Introduction to the School of Electrical Engineering, Electronics and Computer Science at Liverpool

The University of Liverpool School of Electrical Engineering, Electronics and Computer Science is at the forefront of world-leading and internationally acclaimed research. The School brings together two departments which have complementary skills that are in demand worldwide.

This expertise and knowledge is part of our research-led teaching and you will be taught by academics who are leaders in their research fields. Staff in the School are committed to the development of programmes that will further enhance the employability of our students and provide an excellent student experience. The high National Student Survey scores confirm that our students are receiving excellent teaching and a great student experience.

Many of our programmes offer a year in industry or an opportunity to study overseas which provides opportunities and benefit to those students. We have strong interdisciplinary collaborations with governments and industrial partners worldwide, meaning we are at the cutting-edge of innovative technologies of the future and our graduates are industry ready.

Study abroad
Both Computer Science and Electrical Engineering and Electronics students have the exciting opportunity of studying abroad at our partner institution of Xi’an Jiaotong-Liverpool University in Suzhou, China. In addition, Computer Science students can apply to study at partner universities in the USA and Canada. Studying abroad has huge personal and academic benefits, as well as giving you a head start in the graduate job market. For more information, visit www.liverpool.ac.uk/goabroad

Year in China
The Year in China is the University of Liverpool’s exciting new flagship programme enabling undergraduate students, from a huge range of departments, including Electrical Engineering and Electronics and Computer Science, the opportunity to spend one year at our sister university Xi’an Jiaotong-Liverpool University (XJTLU), following XJTLU’s BA China Studies degree classes. See www.liverpool.ac.uk/study/undergraduate/goabroad/year-in-china for more information.
Why choose Computer Science at Liverpool?

Ground-breaking developments in computer science have revolutionised our lives. With a seemingly endless demand for new generations of computer scientists to develop apps, algorithms and systems that will continue this revolution, the career prospects for computer science graduates have never been better. Whatever your prior experience of computing, a degree from the University of Liverpool will unlock these opportunities for you and kick-start your career as a computer scientist.
Create a degree to suit you

Computer Science is now a huge and diverse discipline and we realise that it can be difficult for students to decide upfront on the specific direction that they will take. Therefore, we give you the flexibility to tailor your learning to your own interests as they develop during your studies. You can either maintain a broad coverage of topics, or specialise by choosing from a wide selection of optional modules ranging from software engineering, big data and computer game development to robotics and financial computing.

Based on an extensive analysis of current employment opportunities, and in consultation with both students and employers, we offer specialisms in artificial intelligence, algorithms and optimisation, data science and software development.

- **Artificial intelligence** is an exciting and revolutionary field of computer science, with cutting-edge applications in areas as diverse as intelligent robotics and autonomous vehicles, healthcare, law, climate change, and computer games.

- **Algorithms** are at the heart of every computer system. Our algorithms and optimisation specialism will introduce you to the fascinating world of design, analysis and the optimisation of algorithms, covering a wide range of relevant areas from finance to information security, and from biological systems to social networks.

- **Many cutting-edge applications of computer science** are now data intensive, and data scientists are in high demand. Our data science specialism prepares you to fill the looming employment gap in the field of big data analytics, especially in the context of the skills required with respect to the application of high performance computing capabilities to address large scale data intensive problems that occur in many fields.

- **Software developers** bring system designs to life. Our software development specialism prepares our students to build commercial ready systems in prominent domains such as networks, the web, mobile apps and computer games.

**Good to know:**

166

Year One undergraduates in 2016

1st

in the UK for 4* and 3* research outputs (REF 2014)

93%

of our students said staff are good at explaining things (NSS 2016)

90%

of 2016 graduates are in a professional or managerial level job

Offers study abroad opportunities

Offers a Year in China

Continued over...
Learn from leading experts in a culture of research excellence

The department is a Centre of Excellence with respect to teaching and research. The latest Research Excellence Framework rated 97% of our research outputs as being world-leading or internationally excellent, the highest proportion of any computer science department in the UK.

With our close industry partners, and our Russell Group status, we enjoy strong funding from a mixture of European, National and industrial sponsors, providing a balanced portfolio of activity that feeds back into teaching. This helps us ensure our programmes go beyond the practical application of the subject to inspire you about the possibilities of computer science. Thanks to our industry partnerships, we can inject a significant practical element into your degree programme, including project work, placements and career workshops.

Put your learning into practice through industry experience

We offer a wide range of options that allow you to gain in-depth experience of the application of computing in the real world by spending a year in industry. There are also many opportunities to widen your career prospects through Honours year industry-based projects, paid summer internships and University-supported work placements outside study time. Liverpool has a substantial and growing IT industry, with over 700 related companies on Merseyside offering a wealth of employment opportunities on your doorstep.

Through our programmes you can take part in the Microsoft IT Academy Programme and qualify for Microsoft certification in Network and IT Systems Administration, Software Development, or Database Administration.

Have confidence for the future with our accredited degree programmes

Our Computer Science Single Honours BSc, MEng and MSc programmes have all been accredited by the British Computer Society and so open up a wide variety of career opportunities with excellent employment prospects.

Benefit from studying in a well-established department

Computer Science at the University of Liverpool has a history going back to the 1960s. As the subject grew in importance, the Department of Computer Science was established in 1983 to provide learning and research support in this new and exciting field that spans and interplays with more traditional subjects such as mathematics, physics, biology and engineering. After five decades, the department is still rapidly growing and evolving and remains at the forefront of computer science globally. The department was one of the first in the University to be involved in the collaboration with Xi’an Jiaotong-Liverpool University that has forged a strong international partnership for teaching and research between the two institutes.

We are housed in a grade II listed building which has been extensively refurbished for 21st century needs and challenges and provides state-of-the-art equipment and high-speed communication links. We teach in state-of-the-art PC and Mac laboratories running a variety of different operating systems, as well as iOS and Android tablets to encourage creativity and innovation within a stimulating environment in which to work and study. For those interested in autonomous and robotic systems, we also have dedicated labs where students can build and test their own Lego Mindstorms robots.
Why choose Electrical Engineering and Electronics at Liverpool?

Electrical Engineering and Electronics at Liverpool offers an exciting range of degree programmes which address all of the major subject areas underpinning the technology based modern economy. Whether your interests are in robotics, computers, power systems, communications networks or the internet-of-things, our range of degrees will give you a head start.
Equip yourself to take advantage of excellent career prospects
We work closely with top employers in the development of our programmes so that all of our undergraduate programmes will give you the knowledge and skills that employers are looking for. Emphasis is given to the basic principles of electrical/electronic engineering together with information technology, both software and hardware, and you will use industry standard tools, technologies and working methods ensuring you are industry ready.

Be prepared for the global workplace
The technology economy is truly global and transcends borders. We offer outstanding opportunities for our students to experience different systems, technologies and cultures through placements with the Study Abroad programme and take advantage of our international University partnerships, including studying at Xi’an Jiaotong-Liverpool University in Suzhou, China.

Gain real hands-on experience
Often working closely with leading technology companies, you will work on individual and group projects throughout your studies. Our approach is to enable you to mature through the practical application of concepts and theory, always with awareness of their relevance to the real world. You will take projects from conception, through to design, implementation and operation and there are many opportunities to put your learning into practice through an optional year in industry.

Thrive within our friendly environment
Our supportive and friendly environment is reflected in our high overall student satisfaction rate (National Student Survey). Your personal development and employability skills are reinforced in the supportive small group environment of our fortnightly tutorial sessions.

Apply for generous scholarships
The Institution of Engineering and Technology (IET) offers generous scholarships worth up to £1,000 per year. More details can be found at www.theiet.org/awards

Benefit from our excellent facilities
You’ll study in our £2 million refurbished teaching laboratories and state-of-the-art facilities for robotics and digital systems.

Good to know:
94
Year One undergraduates in 2016

90%
of students agree staff are good at explaining things (NSS 2016)

90%
of students are ‘satisfied’ with their programme (NSS 2016)

90%
of our graduates who are in employment six months after graduating, have a professional or managerial job (Unistats)

Offers study abroad opportunities

Offers a Year in China
## Computer Science Timetable

**Semester One Typical week**

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
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</thead>
<tbody>
<tr>
<td>9.00 Introduction to programming in Java lecture</td>
<td>Introduction to programming in Java lecture</td>
<td>Foundations of computer science lecture</td>
<td>Foundations of computer science lecture</td>
<td>Foundations of computer science lecture</td>
<td>Labs and tutorials</td>
<td>Labs and tutorials</td>
</tr>
<tr>
<td>10.00 Logic in computer science lecture</td>
<td>Foundations of computer science lecture</td>
<td>Professional skills lecture</td>
<td>Introduction to programming in Java lecture</td>
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</tr>
<tr>
<td>11.00 Foundations of computer science lecture</td>
<td>Labs and tutorials</td>
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<tr>
<td>12.00 Professional skills lecture</td>
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<tr>
<td>13.00 Computer systems lecture</td>
<td>Labs and tutorials</td>
<td>University sports match</td>
<td>Computer systems lecture</td>
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<tr>
<td>14.00 Labs and tutorials</td>
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<tr>
<td>15.00 Independent study/assignments</td>
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<td>16.00</td>
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<tr>
<td>19.00 Halls of residence social event</td>
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</tbody>
</table>

Please note: Timetable subject to change and variable depending on options chosen.
### Electrical Engineering and Electronics Timetable

#### Semester One

**Typical week**

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
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</thead>
<tbody>
<tr>
<td>9.00</td>
<td>Engineering skills and experimental skills lecture</td>
<td>Electrical circuits and systems lecture</td>
<td>Engineering skills and experimental skills labs</td>
<td>Electronic circuits lecture</td>
<td>Morning session at the University Sports &amp; Fitness</td>
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<tr>
<td>10.00</td>
<td>Introduction to programming in C lecture</td>
<td>Electronic circuits lecture</td>
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<td></td>
<td>Tutorial with academic advisor</td>
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<tr>
<td>11.00</td>
<td>Mathematics I for electrical engineers lecture</td>
<td>Mathematics I for electrical engineers lecture</td>
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</tr>
<tr>
<td>12.00</td>
<td>Library/independent study</td>
<td>Library – write up lecture notes</td>
<td>Engineering skills and experimental skills labs</td>
<td>Electrical circuits and systems lecture</td>
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<tr>
<td>13.00</td>
<td>Library/independent study</td>
<td>Library – write up lecture notes</td>
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<td>Library – write up lab notes</td>
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<tr>
<td>14.00</td>
<td>Electrical circuits and systems lecture</td>
<td>University sports match</td>
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<tr>
<td>15.00</td>
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<td>Library – write up lab notes</td>
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<td>16.00</td>
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<tr>
<td>18.00</td>
<td>Guild quiz night</td>
<td>EEE society social event</td>
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<tr>
<td>19.00</td>
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</tbody>
</table>

**Please note:** timetable subject to change and variable depending on options chosen.
Invest in your future

Computer Science

Internationally, computer scientists are in the highest-earning category of graduates.

Realise your potential

Computer science graduates are among the highest-earners globally: there is a huge demand from industry for computer programmers, data scientists, artificial intelligence researchers, systems analysts, software engineers, technical consultants and web developers. In 2016, six out of the 10 best performing global companies had a focus on information technology. Over 90% of Liverpool’s Computer Science graduates go onto well-paid graduate jobs with companies like Siemens, BAE Systems, BT, Unilever, Royal Bank of Scotland and Guardian Media Group. Some graduates reach senior management and directorial positions, others enter into self-employment via consultancy agencies or within their own start-up companies, and some choose to continue their studies at masters or PhD level and embark on a research career in academia or industry.

Many go straight into well-paid careers such as:
- Computer programmer
- Software developer
- Systems analyst
- Software engineer
- Technical consultant
- Web designer.

Some reach senior management and directorial positions, as in the case of a former student who became game development manager for one of the largest games producers in the UK.

Recent employers of our graduates
- BAE Systems
- BT Siemens
- Guardian Media Group
- Royal Bank of Scotland
- Unilever.

Work experience opportunities

Our programmes “with a Year in Industry” offer you the opportunity to strengthen employment prospects by putting your computing skills into practice in the workplace. In addition, you may also have the opportunity to work with a commercial partner as part of your final year project, allowing you to gain valuable experience for when you graduate.

