UNIVERSITY OF LIVERPOOL

POSTGRADUATE STUDIES
DEPARTMENT OF ELECTRICAL ENGINEERING AND ELECTRONICS

The Department of Electrical Engineering and Electronics

The Department of Electrical Engineering and Electronics has extensive facilities for research in communications, digital signal processing, advanced devices for VLSI and power, plasma processing, displays, optoelectronic fibre-based sensors, switchgear, bionanoengineering, molecular electronics, robotics, vision systems applications, free electron lasers, e-automation aswell as intelligence engineering and automation.

The Department's research is conducted in its own building, which comprises of approximately 50 rooms, including well equipped laboratories and offices. Specialist sections involve facilities for processing semiconductor devices, technological plasmas, equipment for testing switchgear, underwater and welding robots, e-Automation, RF engineering, bionanoengineering laboratory and excellent mechanical and electrical workshops.

Each group is headed by a Professor who will provide more details of their new activities and the names of relevant supervisors (see also www.liv.ac.uk/eee). The four taught MSc(Eng) programmes in Information and Intelligence Engineering, Micro- and Nano-Technology, Microelectronic Systems, and Microelectronic Systems and Telecommunications offer options relating to communications, signal processing, manufacturing, intelligence engineering, optoelectronics, digital electronics, micro/nano technology and robotics.

Research Overview

There is close involvement with more than 50 major electronic and electrical companies, and research organisations. Collaboration with UK and foreign universities is a feature of most of the groups. Funding for research has been at a high level: research income currently stands at about £2.8 million per annum and the total income available to research groups at any point in time exceeds £7.5 million. The Department's research wing has recently undergone a £2.2 million refurbishment. The Centre for Intelligent Monitoring Systems was established in the Department with over £4 million support from the EU and some major UK companies for promoting fundamental research and technology transfer.

Department Profile

RAE rating:	5A
Academic and research staff:	52
Undergraduate students:	330
Postgraduate research students:	91
Postgraduate taught students:	50
International postgraduate students:	74

Research Assessment Exercise

The Department aims to achieve excellence in selected, dynamic areas of Electrical Engineering and Electronics, building on our previous research strengths; to pursue a modern research activity by promoting interdisciplinarity, maintaining a good balance between strategic, applied, industrial and fundamental research and establishing an international dimension to research; and to create a "research and teaching continuum", in part through the nurture of postgraduate students to become future researchers. The sustained campaign of upgrading the research culture within the Department has resulted in the near doubling of the research output within the census period for the current RAE.

The Department is situated in building reference 32 on the Precinct Plan, www.liv.ac.uk/maps/precinctplan.htm

Admission Information

For details on how to apply for a programme, please refer to page 14. For taught programmes in the Faculty of Engineering, Programme and Major codes are indicated for the MSc(Eng) route only. However, PGCert and PGDip routes are available and students requiring advice about the codes for these programmes should contact the Department.

ENTRY REQUIREMENTS

The indicative entry requirement is an Honours degree in an engineering, physical sciences or computer sciences subject at a level of 2:2 or above for taught programmes and a level of 2:1 or above for research programmes. The above criteria should be used as a guide. Each application is assessed individually and reflect student's qualifications with respect to requirements for each individual programme. Adult Learners are eligible via standard University requirements which allow appropriate qualifications plus experience as an alternative to an Honours degree.

International Qualifications

Applications from international students are welcome. International qualifications will be evaluated in line with the National Recognition Information Centre (NARIC) guidelines.

English Language Qualifications

All applicants must have reached a minimum required standard of English language, and are required to provide evidence of this. Qualifications accepted by the University include: GCSE English; GCE O level English; AS Level English; A Level English Language; IELTS; TOEFL; Cambridge Proficiency etc.

Please see www.liv.ac.uk/international/countries/index.htm for a full list.

Typical requirement:

IELTS	6.0
TOEFL Computer Based	230. TWE of 4-4.5 essay writing
TOEFL iBT	88-89
International Baccalaureate	Standard Level (Grade 5)
Hong Kong Use of English AS level	C
INDIA Standard XII	70% or above from Central and Metro State boards
WAEC	C4 preferred

If you meet our other academic requirements but do not achieve the required level of English, it is possible to come and study at Liverpool upon completion of the University's summer academic English programmes.

If you need to increase your IELTS score by a grade of 0.5 (eg you need to improve from 5.5 to 6.0) you should attend the six week course.

If you need to increase your IELTS score by a grade of 1.0 (eg you need to improve from 5.0 to 6.0) you should attend the ten week course. See www.liv.ac.uk/international/countries/index.htm for details.

If you require additional English language training during your study, the University is able to provide tuition and arrange IELTS tests through its English Language Unit, details of which are available at www.liv.ac.uk/english/elu/index.htm.

