-pass and high pass).
> Bipolar Junction Transistors: Basic BJT concepts and circuit models, BJT Amplifiers (bias circuits, small-signal and large-signal equivalent circuits), BJT Common Emitter and Common Collector amplifiers, Cascaded BJT amplifiers.
> Introduction to Digital Electronics: Number systems, Boolean algebra, Logic gates, Combinational logic circuits, Karnaugh maps, Combinational logic circuit design.

PSPICE is used extensively in the analysis and design.

Indicative Assessment: Computer laboratories (6 per cent); Hardware laboratories (25 per cent); Mid-Semester Exam (19 per cent); Final Exam (50 per cent)

Computing for Engineering Simulation?
ENGN2219 (6 units)

Later Year Course

Second Semester, 2012

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

Prerequisites: COMP1100 or COMP1730

Course Description: This course introduces students familiar with programming concepts to tools and techniques for developing software systems in the computational engineering context. The course teaches the fundamental strategies of modelling, abstraction, decomposition and reuse as methods for constructing software systems used in engineering simulation. Verification and validation techniques, with an emphasis on testing, are taught as a means to ensure that students are able to undertake meaningful simulations using computational tools, and deliver reliable software for this purpose. The course will be taught using one or more programming languages and environments which are widely applicable to engineering simulation.

In particular, the course will cover: interactive and stored program use of computers, modelling in the simulation context; program organisation; accuracy and performance issues in numerical algorithms; structured numeric data types and abstract data types; procedural and object-oriented programming approaches; visual programming approaches for simulation; the software life-cycle; and verification and validation. Case studies will be taken from various engineering simulation scenarios.

Indicative Assessment: Two Assignments (30 per cent); Lab Tests (20 per cent); Final Exam (50 per cent)

Thermal Energy Systems
ENGN2222 (6 units) B

Later Year Course

Second Semester, 2012

Workload: Three lectures per week, two tutorials per week, one field trip, one three-hour heat exchanger lab, two one-hour quizzes; six hours of independent study is required each week, in addition to contact hours.

Prerequisites: PHYS1101 or PHYS1001

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

Indicative Assessment: House Thermal Analysis (20 per cent); Laboratory (15 per cent); Field Trip (5 per cent); Quiz (10 per cent); Final Exam (50 per cent)

Systems Engineering Design
ENGN2225 (6 units)

Later Year Course

First Semester, 2012

Prerequisites: ENGN1211

Course Description: This course provides a framework for the interdisciplinary systems engineering program. It outlines the design process for an engineering product or service. The systems approach is used to give students an understanding of how to integrate the technical engineering disciplines required to solve complex problems. This approach is traditionally applied to highly technical engineering problems. However, students will also see how sustainable design principles can be introduced to the design process in order to accommodate environmental considerations.

Specific topics include:

> Systems engineering definitions and classifications; life-cycle engineering
> Conceptual system design: including problem definition, technical performance measures, quality function deployment (QFD), trade-off analyses, and system specification
> Preliminary system design: subsystem design requirements, design review
> Detailed design and development: Detailed design requirements and design engineering activities; review and feedback, and incorporation of design changes
> Design testing, evaluation and validation
> Design for sustainability: approaches that integrate sustainability principles into the design process

Indicative Assessment: Individual Assignment #1 (15 per cent); Individual Assignment #2 (20 per cent); Quiz (10 per cent); Design Project (55 per cent); (Preparatory Report - 5 per cent, Final Report 50 per cent)

Systems Engineering Analysis
ENGN2226 (6 units)

Later Year Course

Second Semester, 2012

Prerequisites: ENGN2225 and 12 units of MATH

Course Description: This course builds on ENGN2225 Systems Engineering Design. Systems analysis is an important part of the overall interdisciplinary systems engineering approach. This course will show students how to utilise systems analysis for effective design evaluation, and as a means for improving and optimising existing systems.

Specific topics include:

> Probabilistic and statistical approaches to engineering systems analysis
> Models in decision making and decision analysis; design-dependent and design-independent parameters
> Optimization in design and operations
> Queuing theory and analysis
> Control concepts and methods (critical path method, PERT)
> Design for reliability; measures and analysis methods
> Design for maintainability; measure of effectiveness and maintainability in the system life-cycle
> Design for affordability; life-cycle costing

Indicative Assessment: Problem-based tutorials (25 per cent); Systems Analysis laboratory (20 per cent); Mid-Semester exam (15 per cent); Final exam (40 per cent).