Postgraduate opportunities

We offer both taught MSc programmes and research leading to the degrees of MPhil and PhD. These draw on staff specialisms within the department’s two main pillars of research, Algorithms and Artificial Intelligence. The focused research groups that are underpinned by these pillars are recognised internationally for their research excellence, and have strong links with institutions both in the UK and abroad.

Key skills

A degree from the Department of Computer Science will prepare you for life with:
- Effective information retrieval, management and organisational skills
- The ability to use general IT facilities effectively
- The ability to manage your own learning and development
- The ability to work effectively as a member of a development team.
Invest in your future

Electrical Engineering and Electronics

Our degrees have excellent career prospects: 90% of our graduates who are in employment six months after graduating, have a professional or managerial job (Unistats). Graduate employers include Siemens, BAE Systems, BT and Guardian Media Group. Careers are many and varied and include design engineer, systems engineer, medical physicist, postdoctoral research scientist and radio frequency scientist. Some of our graduates go on to work in the industrial sector, in government and in education, whilst others enter non-technical professions such as banking, accountancy, management and law.

Recent employers of our graduates
- ARM Holdings Ltd
- British Nuclear Group
- Daresbury Laboratory
- Deva Electronic Controls
- Energetix Group PLC
- Ericsson Ltd
- Heap and Partners Ltd
- Logica CMG
- Marconi
- Royal Liverpool University Hospital (Clinical Engineering)
- Science and Technology Facilities Council
- Scottish Power
- Siemens UK
- The Highways Agency
- United Utilities PLC.

Work experience opportunities
Our Year in Industry programmes include a placement year during which you will spend time working in an engineering company. This is an excellent opportunity to gain practical engineering experience which will boost your CV. Many placement students continue their relationship with the placement provider by undertaking relevant projects when they return to the University and may ultimately return to work for the company when they graduate. The placement is assessed by two reports, a poster and an oral presentation.

Placements can be near or far, in the UK, Europe or China. Placements have been offered by the National Oceanography Centre which is based on the University campus and CES companies based on Suzhou Industrial Park (SIP) in China. Students who take up a placement on SIP are offered accommodation at our partner University, Xi’an Jiaotong-Liverpool University (XJTLU), based in Suzhou, China and they have access to all the facilities on the XJTLU campus.

Postgraduate opportunities
If you wish to continue your studies at postgraduate level, we offer a range of master’s programmes in addition to opportunities for PhD study drawing on staff specialisms.
Sensor City
Alongside Liverpool John Moores University (LJMU), and in partnership with the Liverpool City Region Local Enterprise Partnership (LEP) we have been awarded £15million to create ‘Sensor City’. This facility will house and support new high tech businesses around ‘sensor technologies’.

Sensors are the crucial link between technological devices and the world around them, capturing data on a whole host of areas such as temperature, humidity and pressure. They can be used in everything from home security systems to medical technology and high value manufacturing. ‘Sensor City’ will help inventions go from the lab to the factory floor even faster and act as a shop window for foreign investment into the city’s high tech start-ups.

New Centre for Plasma Microbiology
We are establishing a new Centre for Plasma Microbiology, which will focus on the development of novel plasma based physical interventions to prevent biofilm formation on medical devices. The new Centre is one of nine projects funded through the Engineering and Physical Sciences Research Council (EPSRC) Healthcare Technologies Challenge Awards, a new scheme to improve healthcare diagnosis and treatment to address unmet healthcare needs.

Organic Electronics
Organic Electronics is an emerging technology for low-cost, high volume and flexible electronics. The scope for application broadens with the possibility of integrating electronic and optoelectronic devices on a same flexible substrate. Most of such applications ranging from Radio Frequency Identification (RFID) tags, sensors to smart objects, require circuitry for logic operations. The Organic Electronics group is focused in the development of low-cost organic circuits that can be utilised as key functional blocks in such applications. This includes generating novels, circuit designs and respective low-cost fabrication processes for building the circuits on flexible plastic substrates.

Liverpool leading the challenge of cyber security
We are developing a new tool that can protect organisations of all sizes from cyber threats. Cyber security is recognised as a serious challenge to economic and national security and it is estimated to cost the UK economy £10 billion a year. Professor Simon Maskell is leading the project in partnership with Hewlett Packard and the Engineering and Physical Sciences Research Council.

Teaching computers to understand human languages
Computer Science researchers at the University of Liverpool have developed a set of algorithms that will help teach computers to process and understand human languages. Whilst mastering natural language is easy for humans, it is something that computers have not yet been able to achieve. The algorithms will enable a computer to act in much the same way as a human would when encountered with an unknown word. When the computer encounters a word it doesn’t recognise or understand, the algorithms mean it will look up the word in a dictionary and try to guess what other words should appear with this unknown word in the text. Learning accurate word representations is the first step towards teaching languages to computers.

New research will help robots know their limits
Robots that can think and act without human intervention are moving from fiction to reality. Many industries are developing autonomous systems to carry out tasks that are too difficult or too dangerous for humans. The Computer Science Department is part of a £1.4 million research project to ensure that autonomous robots built in the future will be safer, make decisions that are ethical and follow legislation on robotics.
Get involved!

**Eshock student society**
Eshock is a student social society which aims to enhance EEE students’ time at the University of Liverpool in both social and academic endeavours. Find more at [www.liverpoolguild.org/groups/eshock](http://www.liverpoolguild.org/groups/eshock)

**Liverpool Women in Science and Engineering (LivWiSE)**
LivWiSE is a society for men and women to celebrate and promote women in science, technology, engineering, maths and medicine (STEM). They regularly host events and networking opportunities which are open to everyone interested in STEM. Find out more at [www.liverpool.ac.uk/livwise](http://www.liverpool.ac.uk/livwise), [www.facebook.com/liverpoolWISE](http://www.facebook.com/liverpoolWISE) or Twitter @LivUniWISE

**Liverpool Comp Soc**
Join students passionate about computers, gaming, and programming to support each other in both academic endeavours and personal hobbies. Find out more at [www.liverpoolguild.org/groups/compsoc](http://www.liverpoolguild.org/groups/compsoc) and follow them on Twitter @livcompsoc

**Liverpool Girl Geeks**
Liverpool Girl Geeks celebrates and inspires women interested in having a career in technology, digital, code and gaming. Find out more at [https://liverpoolgirlgeeks.wordpress.com](https://liverpoolgirlgeeks.wordpress.com) and follow them on Twitter @lpoolgirlgeeks

"Having the ability to create and destroy so easily is unique to computer science. Software Development builds upon this and furthers your understanding and ability to build software. I like to think of it as my way of contributing back to the technology industry that I utilise so much. Since starting my programme here I’ve already been in contact with University of Liverpool alumni on LinkedIn about possible internships at Apple in the USA. However, I’m also looking at software engineering jobs in London. My dream companies to work for are Google, Apple or IBM."

Adam Jarvis
Software Development BSc (Hons)
<table>
<thead>
<tr>
<th>Program</th>
<th>Code</th>
<th>Duration</th>
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</thead>
<tbody>
<tr>
<td>Avionic Systems BEng (Hons)</td>
<td>H430</td>
<td>3 years</td>
</tr>
<tr>
<td>Avionic Systems with a Year in Industry BEng (Hons)</td>
<td>H432</td>
<td>4 years</td>
</tr>
<tr>
<td>Avionic Systems MEng (Hons)</td>
<td>H431</td>
<td>4 years</td>
</tr>
<tr>
<td>Computer Science BSc (Hons)</td>
<td>G400</td>
<td>3 years</td>
</tr>
<tr>
<td>Computer Science with a Year in Industry BSc (Hons)</td>
<td>G403</td>
<td>4 years</td>
</tr>
<tr>
<td>Computer Science MEng (Hons)</td>
<td>G401</td>
<td>4 years</td>
</tr>
<tr>
<td>Computer Science and Electronic Engineering BEng (Hons)</td>
<td>H436</td>
<td>3 years</td>
</tr>
<tr>
<td>Computer Science and Electronic Engineering with a Year in Industry BEng (Hons)</td>
<td>H437</td>
<td>4 years</td>
</tr>
<tr>
<td>Computer Science and Electronic Engineering MEng (Hons)</td>
<td>GH66</td>
<td>4 years</td>
</tr>
<tr>
<td>Computer Science with Software Development BSc (Hons)</td>
<td>G610</td>
<td>3 years</td>
</tr>
<tr>
<td>Computer Science with a Year in Industry BSc (Hons)</td>
<td>G611</td>
<td>4 years</td>
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<tr>
<td>Electrical and Electronic Engineering BEng (Hons)</td>
<td>H603</td>
<td>3 years</td>
</tr>
<tr>
<td>Electrical and Electronic Engineering with a Year in Industry BEng (Hons)</td>
<td>H605</td>
<td>4 years</td>
</tr>
<tr>
<td>Electrical and Electronic Engineering MEng (Hons)</td>
<td>H606</td>
<td>4 years</td>
</tr>
<tr>
<td>Medical and Electronic Engineering with a Year in Industry MEng (Hons)</td>
<td>H607</td>
<td>5 years</td>
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<tr>
<td>Financial Computing BSc (Hons)</td>
<td>GN34</td>
<td>3 years</td>
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<td>Financial Computing with a Year in Industry BSc (Hons)</td>
<td>G3N4</td>
<td>4 years</td>
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<tr>
<td>Mathematics and Computer Science with a Year in Industry BSc (Hons)</td>
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<td>3 years</td>
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<tr>
<td>Mechatronics and Robotic Systems BEng (Hons)</td>
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<td>Mechatronics and Robotic Systems MEng (Hons)</td>
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<td>Mechatronics and Robotic Systems with a Year in Industry MEng (Hons)</td>
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<tr>
<td>Computer Science with Education MEng</td>
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<td>4 years</td>
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<tr>
<td>Computer Science BSc (Hons) (Foundation) (4-year route with Carmel College)</td>
<td>G408</td>
<td>4 years</td>
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<tr>
<td>Engineering Foundation BEng (Hons) (4-year route including a Foundation Year at Carmel College)</td>
<td>H109</td>
<td>4 years</td>
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</tbody>
</table>

1 Students can apply for this programme at the end of Year Two.
2 Foundation programmes have flexible entry requirements. Contact E: degree@carmel.ac.uk for details.

See www.liverpool.ac.uk/study/undergraduate/courses for current entry requirements.
Avionic Systems BEng (Hons)
UCAS code: H430
Programme length: 3 years

Avionic Systems with a Year in Industry BEng (Hons)
UCAS code: H432
Programme length: 4 years

What stops an aircraft from falling out of the sky? The fundamental reason is due to the aerodynamic lift acting on the wings but, for modern aircraft, sophisticated electronics is another essential ingredient. Electronic systems associated with flight are known by the term ‘avionics’. Avionics covers the internal sensors and control systems within aircraft; from airborne communication and navigation systems to ‘stealth’ aircraft design and flight control systems.

The avionics in most aircraft will be upgraded several times during the life of the airframe. This makes avionics one of the most important sectors in the aerospace industry and it is a major employer in the UK.

This degree programme aims to prepare you to work in a variety of related disciplines: radar systems, GPS/inertial navigation systems, guidance and control, and avionics systems design.

We have strong links with industry and a number of undergraduate projects have been generated from industrial projects undertaken by members of the Department. Examples include the development of infrared tracking algorithms for missile warning systems, antenna design for airborne communications and flight control systems for terrain avoidance in low-level flight.

Pilot Studies pathway
Our Avionics programmes give you the option to learn to fly and to build towards either a National Private Pilot’s Licence (NPPL) or a full JAA/PPL in the first year and the ‘frozen’ Air Transport Pilot’s Licence (fATPL) in the second year. If you are seeking a career as a commercial airline pilot it is possible to work towards the fATPL. Our flight training partners are based at Liverpool John Lennon Airport and time for flight training is provided in your timetable. Also, a particularly exciting experimental facility on the University campus is the Bibby Flight Simulation Laboratory featuring motion and visual cueing and a library of different aircraft types that students can ‘try their hands on’. A new two-seat motion simulator is used as support to our Pilot Studies programmes.

An additional fee of approximately £3,400 is required to cover the costs of the mandatory 20 hours pilot training that is required for all students who choose the Pilot Studies pathway and work towards the NPPL, JAA/PPL and fATPL.

Programme in detail
The programme starts by giving you a basic grounding in all of the necessary technical subjects in Year One, with modules in electrical circuits and systems, digital electronics, mathematics and an introduction to aerospace engineering (which covers the principles of flight and terminology of aerospace engineering).