Contacting the Department of Electrical Engineering and Electronics

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Postgraduate taught programmes
Dr I Alexandrou
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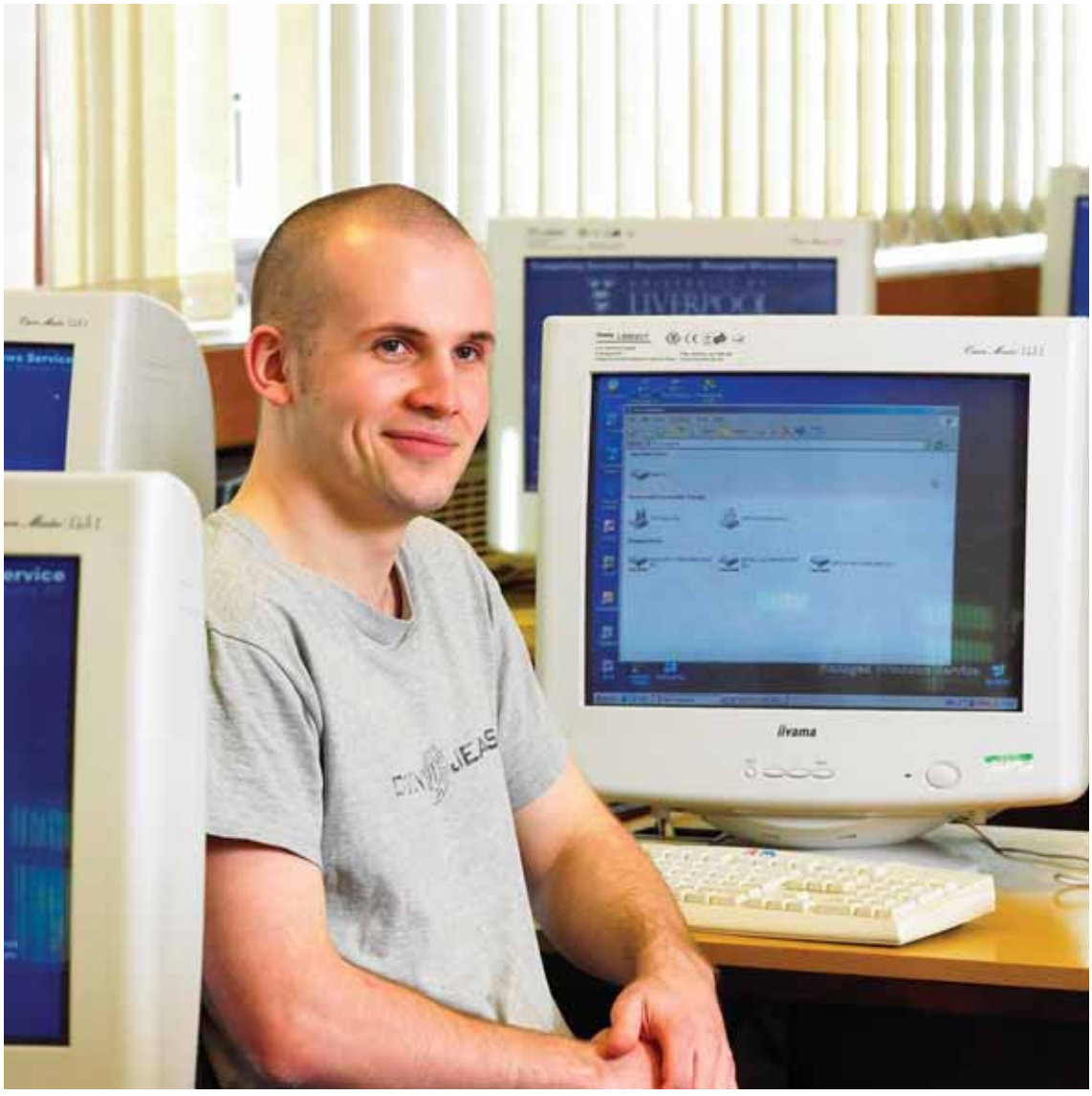
E: msceee@liv.ac.uk
www.liv.ac.uk/eee

"The support and experience I have received in the Department has been excellent, on both a personal and an academic level. The standard of facilities is high, both in the Department and the University as a whole; With a broad range of extra-curricular activities available. Liverpool is a friendly city and an exciting place to be as the Culture Capital in 2008."

Tom Dowrick
PhD in Biologically motivated circuits for third generation neural networks
Department of Electrical Engineering and Electronics



PROGRAMMES AT A GLANCE	Programme code	Major code	Faculty	Full-time	Part-time	Page number
Postgraduate Taught Programmes						
Information and Intelligence Engineering MSc(Eng)						
Full-time	MSC/INTELENG	IEMA	•	1y		05
Micro- and Nano-Technology MSc(Eng)						
Full-time	MSC/MNTEC	EMNT	•	1y		07
Microelectronic Systems MSc(Eng)						
Full-time/Part-time	MSC/MICROSYS	EEMS	•	1y	2y	08
Microelectronic Systems and Telecommunications MSc(Eng)						
Full-time/Part-time	MSC/MICROTE	EEMA	•	1y	2y	10
Postgraduate Research Opportunities						
MPhil/PhD						
Full-time	MPHIL/EN/F	EEER	•			12
Part-time	MPHIL/EN/P	EEER	•			12

y = year m = month s = semester • Faculty of Engineering

FINANCIAL SUPPORT

Taught Programmes

Information on sources of funding may be obtained by visiting the University web-pages www.liv.ac.uk/study/postgraduate/money/funding.htm, or by contacting the Department directly.

Studentships are available for the following postgraduate taught programmes:

- MSc (Eng) Microelectronic Systems
- MSc (Eng) Microelectronic Systems and Telecommunications
- MSc (Eng) Micro- and Nano-Technology

UK and EU students

Full scholarships (fees and maintenance bursaries) are available for UK students as well as for eligible EU nationals. Fees only Scholarships may be awarded to EU students not eligible for the above scholarships.

International Students

A number of Scholarships are also available to international applicants. The Faculty of Engineering offers international students £1,000 for one-year MSc(Eng) postgraduate programmes. Further details can be obtained at www.liv.ac.uk/engfac/prospective/funding.htm

The main criteria for awarding Scholarships are the candidate's academic qualifications, work experience and language certificate.

Further information on the courses can be found at www.liv.ac.uk/eee/courses/postgrdc.htm

Research Programmes

The Department offers a number of EPSRC and industry sponsored research studentships. Most of the projects have close industrial links as well as interaction with other research groups in the UK, Europe and the Far East. Some suitable candidates may be offered Research Assistantships each year but often this is on completion of a very satisfactory first year of study. EPSRC studentships are often enhanced by contributions from industry. Many research students supplement their incomes by undertaking some teaching duties in undergraduate laboratories. Further information can be obtained from Professor J W Bradley, Director of Graduate Studies.

Details of other awards available for international students can be found at www.liv.ac.uk/study/international_students/scholarships.htm

CAREER OPPORTUNITIES

Postgraduate students will benefit from the expertise of members of staff undertaking cutting-edge research in diverse fields in electrical engineering and electronics including: molecular and semiconductor integrated circuit electronics, technological plasmas, communications, digital signal processing, optoelectronics, nanotechnology, robotics, free electron lasers, power electronics, energy efficient systems, e-automation and intelligence engineering. The Department has close collaboration with many industrial partners such as Arm Holdings Plc, which is one of the top 200 UK companies with its core business in microprocessor design and development. We have an excellent record of employment after graduation in a wide range of careers not limited to engineering.