Signal Processing
ENGN2228 (6 units)

Later Year Course

Second Semester, 2012

Workload: Twenty four one-hour lectures, four three-hour labs and six one-hour tutorials

Prerequisites: ENGN2211 or ENGN2218

Incompatibility: ENGN2223

Course Description: Introduction to signals via RC circuits, step functions and impulse functions; impulse, frequency and step responses; Fourier analysis; linear time invariant systems; convolution; DTFT; line codes including power spectra; AM, FM, PM and phase locked loops; speech coding and delta modulation

Indicative Assessment: Proposed Assessment: Written Assignments (30 per cent); Labs (10 per cent); Exams (60 per cent)

Engineering Research and Development Project (Methods)
ENGN2706 (6 units)

Later Year Course

Second Semester, 2012

Workload: A research project with a time commitment of approximately 90 hours, and two assignments with a time commitment of approximately 20 hours each. The projects take into account the student's background and the stage of their degree.

Students are encouraged to meet with their supervisor on a regular basis (at least once a week).

Prerequisites: Academic program BEng(R&D) 4714 or BEng(R&D)/BSc 4715

Course Description: This course is the introductory course for the R&D major which BE(R&D) students have to complete. The course introduces students to some fundamentals of research methodology, and gives students first hand experience by having them carry out a small research project, under close supervision by a member of academic staff.

The course comprises a series of lectures which cover the following topics: How to define a research problem; writing a research paper and report; how to give a seminar; the use of search tools and databases to find relevant literature; scientific methods in practice; design of an experiment.

Students complete an individual research project which requires them to carry out background reading and literature review, and to prepare a research report and give a seminar at the end of the course.

Indicative Assessment: Two assignments, worth 15 per cent each. The project assessment is worth 70 per cent and consists of the project report (65 per cent), a seminar (15 per cent) and other assessment items jointly agreed on by the student and supervisor prior to project commencement (20 per cent).

Practical experience
ENGN3100 (0 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Prerequisites: Completion of 48 units of study

Course Description: The BE degree at ANU is accredited by the Engineers Australia. A requirement of Engineers Australia, as part of the degree accreditation, is that ALL students MUST complete the equivalent of 12 weeks of full-time work experience outside the University during their studies. This is implemented in the BE degree at ANU as the ENGN3100 course. Besides accreditation, the work experience has the following two purposes:

1. to expose the student to the workplace and workplace issues (such as human and industrial relations, job organisation, maintenance, safety and environmental issues).

2. to provide direct insight into professional engineering practice.

It is the student's responsibility to obtain the employment. The School of Engineering provides several resources to help students find work experience, including an annual seminar held in second semester, an ENGN 3100 Frequently Asked Questions (FAQ) document and a list of past employers (updated at the end of each semester).

As a general rule, the ideal would be 12 weeks (420 hours) in an engineering environment where the student is working with or supervised by engineers. Also acceptable is 8 weeks in an engineering environment and remaining 4 weeks in any sort of employment. A variation of this scheme that may be acceptable in a handful of special cases is 4 weeks in any sort of employment, 4 weeks in employment in a technical industry of some kind and 4 weeks of work with engineers in an engineering environment. All work experience claimed must have been completed since the commencement of the degree.

Students are required to submit a 10-15 page report upon completion of their work experience. For details of report requirements, report assessment and submission procedure, please see http://eng.anu.edu.au/courses/ENGN3100/

Engineering Internship
ENGN3200 (6 units to 24 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Course Description: The aim of this course is to use the internship experience to enable students to develop their engineering skills and practice. Students will be placed in industry, working full-time and assessed for academic credit. The internships will be aligned with the aims of the engineering program and its areas of specialisation. Students will experience a real-life engineering workplace and understand how their engineering and professional skills and knowledge can be utilised in industry. They will also be able to demonstrate functioning engineering knowledge, both new and exisiting, and identify areas of further development for their future careers.

Indicative Assessment: Internship Journal (e-Portfolio) and Reflection Items (20 per cent); Internship Report (60 per cent); Industry Supervisor Report (20 per cent);

Investment Decisions and Financial Systems
ENGN3211 (6 units)

Later Year Course

First Semester, 2011

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

Incompatibility: BUSN1001, ASHI2021, ASHI2041, POLS1004, ECHI1105, ECHI1106, ASHI2023

Workload: At least three contact hours per week plus private study time.

Course Description:This course is taught in two parts: Part A - Financial Systems over the first seven weeks, and Part B - Economic Systems over the last six weeks of semester. The Part A Financial systems segment focuses on accounting and financial management concepts and principles. This course equips students with methodologies to identify and analyse accounting information for making sound financial decisions in real business settings.
The Part B Economic systems segment of the course will provide an introduction to the economic principles which underlie decisions on private and public investment. These principles will be used to analyse relevant issues such as choice of capacity, pollution and public goods, safety standards and patents. Mathematical models will be used to inform the analysis.Indicative Assessment: Part A Tasks: Class Quizzes - 15 per cent; Mid-semester examination - 35 per cent Part B Tasks: Assignments - 15 per cent; Final Examination - 35 per cent

Manufacturing Technologies
ENGN3212 (6 units)

Later Year Course

First Semester, 2012

Workload: Thirty five one-hour lectures, eleven three-hour workshops, one metrology lab, one turning lab, one sheet forming lab and one half day field trip/lab

Prerequisites: ENGN2214 or ENGN2217

Course Description: 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.