If you have chosen the option to learn to fly, Year One has a pilot studies module that supports the flying activities and the pilot ground school course for the private pilot’s licence (including meteorology, air navigation and air law) – and time is factored into the Year One timetable to enable you to acquire the flying time required by the ‘with Pilot Studies’ programmes.

In Year Two, avionics is introduced through a dedicated module which covers everything from radar cross-sections of ‘stealth’ aircraft to airborne navigation using the Global Positioning System. Year Two also includes modules in instrumentation (covering the electrical devices that are used to monitor and control the flight of aircraft) and other relevant subjects.

For up-to-date entry requirements and full module details see www.liverpool.ac.uk/study/undergraduate/courses
In Year Three, there is an opportunity to specialise in a particular area of avionics with individual project work and optional modules in antenna and radar systems, control systems or navigation. Throughout the programme, there is a strong multidisciplinary flavour to the subjects being studied, with common elements shared by mainstream aerospace engineering students and electrical engineers. However, the Avionics programme offers a range of avionics modules that will provide you with greater in-depth technical knowledge than is offered by either of the mainstream subject areas.

On H432, students spend their third year of study on industrial placement.

**Key modules**

**Year One**

**Compulsory modules**
- Digital and integrated electronics design
- Electrical circuits and systems
- Electromagnetism and electromechanics
- Electronic circuits
- Experimental skills
- Introduction to programming in C
- Mathematics I for electrical engineers
- Mathematics II for electrical engineers.

**Optional modules**
- Introduction to aerospace engineering
- Pilot studies I.

**Year Two**

**Compulsory modules**
- Avionics and communication systems
- Digital electronics and microprocessor systems
- Electrical circuits and power systems
- Electronic circuits and systems
- Field theory and partial differential equations
- Instrumentation and control
- Signals and systems.

**Optional modules**
- Aircraft performance A
- Electromagnetics
- Pilot studies II
- Pilot studies III
- Project, problem solving and industrial awareness.

**Year in Industry (H432 only)**

**Compulsory modules**
- Placement.

**Final Year (Year Three for H430, Year Four for H432)**

**Compulsory modules**
- Antennas
- Avionic systems design
- Electronics for instrumentation and communications
- Engineering management and entrepreneurial skills
- Flight dynamics and control
- Image processing
- RF engineering and applied electromagnetics.

**Optional modules**
- Advanced modern management
- Application development with C++
- Digital and wireless communications
- Digital control and optimisation
- Digital systems design
- Drives
- Electromagnetic compatibility
- Embedded computer systems
- Integrated circuits-concepts and design
- Neural networks
- Organic electronics
- Photonics and optical information systems
- Power generation, transmission and distribution
- Signal processing and digital filtering.

See pages 30-43 for module descriptions.
**Avionic Systems MEng (Hons)**  
**UCAS code: H431**  
**Programme length: 4 years**

This programme provides a deeper level of knowledge than the BEng degree in Avionic Systems, allowing for more specialisation and a faster route to a recognised professional qualification as a Chartered Engineer. Modules explore the technical and industrial management aspects of a professional engineer’s role. An additional fee of approximately £3,400 is required to cover the costs of the mandatory 20 hours pilot training that is required for all students who choose the pilot studies pathway and work towards the NPPL, JAA/PPL and fATPL.

**Programme in detail**

The first two years of this programme are the same as the BEng programme. In the third year, there is some commonality, but there is more emphasis on longer term project work. This gives you more time to develop your interests and knowledge of the subject.

There is also a group project which interfaces with other disciplines within Aerospace Engineering to provide specialist avionics expertise on large scale airframe design. Examples from previous years have included the design of UAVs (Uninhabited Air Vehicles) and their associated control systems and sensor suites.

The fourth year offers you more depth in your speciality (eg radar systems or navigation systems and flight control) and further hands-on project work. This year also includes flight simulator work with flight handling qualities, advanced guidance systems and avionic systems design modules.

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**Key modules**

**Year One**  
Compulsory and optional modules  
Same as H430 on page 15.

**Year Two**  
Compulsory and optional modules  
Same as H430 on page 15.

**Year Three**  
Compulsory modules  
- Antennas  
- Avionic systems design  
- Electronics for instrumentation and communications  
- Engineering management and entrepreneurial skills  
- Flight dynamics and control  
- Image processing  
- RF engineering and applied electromagnetics.

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For up-to-date entry requirements and full module details see [www.liverpool.ac.uk/study/undergraduate/courses](http://www.liverpool.ac.uk/study/undergraduate/courses)
Optional modules
- Advanced modern management
- Application development with C++
- Digital control and optimisation
- Drives
- Integrated circuits-concepts and design
- Neural networks
- Organic electronics
- Photonics and optical information systems
- Power generation, transmission and distribution
- Signal processing and digital filtering.

Year Four
Compulsory modules
- Advanced embedded computer systems
- Advanced guidance systems
- Advanced systems modelling and control
- Digital and wireless communications
- Electromagnetic compatibility
- Management of design
- Radio propagation for wireless systems.

Optional modules
- Advanced signal processing
- Communications networks and security
- Computational intelligence
- Digital system design
- Energy conversion, renewable energy and smart grids
- High voltage engineering
- Information theory and coding
- Measurement, monitoring and sensors in power systems
- Microprocessor systems
- Power generation, transmission and distribution
- Software engineering and programming.

See pages 30-43 for module descriptions.

Computer Science BSc (Hons)
- with specialism in
  Artificial Intelligence
- with specialism in
  Algorithms and Optimisation
- with specialism in Data Science
UCAS code: G400
Programme length: 3 years

Computer Science with a Year in Industry BSc (Hons)
UCAS code: G403
Programme length: 4 years

Computer Science with Software Development BSc (Hons)
UCAS code: G610
Programme length: 3 years

Computer Science with Software Development with a Year in Industry BSc (Hons)
UCAS codes: G611
Programme length: 4 years

Computer Science MEng (Hons)
UCAS code: G401
Programme length: 4 years

Computer Science is a broad area which includes designing and building hardware and software systems for a wide range of purposes and processing, structuring and managing various kinds of information. Covering all aspects of computer science, including the underlying principles and theory, this programme will ensure that when you graduate you will know what is and isn’t possible with computers and be able to find solutions to the problems you will encounter in your professional life.

You can choose to maintain a mixture of modules throughout your degree or follow a specialist’s pathway in artificial intelligence, algorithms and optimisation or data science. Computer Science with Software Development (G610) is a pathway for those wanting to specialise in development, updating and widespread application of complex software.

Continued over...
Studying Computer Science MEng (G401), you will not only develop a good ‘all-round’ understanding of the academic discipline of Computer Science, you will also go on to develop a much deeper and systematic specialisation in topics at the forefront of current research. This integrated master’s programme offers the same specialism pathways as G400.

On G403 and G611 you spend a year on industrial placement acquiring experience and awareness of practical business and industrial environments.

**Programme in detail**
The first two years cover a range of compulsory modules including: Programming in Java; Computer systems; Databases; Software engineering; Algorithmic foundations; Complexity of algorithms and decision; Computation and language. You then choose from a selection of modules representing the cutting-edge of computer science today. These cover topics such as bio computation, introduction to computational game theory and complex social networks, amongst others. This degree includes a second year group software project and an honours year individual project.

**Key modules**

**Year One**

Compulsory modules
- Analytical techniques for computer science
- Computer systems
- Data structures and algorithms
- Foundations of computer science
- Graduates for the digital society
- Introduction to artificial intelligence
- Introduction to programming
- Object-oriented programming
- Programming language paradigms.

**Year Two**

Compulsory modules
- Complexity of algorithms
- Database development
- Group software project
- Software engineering I.

**Optional modules**
- Advanced object-oriented C languages
- Applied database management
- Artificial intelligence
- Computer-aided software development
- Computer-based trading in financial markets
- Decision, computation and languages
- Distributed systems
- Internet principles
- Planning your career
- Principles of C and memory management
- Principles of computer game design and implementation
- Programming language paradigms
- Scripting languages
- Software development tools.

**Year in Industry (G403 and G611 only)**

Compulsory modules
- Placement.

**Final Year (Year Three for G400, G401 and G610, Year Four for G403 and G611)**

Compulsory modules
- Honours Year computer science project.

Optional modules
- Advanced web technologies
- Biocomputation
- Communicating computer science
- Complex information and social networks
- Computational game theory and mechanism design
- Formal methods
- Image processing
- Introduction to computational game theory
- Knowledge, representation and reasoning
- Mobile computing
- Multi-agent systems
- Neural networks
- Optimisation
- Robotics and autonomous systems
- Software engineering II
- Technologies for e-Commerce.

See pages 30-43 for module descriptions.
Year Four (G401 only)
Compulsory module
- MEng group project
- MEng individual project

Optional modules
- Advanced algorithmic techniques
- Applied algorithmics
- Big data analysis
- Computational intelligence
- Data mining and visualisation
- Knowledge representation
- Machine learning and bioinspired optimisation
- Multi-core and multi-processor programming
- Privacy and security
- Reasoning about action and change
- Safety and dependability

See pages 30-43 for module descriptions.

Programme in detail
During Year One you will be introduced to the fundamentals of electronics as well as the underlying principles and theory of computing. Your lecture modules will cover the core subjects of electronic circuits, digital electronics, Java programming and data structures.

In addition you will take modules such as mathematics and spend one day a week doing practical work in both the computer and electronics laboratories. This will give you excellent practical and transferable skills vital for subsequent years of the programme and invaluable in your future career.

The second year builds on the first with core modules in software engineering, database development, digital electronics and signals and communication systems. More time is spent in the electronics laboratory doing practical work to consolidate the knowledge learnt in lectures and partaking in an extended team project.

In your third year you will have the option of selecting advanced modules from either department according to your chosen area of specialisation. Electronics options include verilog digital system design; digital control; data communications and optical information systems. Typical computer science options are bio computation; image processing; computer vision and graphics; advanced web technologies and e-Commerce technologies.

Also in the final year, you will undertake a 20-week individual project. Recent projects have included ‘real-time GPS tracking of a vehicle fleet by mobile phones’, and a ‘mobile multi-user dungeon (MUD) game using SMS messaging’.

On HG6L, students spend their third year of study on industrial placement.

Key modules
Year One
Compulsory modules
- Digital and integrated electronics design
- Electrical circuits and systems
- Electronic circuits
- Engineering skills
- Graduates for the digital society
- Mathematics I and II for electrical engineers
- Object-oriented programming.
Year Two
Compulsory modules
- Communication systems
- Database development
- Digital electronics and microprocessor systems
- Electronic circuits and systems
- Instrumentation and control
- Operating system concepts
- Project, problem solving and industrial awareness
- Signals and systems
- Software engineering I.

Year in Industry (HG6L only)
Compulsory modules
- Placement.

Final Year (Year Three for HH66, Year Four for HG6L)
Compulsory modules
- Application development with C++
- Embedded computer systems
- Engineering management and entrepreneurial skills
- Honours Year computer science project
- Neural networks
- Software engineering II.

Optional modules
- Advanced modern management
- Antennas
- Biocomputation
- Digital and wireless communications
- Digital control and optimisation
- Digital systems design
- Drives
- Electromagnetic compatibility
- Electronics for instrumentation and communications
- Formal methods
- Image processing
- Integrated circuits-concepts and design
- Introduction to computational game theory
- Multi-agent systems
- Organic electronics

- Photonics and optical information systems
- Power generation, transmission and distribution
- RF engineering and applied electromagnetics
- Signal processing and digital filtering
- Technologies for e-Commerce.

See pages 30-43 for module descriptions.

Computer Science and Electronic Engineering MEng (Hons)
UCAS code: GHK6
Programme length: 4 years

This MEng (Hons) degree programme provides added depth and breadth to the BEng (Hons) programme. The first two years of this programme are identical to the BEng (Hons) in Computer Science and Electronic Engineering (HH66), giving you the flexibility to choose between programmes if you are uncertain which one is your first choice at present. In the fourth year you will also undertake a major group project in which you collectively assign responsibilities and management roles within the team.

Programme in detail
In your third and fourth years you will study a greater range of subjects including management of design and total quality management, important areas for the engineering leaders of the future, and you will have the opportunity to study more advanced topics such as computational intelligence, telecommunications, advanced system modelling and control, and multi-agent systems. The final year includes a 20-week individual project.