Postgraduate Taught Programmes

INFORMATION AND INTELLIGENCE ENGINEERING MSc(Eng)

FULL-TIME:

Programme code:	MSC/INTELENG
Major code:	IEMA
Programme length:	1 year

Programme contact: Dr I Alexandrou
E: msceee@liv.ac.uk
W: www.liv.ac.uk/eee

Programme Outline

The programme involves the study of information acquisition, learning and intelligence methodologies and their applications in engineering. The main areas examined include developments in advanced control and information technology. Other compulsory topics include software, evolutionary computation, neural networks as well as the development of organisational and presentation skills. Optional subjects allow consideration of additional specialist interests; the range of subjects available includes: optical fibre systems, communications, information theory and coding, fuzzy systems, adaptive signal processing, etc. The programme starts in late September each year and is divided into approximately three equal periods. The first and second periods consist of lectures, laboratory classes, and seminars. In the third period students undertake an individually supervised project on a topic relevant to their specialist interests.

Programme Structure

This is a one-year full-time programme providing advanced study in Information and Intelligence Engineering. Information and Intelligence Engineering is a systematic transition of emerging knowledge from the study of information technology, human intelligence and life sciences to engineering.

Classroom and Laboratory-based Taught Modules

Compulsory Modules

Module Code	Module Title	Semester	Credits (180 credits to be taken in total)
ELEC676	Advanced System Modelling and Control	1 + 2	15 credits
ELEC509	Signal Processing	1	7.5 credits
ELEC615	Information Theory and Coding	1	7.5 credits
ELEC619	Image Processing and Pattern Recognition	1	7.5 credits
ELEC631	Programme Development	1	15 credits
ELEC683	Research Skills	1	15 credits
ELEC510	Digital Filtering	2	7.5 credits
ELEC675	Computational Intelligence	2	15 credits
ELEC684	Project Outline Investigation	2	15 credits
ELEC640	Project	3	60 credits

Optional modules

Module Code	Module Title	Semester	Credits
ELEC672	Integrated Circuits – Concepts and Design	1 + 2	15 credits
ELEC505	Computer Architecture	1	7.5 credits
ELEC561	Computer Networks	1	7.5 credits
ELEC613	Photonics	1	7.5 credits
ELEC614	Optical Information Systems	2	7.5 credits
ELEC622	Microprocessor Systems	2	7.5 credits
ELEC636	Computer Communication and Systems	2	7.5 credits

Projects

Project related work accounts for 75 credits; 15 credits are allocated to course work aiming to improve report writing skills and 60 credits are allocated to project specific work undertaken from June onwards.

The project is examined by dissertation, and award of the MSc(Eng) degree will require evidence of in-depth understanding, mastery of research techniques, ability to analyse assembled data, and assessment of outcomes.

MICRO- AND NANO-TECHNOLOGY MSc(Eng)

FULL-TIME:

Programme code:	MSC/MNTEC
Major code:	EMNT
Programme length:	1 year

Programme contact: Dr I Alexandrou
E: msceee@liv.ac.uk
W: www.liv.ac.uk/eee

Programme Outline

In recent years there have been dramatic developments in the scientific understanding of materials, manufacturing and the operation of devices at the micro- and nano-scales. Microelectromechanical Systems (MEMS) and other microdevices are finding increased applications in a variety of industrial and medical fields. Some examples are accelerometers for vehicle airbags, micro-heat-exchangers for cooling of electronic circuits, reactors for separating biological cells, blood analysers, ink-jet printing, diode lasers and high-frequency fluidic control devices. The potential worldwide market for such micro-systems and devices is estimated to be $30 billion. Rapid advances are also being made in the understanding and fabrication of materials and devices at the nano-scale with potential applications in many fields of industry and medicine. There is an increasing need to transfer this knowledge into useful technology. Micro-and Nano-Technology has been designed to train engineers and scientists for this purpose. The foundation of the programme is an appreciation of the novel paradigms that must be invoked for the design and selection of materials for micro-devices. This theme is further developed by the study of the properties of nano-materials, and the fabrication of electronic, opto-electronic devices and MEMS. Students receive hands-on experience with advanced metrological techniques, and instruction in state-of-the-art fabrication methods like laser machining. The overall approach is to develop expertise in a context that emphasises recent developments in the subject and enhances knowledge, skills and personal abilities that are relevant to industry. The programme is particularly appropriate for engineers, chemists, materials scientists and may appeal to biologists with an interest in bio-engineering.

Programme Structure

The programme consists of a taught component and a major research-based project. The taught component is organised in two 12-week semesters with examinations at the end of each semester. The taught part of the programme is assessed in January and May and represents 105 credits from a total of 180. The remaining 75 credits are allocated to the project. Project related work accounts for 75 credits; 15 credits are allocated to course work aiming to improve report writing skills and 60 credits are allocated to project specific work undertaken from June onwards.

Classroom and Laboratory-based Taught Modules

Compulsory Modules

Module Code	Module Title	Semester	Credits (180 credits to be taken in total)
ELEC691	MEMS Design	1+2	15 credits
ELEC692	BioMEMS	1+2	15 credits
ELEC683	Research Skills	1	15 credits
MATS609	Electronic and Optical Devices	1	7.5 credits
MNFG604	Computer Aided Design	1	7.5 credits
MNFG610	Rapid Prototyping	1	7.5 credits
CHEM494	Chemical Nanotechnology	2	7.5 credits
ELEC324	Carbon Based Electronics	2	7.5 credits
ELEC684	Project Outline Investigation	2	15 credits
MATS514	Semiconductor Device Fabrication	2	7.5 credits
MATS515	Smart Materials	2	7.5 credits
PHYS499	Nanoscale Physics and Technology	2	7.5 credits
ELEC640	Project	3	60 credits

Projects

Project work contributes 60 credits, which will be based on a topic of industrial or scientific relevance, and will be carried out in laboratories in the University or at an approved placement in industry. The project is examined by dissertation, and award of the MSc(Eng) degree will require evidence of in-depth understanding, mastery of research techniques, ability to analyse assembled data, and assessment of outcomes.