Indicative Assessment: Reports (7.5 per cent, 7.5 per cent,5 per cent,15 per cent); Group Design Exercise (35 per cent); Final Exam (30 per cent)

Digital Systems and Microprocessors
ENGN3213 (6 units)

Later Year Course

First Semester, 2012

Workload: Twenty one lectures plus three hours of Labs per week.

Prerequisites: ENGN2211 or ENGN2218

Course Description: This course provides an introduction to the analysis and design of digital systems and microprocessors. Review of combinational analysis and design. Analysis and design of synchronous finite state machines and register transfer level systems. Computer aided design and programming of digital electronic circuits through the application of several modern software packages. A detailed introduction to VERILOG hardware description language. Extensive hardware labs involving the implementation of complex digital systems in FPGA programmable logic devices. Microprocessor devices, their architecture and instruction sets. Hardware aspects of instruction execution. Assembly language and C programming. Input/output, bus interfacing, interrupts. Co-design of digital hardware and microprocessor systems.

Indicative Assessment: Assessment (10 per cent); Midterm Exam (20 per cent); Labs (30 per cent); Exam and Project (40 per cent);

Engineering Management
ENGN3221 (6 units)

Later Year Course

Second Semester, 2012

Workload: Twenty nine one-hour lectures, six two-hour company working meetings, two two-hour tutorials and company working meetings and four two-hour workshops.

Prerequisites: ENGN1211 and ENGN3211 (or BUSN1001)

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

The course comprises the following topics:

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

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

Control Systems
ENGN3223 (6 units)

Later Year Course

Second Semester, 2012

Workload: Ten hours

Prerequisites: MATH2305

Course Description: Introduction to control system analysis, identification, design and implementation. Laboratory work involves real-time identification and control of a range of electrical and electromechanical systems. Topics covered include:

> History of Control.
> Representation of linear dynamics and properties of systems.
> Time domain specifications of performance.
> Discrete-time systems and the Z-transform.
> Closed loop and open loop control. Classical PID controllers.
> Steady state errors and system type. Stability and robustness.
> Discrete-time systems and design by emulation.
> Root locus analysis and design of continuous and discrete systems.
> Frequency response of continuous and discrete time systems.
> Nyquist plots and stability margins.
> Lead-Lag control design.
> Sensitivity and robustness in the frequency domain.
> Practical design issues approaches.

Indicative Assessment: Problem Sheets (20 per cent); Laboratories (25 per cent); Tutorial attendance (5 per cent); Final Exam (50 per cent)

Energy Systems Engineering
ENGN3224 (6 units) C

Later Year Course

First Semester, 2012

Workload: Twelve to fourteen hours per week, including background reading and assessment.

Prerequisites: ENGN2222

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

Indicative Assessment: Laboratory quizzes (30 per cent); Assignment (15 per cent); Final Exam (55 per cent)

Digital Communications
ENGN3226 (6 units) C

Later Year Course

First Semester, 2012

Workload: Thirty one-hour lectures, four three-hour computer labs, two three-hour hardware labs and ten one-hour project tutorials

Prerequisites: ENGN2228

Course Description: This course presents the principles and techniques fundamental to the analysis and design of digital communication systems. It focuses on the basic building blocks of a digital communication system (channel encoder/decoder, digital modulator/demodulator and channel characteristics). The emphasis is on mathematical underpinnings of communications theory along with practical applications. Specific topics include:

> Probability and Random Processes: Probability distributions, Random variables, Random processes, Statistical averages, Correlation.

> Digital Modulation Techniques: Signal space analysis, BPSK, QPSK, QAM, bit error rates.

> Digital Demodulation and Detection Techniques: Correlator, Maximum a posteriori detection (MAP), Maximum likelihood detection (MLSD).

> Channel Encoder/Decoder: Linear block codes, Cyclic codes, Convolutional codes, Viterbi algorithm.

> Channel Characteristics: Wireline vs. wireless channels, Mathematical models for communication channels, Characterization of multipath channels.

> Digital Communication Systems: Multiple Access techniques, TDMA vs. CDMA communication systems.

Simulink/Matlab is used extensively in the analysis and design.