This MEng (Hons) programme is the best preparation for either graduate level employment in either the computer or the electronics industry, or a research degree in one of the many strong research groups in the Department of Electrical Engineering and Electronics. It is also a quicker route to chartered engineer status.

Key modules
Year One
Compulsory modules
- Digital and integrated electronics design
- Electrical circuits and systems
- Electronic circuits

For up-to-date entry requirements and full module details see www.liverpool.ac.uk/study/undergraduate/courses
● Engineering skills
● Graduates for the digital society
● Mathematics I and II for electrical engineers
● Object-oriented programming.

Year Two
Compulsory modules
● Communication systems
● Database development
● Digital electronics and microprocessor systems
● Electronic circuits and systems
● Instrumentation and control
● Operating system concepts
● Signals and systems
● Software engineering I.

Year Three
Compulsory modules
● Application development with C++
● Embedded computer systems
● MEng project
● Neural networks
● Project management.

Optional modules
● Advanced modern management
● Antennas
● Digital and wireless communications
● Digital control and optimisation
● Drives
● Electromagnetic compatibility
● Electronics for instrumentation and communications
● Formal methods
● Image processing
● Integrated circuits-concepts and design
● Introduction to computational game theory
● Multi-agent systems
● Organic electronics
● Photonics and optical information systems
● Power generation, transmission and distribution
● RF engineering and applied electromagnetics
● Signal processing and digital filtering
● Software engineering II.

Year Four
Compulsory modules
● Advanced algorithmic techniques
● Communications networks and security
● Digital system design
● Information theory and coding
● Knowledge representation
● Management of design
● MEng group project.

Optional modules
● Advanced embedded computer systems
● Advanced signal processing
● Advanced systems modelling and control
● Biocomputation
● Communications networks and security
● Computational intelligence
● Digital and wireless communications
● Energy conversion, renewable energy and smart grids
● Formal methods
● High voltage engineering
● Information theory and coding
● Integrated circuits-concepts and design
● Introduction to computational game theory
● Measurement, monitoring and sensors in power systems
● Microprocessor systems
● Multi-agent systems
● Plasma engineering
● Power generation, transmission and distribution
● Privacy and security
● Radio propagation for wireless systems
● Reasoning about action and change
● Safety and dependability
● Software engineering and programming.

See pages 30-43 for module descriptions.
Electrical and Electronic Engineering BEng (Hons)
UCAS code: H603
Programme length: 3 years

Electrical and Electronic Engineering with a Year in Industry BEng (Hons)
UCAS code: H605
Programme length: 4 years

Graduates of this degree programme go on to a wide range of careers: you may be responsible for planning the electricity distribution network, or you may be designing the electronics of the next ‘must have’ item. However, you are also not limited to a career in engineering, with many employers actively seeking engineers for their mixture of numerical ability and practical problem solving skills. One day per week is timetabled for practical work in our well-equipped modern laboratories during the first two years. In the final year you will choose from a wide range of projects that is either linked to research work or has some industrial relevance.

Programme in detail
Lecture modules also reflect the broad based nature of this degree. In the first year, subjects covered range from digital electronics and electronics circuits through to electromagnetism and electromechanics. A similar range of modules are covered in the second year. In the final year you will be able to choose a specialisation from electrical engineering; electrical and electronic engineering; electronic engineering; electronic and communication engineering. Electrical engineering is not simply about producing and transmitting electrical energy, it is also about how it is used. In both its transmission and usage there are significant and increasing challenges facing electrical engineers; many of these are related to sustainability and the environment. Over the last decade there has been an increase in the generation of electrical energy from greener sources (eg wind, wave, solar etc) and more efficient consumer products with increased electronics and software.

Electrical and electronic engineering is the broadest of the four specialisations and will allow you to choose lecture modules from an extensive list of options including subjects as diverse as power generation and transmission, antennas and digital systems design with verilog. The electronics specialisation will prepare you for the world of modern electronics. The Department of Electrical Engineering and Electronics is particularly strong in electronics with research groups in solid state silicon electronics, molecular electronics and bionano electronics. The Department also has excellent links with the electronics industry, for example ARM Ltd, who design the microprocessors that go into 90% of all mobile phones, have supported the Department through donations (from the Founding CEO of ARM plc, Sir Robin Saxby, an electronics graduate from the University of Liverpool), summer work placements, ideas for project work and, most significantly, employment for many recent graduates.

It is an exciting time for the electronic and communications industry. New and innovative products are coming out every day. The rapid growth of the wireless market is fuelled by technological innovation. The current wireless communication systems include 3G mobile phones, Bluetooth, wireless local area network (WLAN), and Wi-Fi. More exciting wireless systems and technologies (such as WiMAX and 4G) are emerging all the time. This programme is designed for those students with an interest in communications engineering and associated electronics. It covers a wide range of topics in electronic and communications engineering. You will not only learn how a communication system works, but also understand what electronic components are required for such a system.

Key modules

Year One
Compulsory modules

- Digital and integrated electronics design
- Electrical circuits and systems
- Electromagnetism and electromechanics
- Electronic circuits
- Engineering skills
- Introduction to programming in C
- Mathematics I for electrical engineers
- Mathematics II for electrical engineers.
Year Two
Compulsory modules
- CMOS integrated circuits
- Communication systems
- Digital electronics and microprocessor systems
- Electromagnetics
- Electronic circuits and systems
- Field theory and partial differential equations
- Instrumentation and control
- Signals and systems.

Year in Industry (H605 only)
Compulsory modules
- Placement.

Final Year (Year Three for H603, Year Four for H605)
Compulsory modules
- Drives
- Electronics for instrumentation and communications
- Embedded computer systems
- Power generation, transmission and distribution
- Project management.

Optional modules
- Advanced modern management
- Antennas
- Application development with C++
- Digital and wireless communications
- Digital control and optimisation
- Digital system design
- Electromagnetic compatibility
- Image processing
- Integrated circuits-concepts and design
- Neural networks
- Organic electronics
- Photonics and optical information systems
- RF engineering and applied electromagnetics
- Signal processing and digital filtering.

See pages 30-43 for module descriptions.

Electrical and Electronic Engineering MEng (Hons)
UCAS code: H606
Programme length: 4 years

Electrical and Electronic Engineering with a Year in Industry MEng (Hons)
UCAS code: H607
Programme length: 5 years

The MEng allows you to study your areas of interest in more depth and also gives you the time to widen your knowledge of both electrical and electronic engineering and other subjects including management. This degree leads more directly to Chartered Engineer status and it is the choice programme for a career in engineering management. On H607 you will spend your third year on placement in industry.

Programme in detail
The first two years of the MEng and BEng programmes are identical and there is some flexibility to allow switching between programmes, although a higher academic performance is expected for the MEng. In the third year you study core subjects including analogue and digital communications, embedded computer architecture and total quality management. In the final year the core subjects are advanced signal processing, information theory and coding, management of design and management of product development.

In both years you also choose additional lectures from a list of about 30 module options. Practical project work is very important and you will do a group project in Year Three followed by a major individual project in the final year.

Previous group projects have included the design of an inexpensive heart monitor for use on horses in an outdoor situation. A previous individual project was the production of automation software for ‘system on chip’ design for a major silicon chip design company.

Continued over...
**Key modules**

**Year One**

**Compulsory modules**
- Digital and integrated electronics design
- Electrical circuits and systems
- Electromagnetism and electromechanics
- Electronic circuits
- Engineering skills
- Introduction to programming in C
- Mathematics I and II for electrical engineers.

**Year Two**

**Compulsory modules**
- CMOS integrated circuits
- Communication systems
- Digital electronics and microprocessor systems
- Electromagnetics
- Electronic circuits and power systems
- Field theory and partial differential equations
- Instrumentation and control
- Signals and systems.

**Year in Industry (H607 only)**

**Compulsory modules**
- Placement.

**Year Three/Four (Year Three for H606, Year Four for H607)**

**Compulsory modules**
- Drives
- Electronics for instrumentation and communications
- Embedded computer systems
- Engineering management and entrepreneurial skills
- MEng project
- Power generation, transmission and distribution.

**Optional modules**
- Advanced modern management
- Antennas
- Application development with C++
- Digital and wireless communications
- Digital control and optimisation
- Electromagnetic compatibility
- Image processing
- Integrated circuits-concepts and design
- Neural networks
- Organic electronics
- Photonics and optical information systems
- RF engineering and applied electromagnetics
- Signal processing and digital filtering.

**Final Year (Year Four for H606, Year Five for H607)**

**Compulsory modules**
- Digital system design
- Energy conversion, renewable energy and smart grids
- High voltage engineering
- Management of design
- MEng group project.

**Optional modules**
- Advanced embedded computer systems
- Advanced signal processing
- Advanced systems modelling and control
- Communications networks and security
- Computational intelligence
- Digital and wireless communications
- Information theory and coding
- Integrated circuits-concepts and design
- Measurement, monitoring and sensors in power systems
- Microprocessor systems
- Plasma engineering
- Power generation, transmission and distribution
- Radio propagation for wireless systems
- Software engineering and programming.

See pages 30-43 for module descriptions.

**Financial Computing BSc (Hons)**

**UCAS code: GN34**

Programme length: 3 years

**Financial Computing with a Year in Industry BSc (Hons)**

**UCAS code: G3N4**

Programme length: 4 years

Financial Computing is at the very heart of the world’s global financial centres, from Wall Street to Chicago, London and Tokyo. Taught in conjunction with the Management School and bringing together finance, economics and computing, this dynamic programme will develop your knowledge and skills in aspects of financial services from...
understanding and creating algorithms; financial accounting; designing, implementing and evaluating software systems to analysing stock portfolios and operating financial markets.

On **G3N4** you spend a year on industrial placement acquiring experience and awareness of practical business and industrial environments.

**Key modules**

**Year One**

Compulsory modules
- Analytical techniques for computer science
- Graduates for digital society
- Introduction to financial accounting
- Introduction to management accounting
- Introduction to programming
- Object-oriented programming
- Principles of microeconomics
- Programming language paradigms.

**Year Two**

Compulsory modules
- Computer-based trading in financial markets
- Corporate financial management for non-specialist students
- Database development
- e-Commerce group project
- Financial reporting
- Securities markets
- Software engineering I.

Optional modules
- Accounting theory
- Applied database management
- Computer-aided software development
- International business
- Scripting languages.

**Year in Industry (G3N4 only)**

Compulsory modules
- Placement.

**Final Year (Year Three for GN34, Year Four for G3N4)**

Compulsory modules
- Finance and markets
- Honours Year automated trading project
- Introduction to computational game theory
- Quantitative business finance
- Technologies for e-commerce.

Optional modules
- Computational game theory and mechanism design
- Corporate reporting and analysis
- E-business models and strategy
- Financial reporting II
- Global strategic management
- Multi-agent systems
- Optimisation
- Software engineering II.

See pages 30-43 for module descriptions.

**Mathematics and Computer Science BSc (Hons)**

**UCAS code: GG14**

Programme length: 3 years

**Mathematics and Computer Science with a Year in Industry BSc (Hons)**

**UCAS code: GG16**

Programme length: 4 years

Mathematicians and computer scientists are amongst the most highly-prized graduates today. On this programme, you will divide your studies more or less equally between the two subjects, studying modules from Mathematics (**G100**) and Computer Science (**G400**).

On **GG16** you spend a year on industrial placement acquiring experience and awareness of practical business and industrial environments.

**Key modules**

**Year One**

Compulsory modules
- Algorithmic foundations
- Calculus I
- Calculus II
- Graduates for the digital society
- Introduction to linear algebra
- Introduction to programming
- Object-oriented programming
- Programming language paradigms.

Optional modules
- Dynamic modelling
- Introduction to statistics
- Numbers, groups and codes.
Year Two
Compulsory modules
● Complexity of algorithms.

Optional modules
● Classical mechanics
● Commutative algebra
● Complex functions
● Computer systems
● Database development
● Decision, computation and language
● Financial mathematics II
● Geometry of curves
● Group project
● Introduction to artificial intelligence
● Introduction to the methods of applied mathematics
● Introduction to methods of operational research
● Linear algebra and geometry
● Math models: micro-economics and population dynamics
● Metric spaces and calculus
● Numerical methods
● Operational research: probabilistic models
● Ordinary differential equations
● Software engineering I
● Statistical theory and methods I
● Statistical theory and methods II
● Vector calculus with applications in fluid mechanics.

Year in Industry (GG16 only)
Compulsory modules
● Placement.

Final Year (Year Three for GG14, Year Four for GG16)
Compulsory modules
● Final year project.