MICROELECTRONIC SYSTEMS MSc(Eng)

FULL-TIME:

Programme code:	MSC/MICROSYS
Major code:	EEMS
Programme length:	1 year

PART-TIME:

Programme code:	MSC/MICROSYS
Major code:	EEMS
Programme length:	2 years

Programme contact: Dr I Alexandrou
E: msceee@liv.ac.uk
W: www.liv.ac.uk/eee

Programme Outline

This programme enables students to study microelectronic systems at an advanced level. The content is updated annually to maintain industry relevance.

Programme Structure

The programme is built around a core of compulsory subjects examining large digital system design, the hardware and software aspects of microprocessor systems, and integrated circuit design. Optional subjects allow specialist topics to be studied. They typically include: optical fibre communications and sensing, image processing and pattern recognition, neural fuzzy systems. The programme starts in late September each year and is divided into approximately three equal periods. The first and second periods consist of lectures, laboratory classes, and seminars. In the third period students undertake an individually supervised project on a topic relevant to their specialist interests. Project related work accounts for 75 credits: 15 credits are allocated to course work aiming to improve report writing skills and specific work undertaken from June onwards.

Classroom and Laboratory-based Taught Modules

Compulsory Modules

Module Code	Module Title	Semester	Credits (180 credits to be taken in total)
ELEC672	Integrated Circuits – Concepts and Design	1 + 2	15 credits
ELEC673	Digital System Design with VHDL	1 + 2	15 credits
ELEC509	Signal Processing	1	7.5 credits
ELEC561	Computer Networks	1	7.5 credits
ELEC631	Programme Development	1	15 credits
ELEC683	Research Skills	1	15 credits
ELEC510	Digital Filtering	2	7.5 credits
ELEC622	Microprocessor Systems	2	7.5 credits
ELEC684	Project Outline Investigation	2	15 credits
ELEC640	Project	3	60 credits

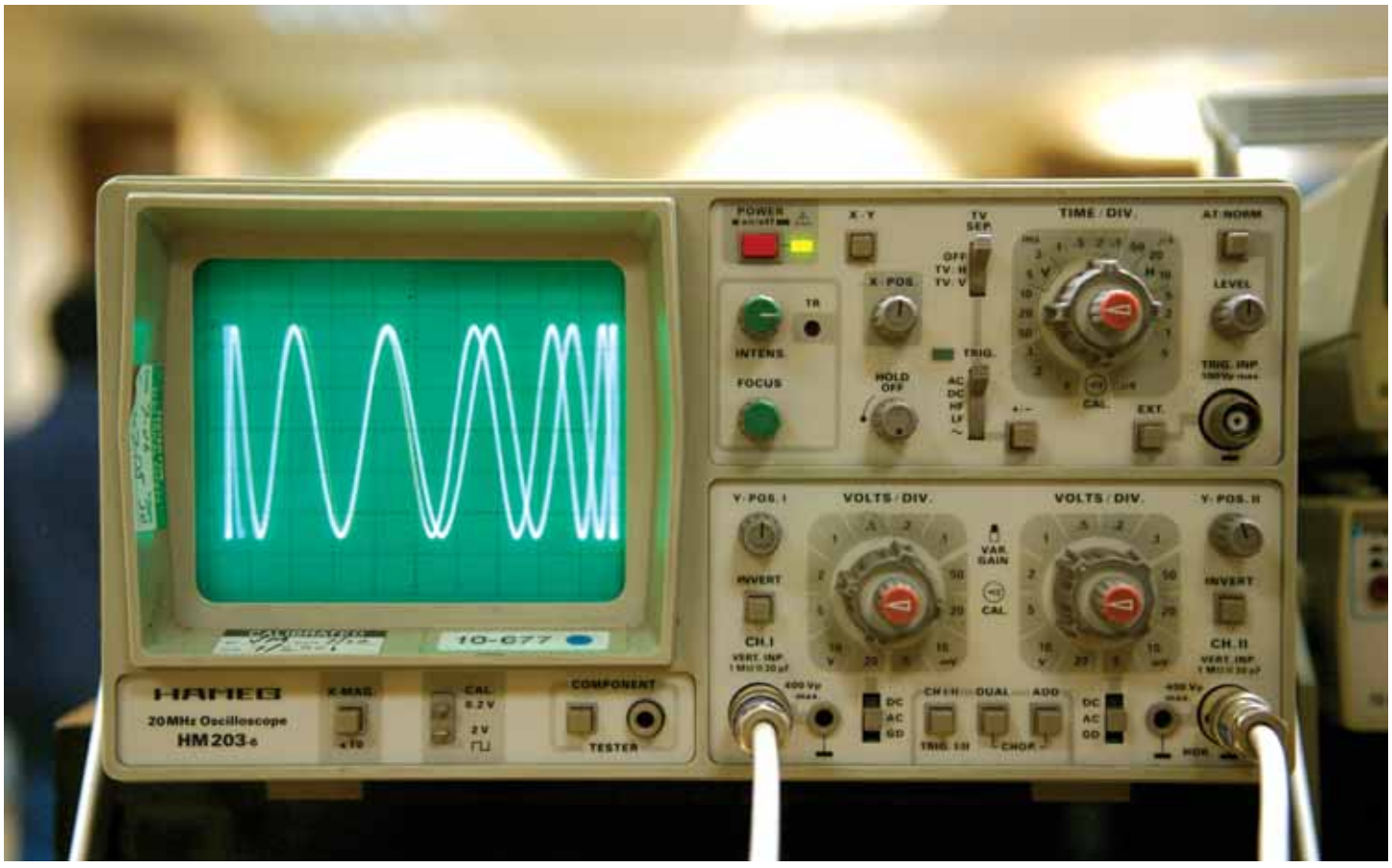
Optional modules

Module Code	Module Title	Semester	Credits
ELEC613	Photonics	1	7.5 credits
ELEC615	Information Theory and Coding	1	7.5 credits
ELEC619	Image Processing and Pattern Recognition	1	7.5 credits
ELEC633	Radio Propagation	1	7.5 credits
ELEC512	Antennas	2	7.5 credits
ELEC534	Electromagnetic Compatibility	2	7.5 credits
ELEC614	Optical Information Systems	2	7.5 credits
ELEC675	Computational Intelligence	2	15 credits

Projects

Project related work accounts for 75 credits; 15 credits are allocated to course work aiming to improve report writing skills and 60 credits are allocated to project specific work undertaken from June onwards.