Indicative Assessment: Labs (18 per cent); Project (20 per cent); Mid-Semester Exam (12 per cent); Final Exam (50 per cent)

System Dynamics
ENGN3331 (6 units)

Later Year Course

Second Semester, 2012

Workload: Three to four hours a week not including assessment items or lecture periods

Prerequisites: MATH1014

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

Indicative Assessment: Problem Sets (5) (30 per cent); Mid-Semester Quizzes (2) (20 per cent); Final Exam (50 per cent)

Semiconductors
ENGN3334 (6 units) B

Later Year Course

Second Semester, 2012

Prerequisites: ENGN2211 or ENGN2218

Incompatibility: ENGN2224

Course Description: This course introduces semiconductor physics, devices and technology. Physics topics comprise basic semiconductor physics, diodes, solar cells and transistors. Technology topics comprise oxidisation, diffusion, ion implantation, photolithography, film deposition, electrical interconnection, characterisation, packaging and process integration.

Indicative Assessment: Laboratories (6 per cent); Seminar (12 per cent); Quiz (20 per cent); Tutes (8 per cent); Final Exam (54 per cent)

Engineering Sustainable Systems
ENGN3410 (6 units)

Later Year Course

Second Semester, 2012

Workload: Weekly workload comprised of reading and tutorial preparation (two hours), one one-hour tutorial, one three-hour project laboratory, self-directed study (three hours).

Prerequisites: ENGN2225 Systems Engineering Design or ENVS2011 Human Ecology.

Course Description: The increasing need for engineers to address sustainability will add significant complexity to their tasks. They will therefore need the skills and knowledge to understand and predict the impact of their practice. This course will focus on the dynamics of complex systems in the context of the environmental and social impacts of technological innovation. Students will develop knowledge and skills that provide a basis for the design and sustainable operation of engineering-environment-social systems that are highly non-linear.

Sustainability will be defined in engineering terms, and basic dynamical principles will be explored in tutorial discussions. The course will be presented using a 'problem based learning' mode of delivery.

Indicative Assessment: Tutorial Participation (30%); Research Project -

Individual Components (40%); Research Project - Group Components (30%).

Optical Physics
ENGN3512 (6 units)

Later Year Course

First Semester, 2012

Workload: Approximately thirty lectures, six tutorials, and eighteen hours of laboratories

Prerequisites: PHYS2017

Recommended: Recommended PHYS2016

Course Description: Optics continues to play a central role in answering the most profound scientific questions of our time. Optics is at the heart of many of the world's most powerful scientific instruments, enabling modern telescopes to achieve previously unimaginable resolution, and probing general relativity with a global network of gravitational wave detectors. This course includes interferometry, electro-optic modulation, light detection, quantum noise, nonlinear optics, photonics and the use of lasers. Expert guest lecturers will describe the application of these techniques to fields such as space science and nanophotonics. The course will also provide critical experimental skills with optical instrumentation needed for many areas of research. This course is the core 3rd year optics course and complements PHYS3031 which focuses on the concepts of atom-light interaction.

Indicative Assessment: Examination 30 per cent, Laboratory 30 per cent, Assignment 30 per cent, Case-study 10 per cent

Engineering Materials
ENGN3601 (6 units) C

Later Year Course

First Semester, 2012

Prerequisites: ENGN2214 or ENGN2217

Course Description: This subject develops a knowledge of the variety of engineering materials, their properties and characteristics. Equilibrium phase diagrams and kinetic TTT diagrams for predicting microstructure in materials. Properties of alloys (steels, aluminium, magnesium, titanium, and other non-ferrous metals); ceramic materials: ceramics and glasses; forming of ceramics; structure and defects in ceramics; characterisation, structure and properties of polymers; polymer processing; rubber elasticity; strengthening and toughening mechanisms for materials; fracture mechanics; characterisation methods (mechanical and microstructural); biomaterials and nano-materials; stereoscopy, surfaces and spatial distributions, analytical and visualisation software; focal plane, Fraunhofer diffraction, Fourier transform; reflected optical microscopy, and electron microscopy.

Indicative Assessment: Assignments (20 per cent); Course project (30 per cent); Final Exam (50 per cent)

Engineering Research and Development Project
ENGN3706 (6 units)

Later Year Course

Summer Session, 2012, First Semester, 2012, and Second Semester, 2012

Workload: A research project of variable duration (approximately 130 hrs total time commitment hours per 6 units). The projects take into account the students' background and the stage of their degree.

Students are encouraged to meet with their supervisor on a regular basis (at least once a week).

Prerequisites: Prerequisite ENGN2706 and enrolment in the BE (R&D) 4714 or BE(R&D)/BSc 4715

Course Description: This course is one of a suite of research and development courses designed for the BE (R&D) Program. These courses are of varying length and are offered at different stages of the degree program and are essentially stand-alone research projects. ENGN3706 is a 6-unit research course designed to complement the students' basic research skills through non-trivial research work in an area chosen by the student. The course forms part of the 42-unit R&D major that is a compulsory component of the aforementioned degree program. Each student will have their research supervised by one or more academic supervisors, with the approval of Head of Department or the Delegated Authority. Students are responsible for engaging and obtaining appropriate supervisory support.