Optional modules
● Analysis and number theory
● Applied probability
● Artificial intelligence
● Biocomputation
● Cartesian tensors and mathematical models of solids and viscous fluids
● Chaos and dynamical systems
● Combinatorics
● Communicating computer science
● Computational game theory and mechanism design
● Differential geometry
● Efficient sequence algorithms
● Formal methods
● Further methods of applied mathematics
● Group theory
● Introduction to computational game theory
● Knowledge, representation and reasoning
● Linear statistical models
● Mathematical biology
● Mathematical economics
● Mathematical risk theory
● Medical statistics
● Multi-agent systems
● Networks in theory and practice
● Number theory
● Optimisation
● Quantum mechanics
● Relativity
● Software engineering II
● Technologies for e-commerce
● Theory of statistical interference.

See pages 30-43 for module descriptions.

For mathematics modules descriptions visit www.liverpool.ac.uk/mathematical-sciences

Mechatronics and Robotic Systems BEng (Hons)
UCAS code: HH67
Programme length: 3 years

Mechatronics and Robotic Systems with a Year in Industry BEng (Hons)
UCAS code: HHP7
Programme length: 4 years

Mechatronics and robotic systems involves technologies in mechanical engineering, electronics, electrical engineering, control engineering and computing. Remotely operated vehicles on Mars, programmable washing machines at home and automated robots at manufacturing assembly lines are just some examples of mechatronics and robotic systems.
These products are essentially mechanical in nature but could not function without electrical and computer control systems.

There are also numerous automotive applications; modern high performance cars have more than 100 computers hidden in the engine management system, anti-lock brakes, active suspension control and elsewhere. Engineers with experience in mechatronics and robotic systems are therefore in high demand.

Programme in detail
In the first year of this programme you study the fundamentals of digital computers, electronic and electrical circuits and mechanical engineering. You will also take modules in mathematics, computer programming in C and information technology. The second year builds on this knowledge with lecture modules covering topics such as dynamic systems, engineering structures, digital electronics, microprocessor systems and control systems.

Project work will develop your ability in teamwork, leadership and independent problem solving. In the final year you will take compulsory modules covering the fundamentals of mechatronics and robotic systems. This includes modules covering topics such as embedded computer systems, drives and industrial robotics. With the optional modules of your own choice, you can develop your skills in a particular area in which you are interested. The final year includes an individual project.

A recent example of a final year project was the development of electronic traction control for automotive applications using a fuzzy logic controller.

Key modules
Year One
Compulsory modules
- Digital and integrated electronics design
- Electrical circuits and systems
- Electronic circuits
- Experimental skills
- Introduction to mechatronics
- Introduction to programming in C
- Mathematics I and II for electrical engineers
- Solids and structures I.

Year Two
Compulsory modules
- Digital electronics and microprocessor systems
- Dynamic systems
- Electronic circuits and power systems
- Electronic circuits and systems
- Field theory and partial differential equations
- Instrumentation and control
- Project, problem solving and industrial awareness
- Signals and systems
- Solids and structures II.

Year in Industry (HHP7 only)
Compulsory modules
- Placement.

Final Year (Year Three for HH67, Year Four for HHP7)
Compulsory modules
- Digital control and optimisation
- Drives
- Embedded computer systems
- Engineering systems
- Industrial robotics and automated assembly
- MEng project
- Project management.

Optional modules
- Advanced modern management
- Antennas
- Application development with C++
- Digital and wireless communications
- Digital systems design
- Electromagnetic compatibility
- Electronics for instrumentation and communication
- Image processing
- Integrated circuits-concepts and design
- Neural networks
- Organic electronics
- Photonics and optical information systems
- Power generation, transmission and distribution
- RF engineering and applied electromagnetics
- Signal processing and digital filtering.

See pages 30-43 for module descriptions.
Mechatronics and Robotic Systems MEng (Hons)
UCAS code: HH76
Programme length: 4 years

Mechatronics and Robotic Systems with a Year in Industry MEng (Hons)
UCAS code: HHR6
Programme length: 5 years

This MEng (Hons) degree programme has more depth and breadth than the BEng (Hons) programme in Mechatronics and Robotic Systems, studying core subjects, such as advanced system modelling and control, in more detail and a greater range of subjects. In addition to the individual final year project, you will also undertake a major group project in the third year.

Key modules

Year One
Compulsory modules
- Electronic circuits
- Introduction to programming in C
- Electrical circuits and systems
- Digital and integrated electronics design
- Mathematics I and II for electrical engineers
- Solids and structures I.

Year Two
Compulsory modules
- Digital electronics and microprocessor systems
- Dynamic systems
- Electronic circuits and power systems
- Electronic circuits and systems
- Field theory and partial differential equations
- Instrumentation and control
- Signals and systems
- Solids and structures II.

Year in Industry (HHR6 only)
Compulsory modules
- Placement.

Year Three/Four (Year Three for HH76, Year Four for HHR6)
Compulsory modules
- Digital control and optimisation
- Drives
- Embedded computer systems
- Engineering management and entrepreneurial skills
- Industrial robotics and automated assembly
- Mechatronics
- MEng project.

Optional modules
- Advanced modern management
- Antennas
- Application development with C++
- Digital and wireless communications
- Digital systems design
- Electromagnetic compatibility
- Electronics for instrumentation and communication
- Image processing
- Integrated circuits-concepts and design
- Neural networks
- Organic electronics
- Photonics and optical information systems
- Power generation, transmission and distribution
- RF engineering and applied electromagnetics
- Signal processing and digital filtering.

Final Year (Year Four for HH76, Year Five for HHR6)
Compulsory modules
- Advanced systems modelling and control
- Computational intelligence
- Digital system design
- Image processing
- Management of design
- MEng group project
- Microprocessor systems.

Optional modules
- Power generation, transmission and distribution
- High voltage engineering
- Radio propagation for wireless systems
- Information theory and coding
- Software engineering and programming

For up-to-date entry requirements and full module details see www.liverpool.ac.uk/study/undergraduate/courses
Energy conversion, renewable energy and smart grid
- Communications networks and security
- Advanced signal processing
- Advanced systems modelling and control
- Digital and wireless communications
- Plasma engineering.

See pages 30-43 for module descriptions.

**Computer Science with Education MEng**  
UCAS code: N/A. Students can apply at the end of Year Two
Programme length: 4 years

The University of Liverpool is one of the first universities in the UK to offer undergraduate students the opportunity to complete a master’s in Computer Science with Education (with recommendation for QTS) degree programme, satisfying the criteria to become a computer science teacher.

This unique degree programme is part of a joint degree enabling students to qualify with the necessary skills, experience and qualifications to teach in England after their graduation. We pride ourselves on the flexibility we offer with our degree programmes and any computer science undergraduates interested in doing this degree only need to confirm if they want to do the MEng Computer Science with Education by the end of Year Two.

**Computer Science BSc (Hons)**  
(Foundation) (4-year route with Carmel College)  
UCAS code: G408  
Programme length: 4 (1+3) years

This programme provides a four-year route into the Computer Science BSc (Hons) degrees. You will spend your first year at Carmel College in St Helens, about nine miles from the main University campus. The college offers small class sizes and high standards of academic achievement.

**Programme in detail**
At Carmel College, you will take foundation modules in mathematics and a choice of modules from physics, chemistry, biology, geography and IT. You then join the Computer Science BSc (Hons) programme at Liverpool. The first two years cover a range of compulsory modules covering topics such as programming in Java; computer systems; databases; software engineering; algorithmic foundations; complexity of algorithms; and decision, computation and language.

You then choose from a selection of modules representing the cutting-edge of computer science today. These cover topics such as bio computation, introduction to computational game theory and complex social networks, amongst others. This degree includes a second year group software project and an honours year individual project.

**Year Zero**
Based at Carmel College in St Helens, about nine miles from the main University precinct. The college offers small class sizes and high standards of academic achievement. You follow a foundation module in mathematics and have a choice of two other modules taken from physics, chemistry, biology, information technology or geography.

**Engineering Foundation BEng (Hons)**  
(4-year route including a Foundation Year at Carmel College)  
UCAS code: H109  
Programme length: 4 (1+3) years

This modular programme provides a four-year route to all our degree programmes for those students who do not have the appropriate A level qualifications. First year (Year Zero) is based at Carmel College in St Helen’s (approximately nine miles from the main university campus). The foundation year comprises modules in physics and mathematics, and you can choose your third optional module from chemistry or information technology.
# Core and selected optional modules overview

## Year One

<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytic techniques for computer science</td>
<td>2</td>
<td>15</td>
<td>Introduces students to a range of methodologies and practical experiences for the treatment of computational issues.</td>
</tr>
<tr>
<td>Calculus I</td>
<td>1</td>
<td>15</td>
<td>Introduces the basic ideas of differential and integral calculus, to develop the basic skills required to work with them and to apply these skills to a range of problems.</td>
</tr>
<tr>
<td>Calculus II</td>
<td>2</td>
<td>15</td>
<td>Explores local behaviour of functions using Taylor's theorem and introduces multivariable calculus including partial differentiation, gradient, extremum values and double integrals.</td>
</tr>
<tr>
<td>Computer systems</td>
<td>2</td>
<td>15</td>
<td>Introduces how computers function at the instruction operation level.</td>
</tr>
<tr>
<td>Data structures and algorithms</td>
<td>2</td>
<td>15</td>
<td>Introduces the notation, terminology, and techniques underpinning the study of algorithms.</td>
</tr>
<tr>
<td>Digital and integrated electronics design</td>
<td>2</td>
<td>15</td>
<td>Provides a knowledge of number systems such as binary, hexadecimal, BCD, laws of Boolean Algebra, basic design methods for combinational and sequential logic circuits, operation of various silicon electronic devices, the opportunity to understand the basic principles of silicon microelectronics design.</td>
</tr>
<tr>
<td>Electrical circuits and systems</td>
<td>1</td>
<td>15</td>
<td>Enables you to become familiar with a range of circuit analytical techniques.</td>
</tr>
<tr>
<td>Electromagnetism and electromechanics</td>
<td>2</td>
<td>15</td>
<td>Introduces the basic elements of electrostatics and electromagnetics.</td>
</tr>
<tr>
<td>Electronic circuits</td>
<td>1</td>
<td>15</td>
<td>Introduces fundamental electronic devices (diodes and transistors).</td>
</tr>
<tr>
<td>Engineering skills</td>
<td>1 and 2</td>
<td>15</td>
<td>Covers the fundamental concepts and techniques necessary to use industrial/commercial windows-based software applications.</td>
</tr>
<tr>
<td>Experimental skills</td>
<td>1 and 2</td>
<td>7.5</td>
<td>Covers the fundamental concepts and techniques necessary to use industrial/commercial windows-based software applications.</td>
</tr>
<tr>
<td>Foundations of computer science</td>
<td>1</td>
<td>15</td>
<td>Introduces the notation, terminology, and techniques underpinning the discipline of theoretical computer science.</td>
</tr>
<tr>
<td>Graduates for the digital society</td>
<td>1</td>
<td>15</td>
<td>Develops students’ understanding of concepts of professional ethics as well as social, legal and ethical aspects of computing. Develops employability skills.</td>
</tr>
<tr>
<td>Introduction to aerospace engineering</td>
<td>2</td>
<td>7.5</td>
<td>Provides an introduction to aerodynamic performance and stability and control disciplines that are built upon in subsequent years of study.</td>
</tr>
<tr>
<td>Introduction to artificial intelligence</td>
<td>1</td>
<td>15</td>
<td>Provides an introduction to artificial intelligence through studying search problems, reasoning under uncertainty, knowledge representation, planning, and learning in intelligent systems.</td>
</tr>
</tbody>
</table>