The project is examined by dissertation, and award of the MSc(Eng) degree will require evidence of in-depth understanding, mastery of research techniques, ability to analyse assembled data, and assessment of outcomes.



MICROELECTRONIC SYSTEMS AND TELECOMMUNICATIONS MSc(Eng)

FULL-TIME:	
Programme code:	MSC/MICROTEL
Major code:	EEMA
Programme length:	1 year
PART-TIME:	
Programme code:	MSC/MICROTEL
Major code:	EEMA
Programme length:	2 years

Programme contact: Dr I Alexandrou
E: msceee@liv.ac.uk
W: www.liv.ac.uk/eee

Programme Outline

This is a well-established programme providing advanced study of important aspects of microelectronics and telecommunications. The content is updated annually to maintain industry relevance.

Programme Structure

The main areas of compulsory subjects examined include: microprocessor hardware and software technology, signal processing, cellular radio communications systems and related topics. Optional subjects allow consideration of specialist interests; the range of subjects available includes: optical fibre systems, radio propagation, communication signal processing, neural networks, integrated circuit design etc. The programme starts in late September each year and is divided into three approximately equal periods. The first and second periods consist of lectures, laboratory classes, seminars and similar material. In the third period students undertake an individually supervised project on a topic relevant to their specialist interests. Part-time study is in co-operation with the students' employers, and applicants for part-time study should contact the Programme Director before applying.

Classroom and Laboratory-based Taught Modules

Compulsory Modules

Module Code	Module Title	Semester	Credits (180 credits to be taken in total)
ELEC673	Digital System Design with VHDL	1 + 2	15 credits
ELEC674	Advanced Digital Signal Processing	1 + 2	15 credits
ELEC677	Telecommunications	1 + 2	15 credits
ELEC561	Computer Networks	1	7.5 credits
ELEC631	Programme Development	1	15 credits
ELEC683	Research Skills	1	15 credits
ELEC622	Microprocessor Systems	2	7.5 credits
ELEC684	Project Outline Investigation	2	15 credits
ELEC640	Project	3	60 credits

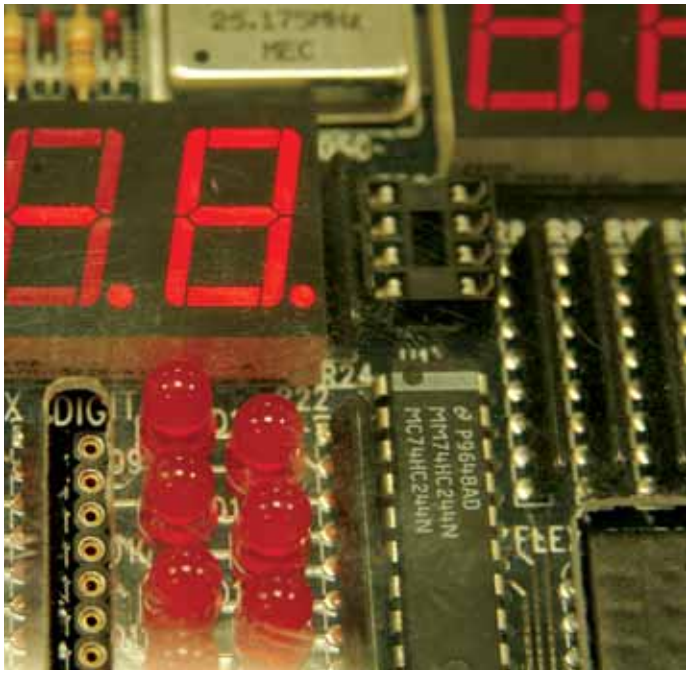
Optional modules

Module Code	Module Title	Semester	Credits
ELEC672	Integrated Circuits – Concepts and Design	1 + 2	15 credits
ELEC511	Applied Electromagnetics	1	7.5 credits
ELEC613	Photonics	1	7.5 credits
ELEC615	Information Theory and Coding	1	7.5 credits
ELEC619	Image Processing and Pattern Recognition	1	7.5 credits
ELEC633	Radio Propagation	1	7.5 credits
ELEC512	Antennas	2	7.5 credits
ELEC534	Electromagnetic Compatibility	2	7.5 credits
ELEC614	Optical Information Systems	2	7.5 credits
ELEC675	Computational Intelligence	2	15 credits

Projects

Project related work accounts for 75 credits: 15 credits are allocated to course work aiming to improve report writing skills and 60 credits are allocated to project specific work undertaken from June onwards.

The project is examined by dissertation, and award of the MSc(Eng) degree will require evidence of in-depth understanding, mastery of research techniques, ability to analyse assembled data, and assessment of outcomes.



Postgraduate Research Opportunities

MPhil/PhD	
FULL-TIME:	
Programme code:	MPHIL/EN/F
Major code:	EEER
PART-TIME:	
Programme code:	MPHIL/EN/P
Major code:	EEER

Programme contact: Professor J W Bradley
E: j.w.bradley@liv.ac.uk
W: www.liv.ac.uk/eee

Staff Research Interests

Signal Processing and Communications

Professor Asoke Nandi, Dr Waleed Al-Nuaimy, Dr Lu Gan, Dr Yi Huang, Dr Jason Ralph and Dr Xu Zhu

Recent innovations in communications – mobile telephone, internet, etc – have been growing rapidly and it is envisaged that they will continue to do so for the foreseeable future. This Group covers research in many diverse areas to develop techniques and to demonstrate their hardware capabilities for future advances in these and other application areas.

Current research includes: communications signal processing, audio signal separation, blind signal equalisation, blind source separation, multimedia signal processing, image processing, biomedical signal processing, machine condition monitoring, pattern recognition/ classification, handwritten digit recognition, data fusion, software radio, the propagation of electromagnetic waves in urban areas and buildings, the design of channel simulators for assessing the performance of radio systems, the modelling of antennas on various structures with a view to synthesising configurations to meet special requirements, electromagnetic compatibility, the application of ground penetration radar for environmental protection, the use of signal processing techniques in telephony, optical communications and bioinformatics.