Indicative Assessment: Continuous assessment of research

Course page http://eng.anu.edu.au/study/currentstudents/courses

Engineering Research and Development Project
ENGN3712 (12 units)

Later Year Course

Summer Session, 2012, First Semester, 2012, and Second Semester, 2012

Workload: A research project of variable duration (approximately 130 hrs total time commitment hours per 6 units). The projects take into account the students' background and the stage of their degree.

Students are encouraged to meet with their supervisor on a regular basis (at least once a week).

Prerequisites: ENGN2706 and enrolment in the BE (R&D)

Course Description: This course is one of a suite of research and development courses designed for the BE (R&D) program. These courses are varying length and are offered at different stages of the degree program and are essentially stand-alone research projects. ENGN3712 is a 12 unit research course designed to complement the student's basic research skills through non-trivial research work in an area chosen by the student.

Indicative Assessment: Continuous assessment of research through reports, posters and seminars.

Individual Project
ENGN4200 (6 units to 12 units)

Later Year Course

Summer Session, 2012, First Semester, 2012, and Second Semester, 2012

Workload: Students must enrol in both Semester 1 and 2.

The work-load expectation for Individual Project is no less than one full day per week during each semester, including mid-semester break. It is strongly recommended that additional time is spent during summer holiday (early start involving literature survey, learning to use equipment, preparatory experiments, etc.).

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

Course Description: Students undertake an individual engineering project, with supervision.

Students are encouraged to put forward their own ideas for the individual project, or they may select a project from a range of ideas offered by researchers across ANU. If the student initiates an idea, he or she must find a supervisor to accept the project. Students and their respective supervisors must jointly sign-off on acceptance of the project concept as part of the project registration process.

Project selection is normally completed as part of ENGN3221 - Engineering Management, by week 3 of the semester prior to commencement of ENGN4200. The planning phase of the project is integrated into the Engineering Management course, providing a deliberate foundation for the project execution phase that is ENGN4200.

Students are expected to manage all aspects of their individual project from conceptualization through the planning phase to the monitoring and control of the project performance and the ultimate achievement of the following deliverables:

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

Indicative Assessment: Work Schedule (10 per cent); Seminar (10 per cent); Thesis (80 per cent)

Systems Engineering Project
ENGN4221 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: One two-hour weekly lecture, two one-hour weekly formal group meetings; one one-hour weekly meetings for team leaders, additional group/sub-group meetings as required (~one to two hours/week), individual research/reporting as required (~two to four hours/week)

Prerequisites: ENGN2225, ENGN2226 and ENGN3221

Course Description: 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.

Indicative Assessment: Project Concept Document (10 per cent); Project plan and timeline (10 per cent); Requirements Report (20 per cent); Ideas review (15 per cent), Design Report (30 per cent); Design Presentation (15 per cent).

The grade for each team member will be moderated around the group grade based on the review of the Individual Performance Review Document (IPRD).

Sustainable Product Development
ENGN4420 (6 units)

Later Year Course

First Semester, 2012

Workload: Weekly workload comprised of lectures and linked activities (2 hours), tutorial (1 hour), quizzes (1 hour), project work (3 hours), self-directed study (3 hours).

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Prerequisites: ENGN2225 Systems Engineering Design

Course Description: This course will cover sustainability issues for industry, such as techniques for environmental conscious product design and sustainable product-service development. The syllabus will include life-cycle analysis (LCA) based on ISO14000 standards, end-of-life product management considerations (recycling, remanufacture, and reuse), and carbon emission issues such as global warming potential and ecological/carbon footprint, and cleaner production technologies.

Indicative Assessment: Project with interim reports (15 per cent) and final reports (60 per cent); Tutorials (10 per cent); Presentation (15 per cent)

Composite Materials
ENGN4511 (6 units) C

Later Year Course

Second Semester, 2012

Prerequisites: ENGN2214 or ENGN2217

Course Description: 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.

Indicative Assessment: Laboratories (20 per cent); Quizzes (40 per cent); Research Report (40 per cent)

Fibre Optics Communications Systems
ENGN4513 (6 units) C

Later Year Course

First Semester, 2012

Prerequisites: PHYS1201 (PHYS2016 and PHYS2017 are also recommended)

Incompatibility: PHYS3060, PHYS3050 and PHYS3051

Course Description: Optical fibres now constitute the backbone of the worlds long-distance telecommunications systems and are also being used increasingly in other areas, such as sensing, biophotonics, automotive, etc. The course sets out to provide a basic understanding of optical transmission systems concentrating on light propagation along fibres and light processing using fibre- and planar waveguide-based devises. Light propagation includes: modal propagation and Maxwell's equations; ray tracing, Snell's and Fesnel's Laws; single-mode, multi-mode and special fibres; pulse propagation and dispersions; nonlinear effects; fibre and planar waveguide fabrication; analytical and numerical techniques; birefringence and bend loss. Light processing devices include: couplers and splitters; gratings and arrayed waveguide gratings; Mach-Zehnder and multimode interferometers; optical amplifiers and attenuators; polarisers. Laboratory work covers both hands-on fibre-based experiments and numerical simulations.