Please note: modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to financial accounting</td>
<td>1</td>
<td>15</td>
<td>Develops knowledge and understanding of the underlying principles and concepts relating to financial accounting and technical proficiency in the use of double entry accounting techniques in recording transactions, adjusting financial records and preparing basic financial statements.</td>
</tr>
<tr>
<td>Introduction to linear algebra</td>
<td>1</td>
<td>15</td>
<td>Develops techniques of complex numbers and linear algebra, including equation solving, matrix arithmetic and the computation of eigenvalues and eigenvectors.</td>
</tr>
<tr>
<td>Introduction to management accounting</td>
<td>2</td>
<td>15</td>
<td>Introduces the nature and purpose of management accounting and establishes a sound foundation in its fundamental techniques.</td>
</tr>
<tr>
<td>Introduction to mechatronics</td>
<td>2</td>
<td>7.5</td>
<td>Introduces the basic elements of electromechanics.</td>
</tr>
<tr>
<td>Introduction to programming in C</td>
<td>1 and 2</td>
<td>15</td>
<td>C is one of the most popular languages for programming embedded systems that are found in automobiles, cameras, DVD players and many other modern appliances. This module enables you to learn and use the C programming language to solve real engineering problems and acquire fundamental software development skills covering program design, coding and testing.</td>
</tr>
<tr>
<td>Introduction to programming</td>
<td>1</td>
<td>15</td>
<td>Introduces concepts and principles of problem solving by computer, and the construction of appropriate algorithms for the solution of problems.</td>
</tr>
<tr>
<td>Introduction to statistics</td>
<td>2</td>
<td>15</td>
<td>Topics in statistics introduced to enable students to describe and discuss basic statistical methods and applications.</td>
</tr>
<tr>
<td>Mathematics I and II for electrical engineers</td>
<td>1 and 2</td>
<td>30</td>
<td>Brings students from varying backgrounds up to a common level in preparation for further modules in mathematics and provides a detailed introduction to techniques (change of variable, integration by parts and partial fractions) for, and applications of one-dimensional integrals.</td>
</tr>
<tr>
<td>Object-oriented programming</td>
<td>2</td>
<td>15</td>
<td>Develops understanding of object-oriented software methodology, in theory and practice.</td>
</tr>
<tr>
<td>Pilot studies I</td>
<td>1</td>
<td>7.5</td>
<td>Introduces topics that relate to the systems and operation of a light aircraft: aircraft technical, navigation and radio aids, meteorology, flight performance and planning, radio communications and human performance.</td>
</tr>
<tr>
<td>Principles of microeconomics</td>
<td>1</td>
<td>15</td>
<td>Introduces elementary microeconomic theory.</td>
</tr>
<tr>
<td>Programming language paradigms</td>
<td>1</td>
<td>15</td>
<td>Introduces the functional programming paradigm and to compare and contrast it with the imperative programming paradigm.</td>
</tr>
<tr>
<td>Solids and structures I</td>
<td>1 and 2</td>
<td>15</td>
<td>Introduces the fundamental principles of dynamics, statics, solid and structural mechanics, and to show you how representative engineering problems can be formulated and solved.</td>
</tr>
</tbody>
</table>

Please note: modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
# Core and selected optional modules overview

## Year Two

<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting theory</td>
<td>2</td>
<td>15</td>
<td>Increases your knowledge of the theory of accounting and its relevance to the study of accounting practice.</td>
</tr>
<tr>
<td>Advanced object-oriented C languages</td>
<td>2</td>
<td>7.5</td>
<td>Introduces object orientation and illustrate the differences between message-based and method-based object-oriented approaches, through the introduction of two object-oriented variants of C.</td>
</tr>
<tr>
<td>Aircraft performance A</td>
<td>2</td>
<td>7.5</td>
<td>Acquaints you with the fundamentals of the performance of fixed-wing aircraft; to develop from first principles the theory required to formulate and solve representative performance problems; to discuss the limitations of the theory; to introduce you to the basics of aircraft stability.</td>
</tr>
<tr>
<td>Applied database management</td>
<td>2</td>
<td>7.5</td>
<td>Utilises relational algebra to develop efficient database query language code.</td>
</tr>
<tr>
<td>Artificial intelligence</td>
<td>1</td>
<td>15</td>
<td>Provides an introduction to the topic of artificial intelligence (AI) through studying problem-solving, knowledge representation, planning, and learning in intelligent systems and a grounding in the AI programming language Prolog.</td>
</tr>
<tr>
<td>Avionics and communication systems</td>
<td>2</td>
<td>15</td>
<td>Develops an understanding of basic communication systems, avionic systems, including radar, navigation and aircraft vision systems.</td>
</tr>
<tr>
<td>CMOS integrated circuits</td>
<td>2</td>
<td>7.5</td>
<td>Combines CMOS integrated circuits design activity with very relevant industrial concepts and a deeper understanding of MOSFET device physical principles and electromagnetism; provides the background for later modules, relevant final year projects, but particularly for employment in those industries that are firmly based in microelectronics technology.</td>
</tr>
<tr>
<td>Communication systems</td>
<td>2</td>
<td>7.5</td>
<td>Presents the concepts involved with signals and communication systems.</td>
</tr>
<tr>
<td>Complexity of algorithms</td>
<td>2</td>
<td>15</td>
<td>Demonstrates how the study of algorithms has been applied in a number of different domains, introduces formal concepts of measures of complexity and algorithms analysis, introduces fundamental methods in data structures and algorithms design, makes you aware of computationally hard problems and possible ways of coping with them.</td>
</tr>
<tr>
<td>Computer aided software development</td>
<td>2</td>
<td>7.5</td>
<td>Introduces a range of techniques and tools used in modern, large-scale industrial software development.</td>
</tr>
<tr>
<td>Computer-based trading in financial markets</td>
<td>2</td>
<td>15</td>
<td>Develops an understanding of financial markets at the level of individual trades; markets provides an overview of the range of different computer-based trading applications and techniques; introduces key issues with using historical high-frequency financial data for developing computer-based trading strategies; provides an overview of statistical and computational methods for the design of trading strategies and their risk management.</td>
</tr>
</tbody>
</table>

Please note: modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate financial management for non-specialist students</td>
<td>1</td>
<td>15</td>
<td>Provides an introduction to financial markets and to contextualise the application of mathematical techniques.</td>
</tr>
<tr>
<td>Database development</td>
<td>1</td>
<td>15</td>
<td>Introduces you to the problems arising from concurrency in databases, information security considerations and how they are solved.</td>
</tr>
<tr>
<td>Decision, computation and languages</td>
<td>2</td>
<td>15</td>
<td>Introduces formal concepts of automata, grammars and languages; introduces ideas of computability and decidability; illustrates the importance of automata, formal language theory and general models of computation in computer science and artificial intelligence.</td>
</tr>
<tr>
<td>Digital electronics and microprocessor systems</td>
<td>1</td>
<td>15</td>
<td>Provides you with the ability to design digital systems using the Algorithmic State Systems Machine (ASM) methodology; understand the features of Programmable Logic Devices (PLDs) and use them in their designs; interface memory and other peripherals to microprocessor systems; understand how basic microprocessors work; understand basic assembly language programmes; know the different data formats such as ASCII 2's complement and floating point format and more advanced microprocessor concepts such as pipelines and Harvard architecture.</td>
</tr>
<tr>
<td>Distributed systems</td>
<td>2</td>
<td>15</td>
<td>Provides an understanding of the technical issues involved and solutions for modern distributed systems.</td>
</tr>
<tr>
<td>Dynamic systems</td>
<td>1 and 2</td>
<td>15</td>
<td>Develops an understanding of the essential principles governing the behaviour of first and second order systems in the time and frequency domains and to introduce the concepts of feedback control and dynamic stability; develops skills in carrying out and reporting upon simple experiments in dynamic systems.</td>
</tr>
<tr>
<td>e-Commerce group project</td>
<td>2</td>
<td>15</td>
<td>You will work in groups of four to produce a working e-commerce software application.</td>
</tr>
<tr>
<td>Electrical circuits and power systems</td>
<td>1</td>
<td>15</td>
<td>Equips you with tools to analyse interrelated circuits; provides an introduction to the components and composition of an electric power system; considers the different primary energy sources and the way in which power is delivered to the customers.</td>
</tr>
<tr>
<td>Electromagnetics</td>
<td>2</td>
<td>7.5</td>
<td>Further enhances your knowledge and use of Maxwells equations and their use in practical EM applications.</td>
</tr>
<tr>
<td>Electronic circuits and systems</td>
<td>2</td>
<td>15</td>
<td>Covers how electronic circuits are designed and undertake some simple design exercises; how electronic devices can be represented by simple, linear equivalent circuits; how complex circuits can be sub-divided into building blocks and these blocks in turn represented by linear equivalent circuits which can be analysed using standard circuit techniques; how interaction between the building blocks to allow estimation of important systems parameters such as gain, input output resistance etc; the importance of negative feedback in improving electronic systems performance and tolerance.</td>
</tr>
<tr>
<td>Field theory and partial differential equations</td>
<td>1</td>
<td>7.5</td>
<td>Introduces you to the concepts of scalar and vector fields; develops techniques for evaluating line, surface and volume integrals; introduces you to some of the basic methods for solving partial differential equations.</td>
</tr>
<tr>
<td>Financial reporting</td>
<td>1</td>
<td>15</td>
<td>Enables you to prepare single entity financial statements, and extracts from those financial statements, covering a wide range of International Financial Reporting Standards (IFRS).</td>
</tr>
</tbody>
</table>

Please note: modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
### Core and selected optional modules overview

**Year Two (continued)**

<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group software project</td>
<td>2</td>
<td>15</td>
<td>You will work in groups of four to produce a working software system.</td>
</tr>
<tr>
<td>Instrumentation and control</td>
<td>1 and 2</td>
<td>15</td>
<td>Provides you with the ability to select a suitable transducer and associated system for a given measurement application and to consider possible alternative solutions. Provides a thorough understanding of the principles of a closed loop control system via system modelling, performance analysis and controller design and synthesis.</td>
</tr>
<tr>
<td>International business</td>
<td>2</td>
<td>15</td>
<td>An introduction to both mainstream and alternative theories of why businesses internationalise and how they operate as transnational corporations.</td>
</tr>
<tr>
<td>Internet principles</td>
<td>1</td>
<td>15</td>
<td>Introduces students to the internet, its architecture, features and its main protocols.</td>
</tr>
<tr>
<td>Operating system concepts</td>
<td>2</td>
<td>15</td>
<td>Introduces students to the structure and functionality of modern operating systems.</td>
</tr>
<tr>
<td>Pilot studies II</td>
<td>1 and 2</td>
<td>15</td>
<td>Provides knowledge of navigation, meteorology, aircraft instrumentals, human factors aircraft performance and principles of flight, radio navigation systems and aircraft general knowledge appropriate to commercial aircraft commercial operations.</td>
</tr>
<tr>
<td>Pilot studies III</td>
<td>2</td>
<td>7.5</td>
<td>Provides knowledge of aircraft performance and principles of flight, radio navigation systems and aircraft general knowledge appropriate to commercial aircraft operations.</td>
</tr>
<tr>
<td>Planning your career</td>
<td>1</td>
<td>7.5</td>
<td>Provides more in-depth experience of crucial employability skills.</td>
</tr>
<tr>
<td>Principles of C and memory management</td>
<td>2</td>
<td>7.5</td>
<td>Introduces the issues of memory and memory management within the context of a system-level procedural programming language (C), and debugging.</td>
</tr>
<tr>
<td>Principles of computer game design and implementation</td>
<td>2</td>
<td>15</td>
<td>Introduces the main issues surrounding computer games architecture, fundamental concepts and software engineering associated with computer games.</td>
</tr>
<tr>
<td>Programming language paradigms</td>
<td>1</td>
<td>15</td>
<td>Introduces the functional programming paradigm and to compare and contrast it with the imperative programming paradigm.</td>
</tr>
<tr>
<td>Project, problem solving and industrial awareness</td>
<td>1 and 2</td>
<td>7.5</td>
<td>Provides you with practical work which underpins, confirms and gives application focus for academic study, while testing a wide range of skills.</td>
</tr>
<tr>
<td>Scripting languages</td>
<td>2</td>
<td>7.5</td>
<td>Provides you with an understanding of the nature and role of scripting languages.</td>
</tr>
<tr>
<td>Securities markets</td>
<td>2</td>
<td>15</td>
<td>Provides an understanding of the role of securities markets in the economy, their basic mechanics and technical features, the valuation of financial assets, the operational and allocative efficiency of the market.</td>
</tr>
<tr>
<td>Signals and systems</td>
<td>1</td>
<td>15</td>
<td>Introduces the fundamentals of the analysis of continuous- and discrete-time signals and systems; equips you with the mathematical tools that would allow him/her to design and/or analyse a linear time-invariant system; presents the concepts involved with signals and systems.</td>
</tr>
</tbody>
</table>

**Please note:** modules are provided for information only and may change. Timetabling restrictions may apply.

**Please note:** modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software development tools</td>
<td>2</td>
<td>15</td>
<td>Provides the knowledge and skills required for the effective use of tools in the software development lifecycle.</td>
</tr>
<tr>
<td>Software engineering I</td>
<td>1</td>
<td>15</td>
<td>Develops an understanding of the problems associated with the development of significant computing systems and to appreciate the techniques and tools necessary to develop such systems efficiently, in a cost-effective manner.</td>
</tr>
<tr>
<td>Solids and structures II</td>
<td>1 and 2</td>
<td>15</td>
<td>Provides awareness and some understanding of the principles of solid mechanics applied to engineering structures. In particular, the behaviour and types of failure (instability) of simple elastic systems and structural members used in aerospace, civil and mechanical engineering applications.</td>
</tr>
</tbody>
</table>

**Please note:** modules may not be available across all programmes, please check programme specific module lists on pages 13-29.