Solid State Electronics

Professor Steve Hall, Professor Bill Eccleston, Dr Octavian Buiu, Dr Steve Taylor, Dr Keith Nuttall and Dr John Marsland

The interests of the Group include the use and design of devices for use in silicon VLSI, Power Electronics, Displays, Polymer Semiconductor Materials and devices, and the development of electron transport models and neural network algorithms. Emphasis in the VLSI area is on the use of newer materials and techniques, in advanced technologies, for improving the performance of existing logic families. Higher performance at lower power consumption for both bipolar transistors and CMOS is a key factor for electronic circuits for mobile phones and laptops. A major part of the current work is the development of novel device structures employing epitaxial SiGe alloys and SOI in VLSI circuits. In the power device area there is emphasis on high voltage optically activated structures and the development of new high voltage device structures which are suitable for the next generation of high voltage integrated circuits (HVIC). A particular interest is the study of device reliability through thermal analysis of power transistor chips using an advanced thermal imaging facility in this Department. The work on new Display technologies covers vertical transistor structures using polymer materials where the film thickness can be used to define very small channel lengths. Research is also directed at utilising its low electron affinity property in cold cathodes for a new generation of field emission displays. An important new area of activity is the development of very small quadropoles, through the use of micromachining, for use in mobile mass spectrometers. The Group has produced the smallest quadropole ever reported and the commercial potential for the device is currently being investigated. In the area of interfacing with biological material, the Group has developed an array of electrodes on an integrated circuit which can both stimulate and record neural activity in biological tissue. New neural network algorithms have been developed which demonstrate quicker training and better generalisation than standard techniques.

Plasma and Complex Systems Monitoring

Professor James Bradley, Dr Dmitry Samsonov, Dr Ray Gibson, Dr Joe Spencer, Dr Joseph Yan, Dr Yannis Goulermas and Dr Ioannis Alexandrou

The Group is concerned with evolving and applying novel approaches (such as chromatic technology) for monitoring and modelling real complex systems to yield operation information fault development etc. The range of systems being addressed include: Electric arcs in high-voltage circuit breakers; Electromagnetic fields in industrial devices; Fuel and energy systems; Mechanically vibrating systems; Electric plasma for materials processing; Biodegradation recycling system; Particles pollution and air quality; and Person health, well-being and protection. The sensing domain covered includes optical (fibre and remote) acoustical (audible and ultrasonic), radio frequency, infrared and chemical species. The intelligent

monitoring activities are undertaken within the Centre for Intelligent Monitoring System (CIMS) (www.cims.org.uk) established with European Regional Development funds.

The Group also has a strong research theme in the development and study of technological plasma systems for materials processing applications (www.liv.ac.uk/eee/research/tp/index.htm). Plasma research activities at Liverpool include pulsed plasma deposition of functional films and coatings on glass and polymeric materials eg low-emissivity coatings, and novel TCO coatings for use in solar cells; the pulsed deposition of polymerised functional materials for bio-physical and life science applications, including biosensors; the plasma synthesis and microscopy of carbon nanotubes and nanostructures; the study and modelling of fundamental phenomena in the area of plasma surface interactions and plasma material sheath boundary behaviour and finally design and development of plasma sources including; PVD pulsed magnetron sources, RF plasma etching and pulsed RF surface modification/polymerisation sources, CVD plasma discharges and high-pressure plasma sources for applications in waste disposal and environmental management. New areas of research in the group now include complex (dusty) plasmas. This is a new highly interdisciplinary field of plasma physics, with links to solid state physics, astrophysics, acoustics, optics, nonlinearscience, physics of electronic devices, gas and fluid dynamics, thermodynamics, space exploration and nanoscience. It's practical applications include contamination removal in plasma processing, fine powder production, nanoparticle coating, modelling of acoustic and thermal properties of materials, Tokamak decontamination, Moon dust removal, satellite decharging, study of the basic properties of life and the universe. Part of our research programme is conducted on the International Space Station.

Intelligence Engineering and Automation

Professor Henry Wu, Dr Jihong Wang,
Dr Qing-Chang Zhong and Dr Wenhu Tang

The Group's research activities are concerned with Computational Intelligence, Systems Control and Analysis, Information Processing and Management; and their applications to industrial and engineering systems, in particular to Electrical Power Engineering. The current research includes non-linear systems and control, robust control for the systems with time delay, support vector machines, mathematical morphology, neural networks, reinforcement learning, evolutionary computation, fuzzy logic, decision making support, biocomputation, multi-agents, IP network based systems, information management and condition monitoring; and their applications to operation and control of electrical power systems, condition monitoring of electrical apparatus and energy systems. One part of the Group has a particular strength in the application of microprocessors, DSPs and embedded systems to a wide range of processes and products, especially automated manufacture using robots controlled by vision systems. The research activities also extend to many aspects of industrial relevance. An e-Automation laboratory (www.liv.ac.uk/e-automation) has recently been established by the research group in a partnership with National Instruments. This international flagship laboratory for e-Automation undertakes research in the area of network-based industrial automation to define a new generation of automation systems for information management condition monitoring and real-time control of a wide range of distributed industrial systems, with integration of the latest networking and agent technologies.

RF/Microwave Engineering and Robotics

Professor Jeremy Smith, Jim Lucas and Yi Huang

The Group has established a national and international reputation through various successful research grants from EU, DTI, EPSRC and industries. The research activities include Industrial Free Electron Laser (FEL) for various applications (in medical, communications, material processing, chemistry and production of UV and Ozone); microwave plasma theoretical and experimental studies for food, material processing, spray, pollution reduction and particulates and sustainable environmental applications; underwater communications and robotics; computer electronics; RFID (radio frequency identification), indoor radio positioning systems; antennas, computational electromagnetics, electromagnetic compatibility (EMC) and measurements; RF/microwave imaging, non-destructive and non-intrusive sensor technology; and new research areas such as THz imaging and homeland security.