Indicative Assessment: Examination (50 per cent); Laboratories (30 per cent); Assignments (20 per cent)

Energy Resources and Renewable Technologies
ENGN4516 (6 units)

Later Year Course

Second Semester, 2012

Prerequisites: ENGN3211 (or equivalent) or approval of Head of Engineering

Course Description: Climate change is one of the biggest challenges facing humankind. As a response to it, profound changes to the way energy is produced and utilised are rapidly taking place. Energy Change encompasses the development of new energy technologies together with economic, social and policy measures needed for their widespread deployment. This course focuses on renewable energies and energy efficiency. It aims to help students identify the major 'big picture' questions in the area of energy resources and energy technologies and then develop technically sound ways of answering them.

The course commences with a brief description of the scientific evidence for climate change, followed by an overview of the main source of carbon emissions, energy production. A look into the main indicators of energy supply and consumption in the world sets the scene for discussing different scenarios for an energy mix that could limit the predicted increase in the world's average temperature. Such energy mix relies heavily on the deployment of renewable energy technologies: biomass, geothermal, hydroelectric, solar, tidal, wave and wind. The scientific and technical foundations of these technologies are examined in order to assess their ultimate potential as well as their practical limitations. Because of the rapid pace of change in this field the course focuses on developing students' skills in framing questions and finding answers, as well as being able to critically evaluate those answers and support them with scientific evidence.

Indicative Assessment: Major project (40 per cent total); On-line discussion forum (10 per cent); Assignments and quizzes (30 per cent); Opinion piece (20 per cent)

Special Topics in Engineering I
ENGN4520 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: Two one-hour lectures and one-hour tutorial per week and two-hour computer labs during the weeks 8, 9 and 10.

Prerequisites: Written approval of the Head of Engineering

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

Indicative Assessment: Tutorial Problems (15 per cent); Mid-semester Quiz (20 per cent); Project (20 per cent); Final Exam (45 per cent)

Topics

The details for the course(s) shown above apply to all of the following topics. Specific descriptions for Syllabus and Proposed Assessment that apply to each topic are detailed below.

Discrete Time Signal Processing
Engineering Practice
Engineering Sustainable Systems
Functional Nanomaterials
Intelligent Manufacturing Systems
Operations Management
Pattern Recognition for Computer Vision

Special Topics in Engineering 2
ENGN4521 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Topics

The details for the course(s) shown above apply to all of the following topics. Specific descriptions for Syllabus and Proposed Assessment that apply to each topic are detailed below.

Finite Element Analysis
Microphotonics, Biophotonics and Nanophotonics
Radar Signal Processing
Solar Thermal Technologies

Special Topics in Engineering 3
ENGN4522 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Prerequisites: Written approval of the Head of Engineering

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

Topics

The details for the course(s) shown above apply to all of the following topics. Specific descriptions for Syllabus and Proposed Assessment that apply to each topic are detailed below.

Advanced Computer Vision
Prototyping
Radar Signal Processing
Supply Chain Management

Special Topics in Engineering 4
ENGN4523 (6 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Prerequisites: Written approval of the Head of Engineering

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

Topics

The details for the course(s) shown above apply to all of the following topics. Specific descriptions for Syllabus and Proposed Assessment that apply to each topic are detailed below.

Engineering Materials
Indoor Radio Propagation

Photovoltaic Technologies
ENGN4524 (6 units) C

Later Year Course

First Semester, 2012

Workload: This course has the same workload expectations to that of a traditional course. The indicative time is ten to twelve hours per week and is outlined in more detail on the WATTLE site.

Prerequisites: ENGN2224 or ENGN3334

Assumed Knowledge and Required Skills: Basic physics and mathematics

Corequisites: ENGN3224

Course Description: Photovoltaic electric systems have become an important area of engineering and are expected to become a mainstream source of energy in the near future. They are an example of interdisciplinary systems engineering, where basic electronic materials science is combined with power electronics, mechanical design, control systems and economic optimisation. The course will give an overview of the solar energy resource and photovoltaic 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 presented. Economic, technical and societal issues that must be considered and dealt with in the design of Photovoltaic systems will be covered. Computer modelling of photovoltaic systems will be used to reinforce understanding and acquire a familiarity with engineering tools for PV system design.