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### Core and selected optional modules overview

#### Year in Industry

<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placement</td>
<td>1 and 2</td>
<td>120</td>
<td>Provides you with experience of an industrial environment and to assess operational aspects of the company, its products, working practices, marketing and management structures.</td>
</tr>
</tbody>
</table>

**Please note:** modules may not be available across all programmes, please check programme specific module lists on pages 13-29.

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### Core and selected optional modules overview

#### Year Three/Four/Five

<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced algorithmic techniques</td>
<td>1</td>
<td>15</td>
<td>Provides a sound foundation concerning the design and analysis of advanced discrete techniques algorithms; a critical rational concerning advanced complexity theory and algorithmics and an in-depth, systematic and critical understanding of selected significant issues at the forefront of research explorations in the design and analysis of discrete algorithms.</td>
</tr>
<tr>
<td>Advanced embedded computer systems</td>
<td>1 and 2</td>
<td>15</td>
<td>Gives an understanding of the construction and operation of embedded computer systems and their components; gives an understanding of how computer performance is dependent upon the design of computer architectures and sub-circuits.</td>
</tr>
</tbody>
</table>

**Please note:** modules may not be available across all programmes, please check programme specific module lists on pages 13-29.

Continued over...
## Core and selected optional modules overview

### Year Three/Four/Five (continued)

<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced guidance systems</td>
<td>2</td>
<td>7.5</td>
<td>Develop an understanding of the use of advanced guidance laws in autonomous air systems, including the interactions of airframe dynamics, sensors and control and the use of the Kalman and Extended Kalman filters in aerospace systems.</td>
</tr>
<tr>
<td>Advanced modern management</td>
<td>1</td>
<td>7.5</td>
<td>Introduces various aspects of advanced modern management; a knowledge and understanding of modern management tools; an appreciation of management and its importance in organisational success.</td>
</tr>
<tr>
<td>Advanced signal processing</td>
<td>1 and 2</td>
<td>15</td>
<td>Develops higher level signal processing techniques and applies them to some problems and different types of filters and demonstrates their applications.</td>
</tr>
<tr>
<td>Advanced systems modelling and control</td>
<td>1</td>
<td>15</td>
<td>Introduces advanced system analysis and design techniques and develops the skills of considering engineering problems from system point of view.</td>
</tr>
<tr>
<td>Advanced web technologies</td>
<td>2</td>
<td>15</td>
<td>Introduces guidelines, concepts and models for designing and evaluating applications using semantic web technologies.</td>
</tr>
<tr>
<td>Antennas</td>
<td>2</td>
<td>7.5</td>
<td>Introduces fundamental antenna principles and concepts based on the underlying electromagnetic theory.</td>
</tr>
<tr>
<td>Application development with C++</td>
<td>1</td>
<td>15</td>
<td>Enables you to: identify functional requirement for an application and produce an adequate specification; design a programme based on functional decomposition method; convert design into efficient C++ code; design and implement an application graphical user interface; use common components including controls in Windows-based programme; implement event handlers and validate the programme functionality and to work independently or as a team member in the management of application development.</td>
</tr>
<tr>
<td>Applied algorithmics</td>
<td>2</td>
<td>15</td>
<td>Develops a strong context for research explorations in the field of algorithms.</td>
</tr>
<tr>
<td>Avionic systems design</td>
<td>2</td>
<td>7.5</td>
<td>You apply your knowledge and creative skills to solve a design problem within the scope of a typical avionic system and further develop your team-working and presentation skills.</td>
</tr>
<tr>
<td>Big data analysis</td>
<td>1</td>
<td>15</td>
<td>Introduces middleware often used in big data analytics.</td>
</tr>
<tr>
<td>Biocomputation</td>
<td>1</td>
<td>15</td>
<td>Introduces work in the field of neural computation; highlights some contemporary issues within the domain of neural computation; equips you with a broad overview of the field of evolutionary computation, placing it in a historical and scientific context; emphasises the need to keep up-to-date in developing areas of science and technology and provide some skills necessary to achieve this; enables students to make reasoned decisions about the engineering of evolutionary (“selectionist”) systems.</td>
</tr>
<tr>
<td>Communicating computer science</td>
<td>1&amp;2</td>
<td>15</td>
<td>Provides students with training, theory and practical experience to develop key transferable skills including; communication, presentation and teamwork in educational settings involving computer teaching.</td>
</tr>
</tbody>
</table>

Please note: modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications networks and security</td>
<td>2</td>
<td>15</td>
<td>Introduces the principles of communications networks, their components and protocols; provides the tools and techniques to analyse the performance of the main communications protocols, including: link layer, MAC layer, network layer (IP) including the main routing protocols, the Transport Control Protocol (TCP), and basic packet queuing theory; provides an overview of the main topic areas in network/cyber security including firewalls, intrusion detection and prevention systems, key ciphers and applied cryptography, and Secure Sockets Layer (SSL).</td>
</tr>
<tr>
<td>Complex information and social networks</td>
<td>2</td>
<td>15</td>
<td>Gives an understanding of the software development opportunities offered by the emergence of these networks, through the study of information retrieval algorithms like the one used by Google; the application development possibilities offered by social networks environments like Facebook; how elementary graph-theoretic concepts may help understanding the structure and certain properties (like the “mysterious” small world phenomenon, or the resilience to failures) of such networks.</td>
</tr>
<tr>
<td>Computational game theory and mechanism design</td>
<td>2</td>
<td>15</td>
<td>Examines games that have some underlying network structure or that appear in auctions. A focus will be on scheduling and routing design as well as the computational aspects in the design of mechanisms and auctions.</td>
</tr>
<tr>
<td>Computational intelligence</td>
<td>2</td>
<td>15</td>
<td>Explores the basic structures and the learning mechanisms underlying neural networks within the field of artificial intelligence and examine how synaptic adaptation can facilitate learning and how input to output mapping can be performed by neural networks. Gives an overview of linear, nonlinear, separable and non-separable classification as well as supervised and unsupervised mapping. Explains the benefit of adopting naturally inspired techniques to implement optimisation of complex systems and acquire the fundamental knowledge in various revolutionary techniques. Explores the basic concepts of systems optimisation and its role in natural and biological systems and entities.</td>
</tr>
<tr>
<td>Computer vision and graphics</td>
<td>1</td>
<td>15</td>
<td>Introduces &quot;image synthesis&quot;, &quot;image analysis&quot; and “computer vision” using a practical “how and it’s done” formulation. Image synthesis covers interactive computer graphics in 2- and 3-dimensions, and the advanced issues of colour, rendering and realism. Image analysis is the extraction of meaning from images or sequences of images and proceeds from a mathematical description of images to techniques for image enhancement, segmentation, and morphology. Computer vision represents a fusion of the other two areas.</td>
</tr>
<tr>
<td>Corporate reporting and analysis</td>
<td>2</td>
<td>15</td>
<td>Develops understanding of financial reporting and to an advanced level by building upon the analysis knowledge and skills gained in earlier financial reporting modules.</td>
</tr>
<tr>
<td>Data mining and visualisation</td>
<td>2</td>
<td>15</td>
<td>Provides an in-depth systematic and critical understanding of some of the current research issues at the forefront of the academic research domain of data mining.</td>
</tr>
<tr>
<td>Digital and wireless communications</td>
<td>1</td>
<td>15</td>
<td>Provides an extensive coverage of the theory and practice of digital and wireless communication systems. Allows you to be able to design and develop digital and wireless communication systems, with an awareness of all the main factors involved and of existing and emerging technologies.</td>
</tr>
</tbody>
</table>

Please note: modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
### Core and selected optional modules overview

**Year Three/Four/Five** *(continued)*

<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital control and optimisation</td>
<td>1</td>
<td>15</td>
<td>Introduces the fundamentals of applied digital control; the use of simulation tools like Matlab and Simulink; digital control design techniques through realistic control examples and applications; digital, PI, PID and full state feedback controller design; how to implement a digital control algorithm in software; the basic concept of optimisation; the conventional optimisation techniques; gradient based optimisation methods and their properties; with the application of optimisation methods.</td>
</tr>
<tr>
<td>Digital systems design</td>
<td>1 and 2</td>
<td>15</td>
<td>Provides you with the ability to design and synthesise digital systems using Verilog and ASM; understand the problems of meta-stability in digital systems; design microprocessors using ASM techniques; develop and test customised NIOS II systems using Altera’s System on a Programmable Chip (SOPC) builder tool and Software Build Tools (SBT).</td>
</tr>
<tr>
<td>Digital and wireless communications</td>
<td>1</td>
<td>15</td>
<td>Provides an extensive coverage of the theory and practice of digital and wireless communication systems; allows you to be able to design and develop digital and wireless communication systems, with an awareness of all the main factors involved and of existing and emerging technologies.</td>
</tr>
<tr>
<td>Drives</td>
<td>1</td>
<td>7.5</td>
<td>Introduces a range of electrical machines (AC and DC) using the concepts of rotating magnetic fields, co-energy; facilitates the prediction of machine performance by the use of equivalent circuits.</td>
</tr>
<tr>
<td>E-business models and strategy</td>
<td>2</td>
<td>15</td>
<td>Provides an introduction to the appraisal and formulation of e-business strategy and contemporary e-business models.</td>
</tr>
<tr>
<td>Efficient sequential algorithms</td>
<td>1</td>
<td>15</td>
<td>Explores advanced topics in the design and analysis of efficient sequential algorithms and a few key results related to the study of their complexity.</td>
</tr>
<tr>
<td>Electromagnetic compatibility</td>
<td>2</td>
<td>7.5</td>
<td>Introduces fundamental EMC principles and concepts based on the underlying electromagnetic theory; introduces EMC standards and regulations; analyse EMC problems; introduce EMC measurements and tests.</td>
</tr>
<tr>
<td>Electronics for instrumentation and communications</td>
<td>1</td>
<td>15</td>
<td>Explores a wide range of analogue components and electronics for instrumentation and communications.</td>
</tr>
<tr>
<td>Embedded computer systems</td>
<td>1 and 2</td>
<td>15</td>
<td>Gives an understanding of the construction and operation of embedded computer systems and their components; gives an understanding of how computer performance is dependent upon the design of computer architectures and sub-circuits.</td>
</tr>
<tr>
<td>Energy conversion, renewable energy and smart grids</td>
<td>1</td>
<td>15</td>
<td>Develops a good understanding of different renewable energy sources and the principle of energy conversion from renewable sources into electricity; an appreciation of the operation of a micro grid and basic principle of smart grid technologies and associated engineering; a good understanding of the reality of the energy and power systems in industry.</td>
</tr>
</tbody>
</table>