Bionanoengineering

Professor Dan Nicolau and Dr David Bakewell

The Group studies natural micro/nano-systems as a source of inspiration for the design fabrication and operation of hybrid micro and nano biodevices, both static and dynamic. These devices, range from biosensors, micro- and nanoarrays for genomics and proteomics, lab-on-a-chip devices and implantable medical devices. The Group's research, which covers both experimental and application-oriented activities as well as modelling, simulation and design, targets the emerging markets placed at the intersection between biology and engineering with emphasis on nanotechnology aspects. The group has extensive expertise in the study of the interaction of biomolecules (proteins and DNA) and cells (neuronal cells, bacteria, fungi) with flat, patterned or structured surfaces; and interaction of biological objects with electric fields; dynamic devices, eg, microfluidics or based on protein molecular motors, advanced microlithography technology and scanning probe microscopy. The new areas the Group is presently developing are single molecule- and extremely rapid bio-detection devices, novel computational devices based on biological algorithms, and quantification of molecular surface properties for the design of bio-mimetic nano-structured surfaces.

Admissions Information

There are three ways to make an application to the University of Liverpool.

1. Complete an online application form, this is available at www.liv.ac.uk/study/postgraduate/applying/online.htm

2. Download a copy of the postgraduate application form from the University's website www.liv.ac.uk/study/postgraduate/applying/index.htm and return it to us by post.

3. Complete a hard copy of the Postgraduate Application form, available from the address below. If you complete a hard copy of the application form, you will need to know the Programme and Major codes associated with the programme of study you wish to undertake, in order to complete section 2. The Programme and Major codes can be found within this brochure under the individual programme entry.

All Applicants

In addition to the information required on the application form, you will need to send copies of the following documents to the Postgraduate Admissions team with your application:

- School or college transcripts/certificates
- University transcripts
- Degree certificates
- Evidence of English Language proficiency
- Personal statement
- Two sealed reference letters
- Proof of funding
- Research proposal (for MPhil/PhD applicants only)

NB: We would advise that photocopies and scanned documents are acceptable at application stage. However, originals may be required should your application be successful.

Research Applicants

Students applying for research degrees (MPhil/PhD) should in addition, follow these steps:

- Check the department's research details on pages 12 and 13 of this document and the departmental website to see if we can offer expert supervision in your chosen area of specialisation.
- Prepare a brief research proposal to outline the research project you would like to undertake.
- Submit a full application with all supporting documents, including a clear statement on how you intend to fund your research degree.

Acknowledgement of your Application

The Postgraduate Admissions team will acknowledge receipt of your application and will pass it to the appropriate academic department(s) for consideration.

Applications from Students with Disabilities

We welcome applications from students with disabilities and consider them on the same academic grounds as those of other students. If you have a disability, medical condition and/or support needs it is important that you inform the University so that you receive appropriate support. To discuss your situation or to obtain a copy of the University's booklet, "A guide to support and services for students with disabilities," please contact a member of the Disability Support Team on +44 (0) 151 794 4714 / 6676 or at disteam@liv.ac.uk.

Admissions Policy

Full details of the admissions procedures operated by individual departments may be found in the departmental Postgraduate Admissions Policies, which are available on the University's website via the 'How to Apply' page at: www.liv.ac.uk/study/postgraduate/applying/index.htm

Deadlines

Although the University does not have an official deadline by which postgraduate applications should be received, some individual departments do have deadlines. Where this is the case, it is normally indicated in the text, but if you are in any doubt, please contact either the department concerned or the Postgraduate Admissions team:

Postgraduate Admissions
UK Student Recruitment Office (UKSRO)
The University of Liverpool
Foundation Building
Brownlow Hill
L69 7ZX
UK
T: +44 (0)151 794 5927
F: +44 (0)151 794 2060
E: pgrecruitment@liv.ac.uk

Representatives Overseas

In some countries the University works with local representatives who can provide more information and help you with the application process. For further details, please visit: www.liv.ac.uk/international/represent.htm

Complex plasmas applied to space exploration: Russian cosmonaut Sergei Krikalev, holds an experimental container (weighing about 50kg) on the tip of his finger on board the ISS during the first expedition. Photo courtesy of Yuri Gidzenko.

Module Summaries

Advanced Digital Signal Processing
ELEC674 (15 credits)
This module aims to: develop higher level signal processing techniques and apply them to some problems; to develop FIR adaptive filters and demonstrate their applications.

Advanced System Modelling and Control
ELEC676 (15 credits)
This module introduces advanced system analysis and design techniques to the students and to develop the skills of considering engineering problems from system point of view. The aims of the module are: to learn the skills required for system modelling and simulation; to extend the students' knowledge from time-driven system to even-driven system modelling and simulation, which covers modelling and simulation of stochastic processes; to understand the principle of advanced control systems; understand principles of basic adaptive and learning systems and their applications; select appropriate adaptive systems and/or learning algorithms to deal with a specific engineering problem; develop software packages using MATLAB to resolve an adaptive and/or learning problem; gain their own knowledge of the subjects of adaptive and learning systems for further development.

Antennas
ELEC512 (7.5 credits)
The aim of this module is to introduce fundamental antenna principles and concepts based on the underlying electromagnetic theory.

Applied Electromagnetics
ELEC511 (7.5 credits)
The aim of this module is: to introduce the students to fundamental concepts of low frequency electromagnetics with examples from electrical power engineering; to present and develop the concepts of low frequency applications in transmission lines(TX) and applying the AC circuits design into waves analysis of the TX; to introduce the students with examples of real applications of TX leading to higher frequency applications using antennas and waveguides systems; to give the student an appreciation of the importance of computational electromagnetics in the context of engineering and their roles in various industrial applications; to give the students a clear understanding of the design elements of power transmission and their measurements using directional couplers, scattering matrix of simple 2 port network, s-parameters and their applications.

BioMEMS
ELEC692 (15 credits)
This module aims to develop to Masters degree level the knowledge, skills and understanding of our postgraduates in the interdisciplinary field of Micro- and Nano- Technology to meet the needs of industry.

Carbon Based Electronics
ELEC324 (7.5 credits)
The main aim of this module is to make students aware of the new developments in large area electronics, particularly those relating to the use of polymer and fullerine based compounds and composites. On successful completion of this module students will have knowledge and understanding of: Schotley diodes; the application of twin film transistors; the principles of light emission for polymers.

Chemical Nanotechnology
CHEM494 (7.5 credits)
The aims of this module are: to introduce the student to some current problems and challenges of materials chemistry; to provide the student with knowledge of important experimental methods in nanostructure research; to create an appreciation for applied aspects of research in this area.