Indicative Assessment: Online Quizzes (5 per cent); Tutorials (9 per cent); Exercises (20 per cent); Group Project (20 per cent); Exam (46 per cent)

Solar Thermal Technologies
ENGN4525 (6 units)

Later Year Course

Second Semester, 2012

Workload: This course requires students to work independently with online resources as well as attending weekly lectures and tutorials for interpretation of the online material.

Prerequisites: ENGN3224

Course Description: Solar thermal systems are capable of providing a diverse range of energy services. In this course students explore the potential for solar thermal to address imminent global energy challenges. Topics covered include low and high temperature solar thermal energy collectors, solar thermal conversion processes, thermal energy storage, systems design and control. This course is a capstone course for the Thermal systems and Energy Systems stream in the Renewable Energy major. Theoretical material is balanced with practical experience in laboratories and design case studies. Students are encouraged to apply knowledge gained in these courses to the design of solar thermal systems in a systems engineering context.

Indicative Assessment: Assignment; laboratory-based assessment; mid-semester quiz; final exam.

Computer Vision
ENGN4528 (6 units)

Later Year Course

First Semester, 2012

Prerequisites: ENGN2226

Course Description: 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.

Indicative Assessment: Laboratories (10 per cent); Assignments (40 per cent); Final Examination (50 per cent)

Wireless Communications
ENGN4536 (6 units)

Later Year Course

Second Semester, 2012

Prerequisites: ENGN3226

Course Description: The purpose of this course is to provide an introduction to modern digital mobile and wireless communication systems. Topics include: overview of digital wireless communications, cellular concept and interference and traffic analysis; wireless radio fading channel modelling and characterization; modulation performance over fading channels; equalization techniques; multi carrier systems; spread spectrum techniques; receiver and transmitter diversity techniques; GSM standards, CDMA cellular systems; 3G and 4G systems, information theory of wireless channels; multiple antenna systems and space-time communications; and cooperative communications.

Indicative Assessment: Fortnightly Assignments (20 per cent); Mid-Semester Exam (25 per cent); Final Exam (55 per cent)

Discrete-Time Signal Processing
ENGN4537 (6 units)

Later Year Course

First Semester, 2012

Workload: Lectures; Weekly tutorial; Computer laboratories.

Prerequisites: ENGN2228

Course Description: Digital Signal Processing (DSP) has become over the years an important tool with applications in Electrical and Mechanical Engineering fields. DSP has penetrated many domains of applications, such as digital communications, medical imaging, audio and video systems, consumer electronics, robotics, remote sensing, finance etc.

The Discrete-Time Signal Processing paradigm is a convenient setting to analyse the basic

principles of DSP. At the end of this course, the students should be able to understand these basic

principles, and apply fundamental algorithms and methods to analyse and design discrete-time

systems for modern DSP applications. Though the course will focus on the study of theoretical concepts, methods and algorithms, the student will be confronted with application and implementation issues, through various examples and assignments requiring personal computer work

including processing of real-world signals.

Indicative Assessment: Weekly problems; mid-semester quiz; Matlab project; final exam.

Engineering Law
ENGN4611 (6 units)

Later Year Course

Second Semester, 2012

Workload: Thirteen two hour lectures. One assignment, 500 words. Revision as necessary.

Prerequisites: ENGN1211

Incompatibility: ENGN4211, BUSN1101, ASHI2268, POLS1002, ECHI1105, ECHI1106

Course Description: 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.

Indicative Assessment: Attendance (10 per cent); Assignment (10 per cent); Practice examination (20 per cent); Final exam (60 per cent)

Microphotonics, Biophotonics and Nanophotonics ENGN4613 (6 units)

Later Year Course

Second Semester, 2012

Workload: Twenty four lectures, six tutorials and twenty four hours laboratory sessions

Prerequisites: PHYS1201

Assumed Knowledge and Required Skills: First and second year physics

Course Description: The micro-photonics part of the course will cover the application of optical fibres outside of the telecommunications applications (covered in ENGN4513) and includes architecture, astronomy a wide range of fibre sensors and applications in architecture, astronomy, automotive, aerospace and structural health (bridges, ships). Bio-Photonics will cover the increasing use of fibre optics in medical procedures and diagnostics including endoscopy, laser therapy and dosimetry. The nano-photonics part of the course will include carbon wires, lithography, photonic crystals, and nanofibres and devices. Laboratory work covers both hands-on, fibre-based experiments and software simulations.

Indicative Assessment: Assignments (20 per cent); Laboratories (30 per cent); Final Exam (50 per cent)

Finite Element Analysis ENGN4615 (6 units)

Later Year Course

Second Semester, 2012

Prerequisites: ENGN2214 or ENGN2217

Course Description: 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.