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<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering management and entrepreneurial skills</td>
<td>1</td>
<td>7.5</td>
<td>Introduces students to some of the tools and constraints associated with managing both small and large projects and with some simple costing approaches.</td>
</tr>
<tr>
<td>Engineering systems</td>
<td>1</td>
<td>7.5</td>
<td>Develop an appreciation of the multidisciplinary systems view in engineering; the importance of alternative methods of modelling systems and their relative advantages; stimulates an interest in the cross-disciplinary and also common mathematical basis for physical systems modelling; fosters an awareness of the growing industrial importance of engineering simulation.</td>
</tr>
<tr>
<td>Final Year project</td>
<td>1 or 2</td>
<td>15</td>
<td>Gives you the opportunity to work in a guided but independent fashion to explore an individual problem in depth, making practical use of principles, techniques and methodologies acquired elsewhere in the course; give experience of carrying out a sustained piece of individual work and in producing a dissertation; enhances communication skills, both oral and written.</td>
</tr>
<tr>
<td>Finance and markets</td>
<td>2</td>
<td>15</td>
<td>Builds on the foundations of the existing finance modules and aims to give you a solid grounding in terms of understanding the recent global financial crisis and a wide range of risk management tools available to financial managers.</td>
</tr>
<tr>
<td>Financial reporting II</td>
<td>1</td>
<td>15</td>
<td>Develops knowledge and skills for the preparation of group financial statements including associates and joint ventures.</td>
</tr>
<tr>
<td>Flight dynamics and control</td>
<td>1 and 2</td>
<td>15</td>
<td>Gives you a good understanding of flight control dynamics/flight control systems principles and to equip them to solve related problems.</td>
</tr>
<tr>
<td>Formal methods</td>
<td>2</td>
<td>15</td>
<td>As more complex computational systems are used within critical applications, it is becoming essential that these systems are formally specified. This module introduces the principles of standard formal methods, such as Z; the basic notions of temporal logic and its use in relation to reactive systems; the use of model checking techniques in the verification of reactive systems; some of the current research issues related to formal methods.</td>
</tr>
<tr>
<td>Global strategic management</td>
<td>1</td>
<td>15</td>
<td>Provides conceptual frameworks within which to formulate and analyse global strategy; practical experience of formulating strategy; theory and evidence regarding the configuration and governance of international operations; conceptual frameworks within which to frame ethical conduct in international business.</td>
</tr>
<tr>
<td>High voltage engineering</td>
<td>2</td>
<td>15</td>
<td>Provides knowledge of the role and importance of high voltage engineering and insulation in power delivery systems; a clear understanding of the underlying theories and principles in relation to network transients, insulation degradation and operation of modern advanced electrical apparatus; opportunities to develop subject specific and transferable skills in deriving technical solutions in response to system requirements and safety risks; an appreciation of practically important issues in executing industrial projects and the latest research development in relation to modelling and experiment of gas discharges.</td>
</tr>
<tr>
<td>Honours Year automated trading project</td>
<td>1 and 2</td>
<td>30</td>
<td>Gives you the opportunity to work in a team to explore in depth the problem of automated trading from a practical perspective; provides experience of all aspects of solving a substantial problem, including the production of a final report and enhances communication skills, both oral and written.</td>
</tr>
</tbody>
</table>

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<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honours Year computer science project</td>
<td>1 and 2</td>
<td>30</td>
<td>Gives you the opportunity to work in a guided but independent fashion to explore a substantial computing problem in depth, making practical use of principles, techniques and methodologies acquired elsewhere in the course. This module also gives you experience in carrying out a large piece of individual work, producing a dissertation and enhances your communication skills, both oral and written.</td>
</tr>
<tr>
<td>Image processing</td>
<td>1</td>
<td>7.5</td>
<td>Introduces the basic concepts of digital image processing and pattern recognition.</td>
</tr>
<tr>
<td>Information theory and coding</td>
<td>2</td>
<td>7.5</td>
<td>Introduces the techniques used in source coding and error correcting codes, including the use of information as a measure.</td>
</tr>
<tr>
<td>Industrial robotics and automated assembly</td>
<td>2</td>
<td>15</td>
<td>Provides the basic knowledge and skills to design, build and operate industrial robotic systems and to understand the advantages and disadvantages of their deployment.</td>
</tr>
<tr>
<td>Integrated circuits-concepts and design</td>
<td>1 and 2</td>
<td>15</td>
<td>Explores the reasons for the predominance and importance of silicon based microelectronics to the semiconductor industry; how materials, devices and circuit issues are interrelated and exploited to make the microchips that underpin the information age and prepares students for entering the semiconductor industry.</td>
</tr>
<tr>
<td>Introduction to computational game theory</td>
<td>1</td>
<td>15</td>
<td>Introduces the notion of a game, its solutions, concepts, other basic notions and tools of game theory, and the main applications for which they are appropriate, including electricity trading markets. Also, to formalise strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in modelling applications. It draws the connections between game theory, computer science, and economics, especially emphasising the computational issues and introduces contemporary topics in the intersection of game theory, computer science, and economics.</td>
</tr>
<tr>
<td>Knowledge representation</td>
<td>1</td>
<td>15</td>
<td>Introduces formalisms to reason about knowledge.</td>
</tr>
<tr>
<td>Knowledge, representation and reasoning</td>
<td>1</td>
<td>15</td>
<td>Introduces knowledge representation as a research area; gives a complete and critical understanding of the notion of representation languages and logics; description logic and their use; study epistemic logic and its use and methods for reasoning under uncertainty.</td>
</tr>
<tr>
<td>Machine learning and bio-inspired optimisation</td>
<td>2</td>
<td>15</td>
<td>Introduces bio-inspired algorithms for optimisation and machine learning, based on reinforcement learning, DNA computing, brain or neural network models, immune systems etc.</td>
</tr>
</tbody>
</table>

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<tr>
<th>Module title</th>
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<th>Credit</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Management of design</td>
<td>2</td>
<td>7.5</td>
<td>Develops an understanding of a wide range of aspects of the design function in a manufacturing company and its management, and in particular a comprehensive understanding of the design process. The core of the module is a detailed study of a six-phase model of the design process derived from several authors and BS7000: product planning and feasibility; design specification; conceptual design; embodiment design; detail design; post-design-release.</td>
</tr>
<tr>
<td>Measurement, monitoring and sensors in power systems</td>
<td>1 and 2</td>
<td>15</td>
<td>Explores the philosophical differences between measurement and monitoring; the role of sensors in providing inputs to these systems; the output requirements for measurement systems and monitoring systems; the need to provide information without the surfeit of data; the application of sensors, measurement systems and monitoring systems for electrical energy and power system networks.</td>
</tr>
<tr>
<td>Microprocessor systems</td>
<td>2</td>
<td>15</td>
<td>Provides an understanding of the construction and operation of microprocessor based systems. You are introduced to programming at low level and interfacing microprocessors to other components.</td>
</tr>
<tr>
<td>Mobile computing</td>
<td>1</td>
<td>15</td>
<td>Provides guidelines, design principles and experience in developing applications for small, mobile devices, including an appreciation of context and location aware services; develops an appreciation of interaction modalities with small, mobile devices (including interface design for non-standard display surfaces) through the implementation of simple applications and use cases; introduces wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices and explores use of transaction and e-commerce principles over such devices to support mobile business concepts.</td>
</tr>
<tr>
<td>Multi-agent systems</td>
<td>2</td>
<td>15</td>
<td>Introduces you to the concept of an agent and multi-agent systems, and the main applications for which they are appropriate; the main issues surrounding the design of intelligent agents and the design of a multi-agent society and introduces a contemporary platform for implementing agents and multi-agent systems.</td>
</tr>
<tr>
<td>Multi-core and multi-processor programming</td>
<td>1</td>
<td>15</td>
<td>Provides students with a deep, critical and systematic understanding of key issues and effective solutions for parallel programming for systems with multi-core processors and parallel architectures.</td>
</tr>
<tr>
<td>Neural networks</td>
<td>2</td>
<td>7.5</td>
<td>Introduces the basic structures and the learning mechanisms underlying neural networks within the field of artificial intelligence and examine how synaptic adaptation can facilitate learning and how input to output mapping can be performed by neural networks.</td>
</tr>
<tr>
<td>Optimisation</td>
<td>1</td>
<td>15</td>
<td>Explores optimisation methods applied for various optimisation models. These methods are extensively used in both academic and industrial practices.</td>
</tr>
<tr>
<td>Organic electronics</td>
<td>1</td>
<td>7.5</td>
<td>Explores how semiconducting organic materials can be designed and synthesised for use in a wide range of electronic devices.</td>
</tr>
</tbody>
</table>

Please note: modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
# Core and selected optional modules overview

## Year Three/Four/Five (continued)

<table>
<thead>
<tr>
<th>Module title</th>
<th>Semester</th>
<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photonics and optical information systems</td>
<td>1</td>
<td>15</td>
<td>Introduces the fundamental principles of opto/electronic systems for the transfer of information; the duality of light as both wave and ray and shows intensity and phase related optical principles; demonstrates optical information transfer through a number of applications.</td>
</tr>
<tr>
<td>Plasma engineering</td>
<td>1</td>
<td>7.5</td>
<td>Develops an appreciation and understanding of industrial plasma discharges and associated engineering.</td>
</tr>
<tr>
<td>Power generation, transmission and distribution</td>
<td>2</td>
<td>15</td>
<td>Gives you a generalised view of the structure of a power system; develops the ability to analyse the steady state and transient operation of an integrated power system in terms of the electrical and other constraints on power flow; familiarises you with some basic concepts of power electronics and the tools to design some basic circuits; enhances the experience in the circuit design of converters regarding hardware ratings for practical engineering applications and shows how power electronics and machines are complementary components of drive or generating systems.</td>
</tr>
<tr>
<td>Privacy and security</td>
<td>1</td>
<td>15</td>
<td>Covers topics including identification and authentication, monitoring protocols, attacks and defences, legal and ethical issues and future direction.</td>
</tr>
<tr>
<td>Project management</td>
<td>1</td>
<td>7.5</td>
<td>Introduces you to some of the tools and constraints associated with managing both small and large projects, and with some simple costing approaches. A virtual project is undertaken by everyone. You are encouraged to adopt a project approach to current and future tasks, and to learn the language adopted by project-oriented employers.</td>
</tr>
<tr>
<td>Quantitative Business finance</td>
<td>1</td>
<td>15</td>
<td>Provides a fundamental understanding of the core theoretical and empirical aspects involved in corporate finance.</td>
</tr>
<tr>
<td>Radio propagation for wireless systems</td>
<td>1</td>
<td>7.5</td>
<td>Develops an appreciation and understanding of radio propagation mechanisms and introduces and applies radio propagation models to applications.</td>
</tr>
<tr>
<td>Reasoning about action and change</td>
<td>2</td>
<td>15</td>
<td>Introduces students to the use of logic as a tool for specifying the desired behaviour of hardware, software and artificial intelligence systems.</td>
</tr>
<tr>
<td>RF engineering and applied electromagnetics</td>
<td>1</td>
<td>7.5</td>
<td>Introduces the fundamental concepts of high frequency electromagnetics (including RF and microwave); presents and develops the underlying theory of transmission lines (TX), including lossy TX; introduces the Smith Chart as an important tool in TX design and analysis; gives an appreciation of the importance of computational electromagnetics and its role in industrial applications; gives a clear understanding of impedance matching and related techniques and introduces the concept of the scattering parameters for 2-port networks and their applications and measurements.</td>
</tr>
</tbody>
</table>

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<tr>
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<th>Credit</th>
<th>Module description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robotics and autonomous systems</td>
<td>1</td>
<td>15</td>
<td>Introduces the concept of an autonomous agent; the key approaches developed for decision-making in autonomous systems; a contemporary platform for programming agents and multi-agent systems; the key issues surrounding the development of autonomous robots and a contemporary platform for experimental robotics.</td>
</tr>
<tr>
<td>Safety and dependability</td>
<td>2</td>
<td>15</td>
<td>Covers techniques for the validation of systems against formal specifications, including issues relating to security, reliability and trustworthiness.</td>
</tr>
<tr>
<td>Signal processing and digital filtering</td>
<td>2</td>
<td>15</td>
<td>Develops basic framework for signal processing and to demonstrate some applications and provides you with a good understanding of the types and behaviours of a number of different digital filters.</td>
</tr>
<tr>
<td>Software engineering and programming</td>
<td>1</td>
<td>15</td>
<td>Equips you with knowledge of the two most popular programming languages, C++ and MATLAB; an understanding of the Functional Decomposition method for program design and practical skills of designing and coding software for engineering applications based on a problem specification.</td>
</tr>
<tr>
<td>Software engineering II</td>
<td>1</td>
<td>15</td>
<td>Introduces you to a range of advanced, near-research level topics in contemporary software engineering.</td>
</tr>
<tr>
<td>Technologies for e-commerce</td>
<td>2</td>
<td>15</td>
<td>Introduces the environment in which e-commerce takes place, the main technologies for supporting e-commerce, and how these technologies fit together and security as a major issue in secure e-commerce. Also to provide an overview of security issues; encryption as a means of ensuring security and to describe how secure encryption can be delivered; issues relating to privacy; auction protocols and negotiation mechanisms as emerging e-commerce technologies.</td>
</tr>
</tbody>
</table>

Please note: modules may not be available across all programmes, please check programme specific module lists on pages 13-29.
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