Computational Intelligence
ELEC675 (15 credits)
The aim of this module is to enable students to: realise the need for Computational Intelligence, and understand the benefit of adopting naturally inspired techniques to implement it; become familiar with the basic concepts of systems optimisation, and its role in natural and biological systems and entities; acquire the fundamental knowledge about various evolutionary techniques, fuzzy methods, neural networks and learning algorithms; select appropriate neural, fuzzy and evolutionary learning algorithms to deal with given engineering problems; apply some of these methods in practice, either via systems design, or via program development.

Computer Aided Design
MNFG604 (7.5 credits)
This module aims to give an introduction to computer aided design, software vendors, design standards and protocols, and to give students hands on experience of using a 3D CAD modelling system to develop: simple 3D solid models, detail engineering drawings, and assemblies; simple mould flow analysis, finite element analysis, animation and mechanism development.

Computer Architecture
ELEC505 (7.5 credits)
The aim of this module is to obtain and understanding of the construction and operation of conventional computer systems, their components and operation.

Computer Communication and Systems
ELEC636 (7.5 credits)
The pre-requisite courses have introduced basic computer systems. This will extend students' knowledge to larger scale systems and networks. The need for communication between system elements will be examined and techniques of implementation will be developed.

Computer Networks
ELEC561 (7.5 credits)
This module is an introductory one into the principles of computer networks, their components and use for various applications. It aims to provide basic concepts about the architecture of the computer networks, reference models that are used for describing and analysing real life situations, as well as providing knowledge about the design and management principles behind the functioning of local area networks.

Digital Filtering
ELEC510 (7.5 credits)
The aim of this module is to provide students with a good understanding of the types and behaviours of a number of different digital filters.

Digital System Design with VHDL
ELEC673 (15 credits)
The aim of this module is to provide students with the ability to: design and synthesise digital systems using VHDL; understand the problems of meta-stability in digital systems; design microprocessors using ASM techniques; develop and test System on a Programmable Chips (SOPC) design using Altera NIOS.

Electromagnetic Compatibility
ELEC534 (7.5 credits)
The aim of this module is to introduce fundamental EMC principles and concepts based on the underlying electromagnetic theory.

Electronic and Optical Devices
MATS609 (7.5 credits)
This module will introduce the electrical properties of materials and their exploitation in electronic and optical devices.

Image Processing and Pattern Recognition
ELEC619 (7.5 credits)
The aim of this module is to introduce the basic concepts of digital image processing and pattern recognition.

Information Theory and Coding
ELEC615 (7.5 credits)
The aim of this module is to introduce the techniques used in source coding and error correcting codes, including the use of information as a measure.

Integrated Circuits – Concepts and Design
ELEC672 (15 credits)
The aim of this module is to explain the reasons for the predominance and importance of silicon based microelectronics to the semiconductor industry. To explore how materials, devices and circuit issues are inter-related and exploited to make the microchips that underpin the information age. To prepare students for entering the Si semiconductor industry.

Nanoscale Physics and Technology
PHYS499 (7.5 credits)
This module aims to: introduce the emerging fields of nanoscale physics and nanotechnology; describe experimental techniques for probing physical properties of nanostructured materials; describe the novel size-dependent electronic, optical, magnetic and chemical properties of nanoscale materials; describe several 'hot topics' in nanoscience research; develop students' problem-solving, investigative, communication and analytic skills through appropriate assignments.

MEMS Design
ELEC691 (15 credits)
This module aims to develop to Masters degree level the knowledge, skills and understanding of our postgraduates in the interdisciplinary field of Micro- and Nano- Technology to meet the needs of industry.

Microprocessor Systems
ELEC622 (7.5 credits)
This module provides an understanding of the construction and operation of microprocessor based systems. Students are introduced to programming at low level and interfacing microprocessors to other components.

Optical Information Systems
ELEC614 (7.5 credits)
The aim of this module is to: introduce the duality of light as both wave and ray; to show intensity and phase related optical principles; to demonstrate optical information transfer through a number of applications.

Project Outline Investigation
ELEC684 (15 credits)
To provide students with the necessary background information so that they will be able to satisfactorily research, plan and undertake their project.

Photonics
ELEC613 (7.5 credits)
The aim of this module is to introduce students to the fundamental principles of opto/electronic systems for the transfer of information.

Programme Development
ELEC631 (15 credits)
The objectives of this module are to teach students essential elements of software engineering and how to code software designs in C/C++ and MATLAB programming languages. Also, the aim of this module is to give the students enough skills and a good understanding in computer programming allowing them to efficiently design complex programs.

Project
ELEC640 (60 credits)
The project provides the 60 credit component of the programme required to complete the third period of study. A total of 180 credits is necessary to complete an MSc (Eng) programme. The project is concerned with a problem related to a student's chosen specialisation, or it is based on one of the programme subjects and will be supervised by Departmental and/or Industrial staff. Outlines of suggested projects will be presented to students in December.

Radio Propagation
ELEC633 (7.5 credits)
The aim of this module is to develop an appreciation and understanding of radio propagation mechanisms.

Rapid Prototyping
MNFG610 (7.5 credits)
This module aims to: provide an overview on the role of rapid prototyping technology in new product development; to develop a generic understanding on the principles and the complete process chain of layer-based manufacturing processes; to provide an awareness on the concept of rapid tooling and rapid manufacturing.

Research Skills
ELEC683 (15 credits)
The aim of this module is to provide students with the necessary background information so that they will be able to satisfactorily research, plan and undertake their project.

Semiconductor Device Fabrication
MATS514 (7.5 credits)
This module aims to develop the understanding of the science, processing and technology underpinning modern manufacture of micro- and opto-electronic devices and materials.

Signal Processing
ELEC509 (7.5 credits)
The aim of this module is to develop a basic framework for signal processing and demonstrate some applications.

Smart Materials
MATS515 (7.5 credits)
This module will introduce the concept of smart behaviour through integration of sensors and actuators at various length scales.

Telecommunications
ELEC677 (15 Credits)
The aim of this module is to introduce students to the theory and concepts of robust data communications systems and to understand the cellular radio communication system, which is one of the most popular and important communication systems. The major elements include: the cellular radio system block diagram; base-stations and mobiles; radio propagation; comparison of the 1st, 2nd and 3rd generation systems.