Indicative Assessment: Problem Sets (20 per cent); Workshops on Design Modeler and Finite Element Analysis (5 per cent); Design Problems (20 per cent); Final Exam (55 per cent)

Power Electronics ENGN4625 (6 units)

Later Year Course

Second Semester, 2012

Prerequisites: ENGN2211 or ENGN2218

Course Description: 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.

Indicative Assessment: Assignments and Presentation (15 per cent); Laboratories (32 per cent); Quiz (8 per cent); Final Exam (45 per cent).

Robotics ENGN4627 (6 units)

Later Year Course

Second Semester, 2012

Workload: Twelve lectures, five assignments and five to six tutorials

Prerequisites: ENGN2221 or ENGN3331

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

Indicative Assessment: Assignments (10 per cent); Computer Lab (10 per cent); Practice project (30 per cent) Final Exam (50 per cent)

Engineering Research and Development Project ENGN4706 (6 units)

Later Year Course

Summer Session, 2012, First Semester, 2012, and Second Semester, 2012

Workload: A research project of variable duration (approximately 130 hrs total time commitment hours per 6 units). The projects take into account the students' background and the stage of their degree.

Students are encouraged to meet with their supervisor on a regular basis (at least once a week).

Prerequisites: ENGN2706 and enrolment in the BE (R&D)

Course Description: This course is one of a suite of research and development courses designed for the BE (R&D) Program. These courses are of varying length and are offered at different stages of the degree program and are essentially stand-alone research projects. ENGN4706 is a 6-unit research course designed to complement the students' basic research skills through non-trivial research work in an area chosen by the student. The course forms part of the 42-unit R&D major that is a compulsory component of the aforementioned degree program. Each student will have their research supervised by one or more academic supervisors, with the approval of Head of Department or the Delegated Authority. Students are responsible for engaging and obtaining appropriate supervisory support.

Indicative Assessment: Continuous assessment of research by reports, posters and seminars.

Engineering Research and Development Project ENGN4712 (12 units)

Later Year Course

Summer Session, 2012, First Semester, 2012, and Second Semester, 2012

Workload: A research project of variable duration (approximately 130 hrs total time commitment hours per 6 units). The projects take into account the students' background and the stage of their degree.

Students are encouraged to meet with their supervisor on a regular basis (at least once a week).

Prerequisites: ENGN2706 and enrolment in the BE (R&D)

Course Description: This course is one of a suite of research and development courses designed for the BE (R&D) Program. These courses are of varying length and are offered at different stages of the degree program and are essentially stand-alone research projects. ENGN4712 is a 12-unit research course designed to complement the students' basic research skills through non-trivial research work in an area chosen by the student. The course forms part of the 42-unit R&D major that is a compulsory component of the aforementioned degree program. Each student will have their research supervised by one or more academic supervisors, with the approval of Head of Department or the Delegated Authority. Students are responsible for engaging and obtaining appropriate supervisory support.

Indicative Assessment: Continuous assessment of research through reports, posters and seminars.

Engineering Research and Development Project ENGN4718 (18 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Workload: A research project of variable duration (approximately 130 hrs total time commitment hours per 6 units). The projects take into account the students' background and the stage of their degree.

Students are encouraged to meet with their supervisor on a regular basis (at least once a week).

Prerequisites: ENGN2706 and BE (R&D)

Course Description: This course is one of a suite of research and development courses designed for the BE (R&D) Program. These courses are of varying length and are offered at different stages of the degree program and are essentially stand-alone research projects. ENGN4718 is an 18-unit research course designed to complement the students' basic research skills through non-trivial research work in an area chosen by the student.

Engineering Research and Development Project ENGN4724 (24 units)

Later Year Course

First Semester, 2012 and Second Semester, 2012

Prerequisites: ENGN2706 and enrolment in BE (R&D)

Course Description: This course is one of a suite of research and development courses designed for the BE (R&D) Program. These courses are of varying length and are offered at different stages of the degree program and are essentially stand-alone research projects. ENGN4724 is a 24-unit research course designed to complement the students' basic research skills through non-trivial research work in an area chosen by the student.

Courses not offered in 2012

Principles of Programming Languages COMP3610 (6 units) C

Prerequisites: COMP2300 and COMP2600

Parallel Systems COMP4300 (6 units) C

Prerequisites: COMP2310; 6 units of 2000-series COMP courses; and 6 units of 2000-series MATH courses or COMP2600

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

Prerequisites: COMP2300 and COMP2310; or ENGN2211 and ENGN2228

Multicore Computing: Principles and Practice COMP4340 (6 units) C

Prerequisites: COMP2300, COMP2310 and 12 units of 3000-level COMP courses.

Computer Graphics COMP4610 (6 units) C

Prerequisites: 6 units of 3000-series COMP courses

Advanced Topics in Statistical Machine Learning COMP4680 (6 units)

Prerequisites: COMP4670