Faculty of Engineering

UNIVERSITY OF LEEDS

Postgraduate
Masters Courses 2013

Contents

Faculty of Engineering

The University of Leeds is home to one of the UK's top engineering and computing faculties. We have an international reputation for our teaching and research, achieving exceptionally high scores in the latest UK Government Research Assessment Exercise (RAE).

This means that when you join us as a postgraduate student, you will be taught and supervised by world-class academics at the cutting edge of their discipline who will challenge, encourage and support you in your studies. Our research feeds directly into our teaching ensuring that our courses are at the forefront of thinking in their respective fields.

Our teaching and research is delivered through our five schools:

- School of Civil Engineering
- School of Computing
- School of Electronic and Electrical Engineering
- School of Mechanical Engineering
- School of Process, Environmental and Materials Engineering

Whatever your area of interest you will find something to suit you. That's because the range and scope of our activity is extensive. We cover all the major engineering and computing disciplines and, as well as the traditional core subjects, we have specific expertise in engineering project management, water and waste engineering, computational fluid dynamics, computer science, communications and wireless technology, energy management, chemical and pharmaceutical engineering and medical engineering.

Our Computing masters courses are not listed in this brochure. For more information on our Computing courses visit the School of Computing website: **www.engineering.leeds.ac.uk/computing**

Faculty of Engineering: **www.engineering.leeds.ac.uk**
University of Leeds: **www.leeds.ac.uk**

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www.facebook.com/facultyofengineeringleeds

Why Choose Us?

Our masters courses are delivered by academic staff who are research active and have extensive knowledge and expertise, many of whom are leading experts in their chosen fields of specialisation. The research they carry out will also feed directly into your teaching, so you'll learn about the latest developments from world-class academics.

Our masters courses will allow you to further your knowledge, widen your skills base and improve your career prospects. They are also excellent preparation if you are thinking of undertaking further study in the form of a PhD. For more information about our research degrees visit

www.engineering.leeds.ac.uk/research-degrees

First-class facilities

Our students have access to all the facilities you would expect from a research-intensive faculty. With over 700 postgraduate students from around the world, we support your studies with facilities of the highest standard. The School of Electronic and Electrical Engineering boasts a state-of-the-art electron-beam lithography system, as well as world-leading terahertz, microwave, and bioelectronics laboratories.

In The School of Civil Engineering, students benefit from our new suite of Public Health laboratories with separate areas for solid waste, water and waste water. We also have excellent computational, manufacturing and measurement facilities in the School of Mechanical Engineering, and the School of Process, Environmental and Materials Engineering hosts an advanced electron optics facility for nano-scale materials characterisation.

Strong industrial links

The content of each course is industrially orientated and members of staff maintain close contact with industry to ensure what you are studying is up-to-date and in-line with employer needs. An Industrial Advisory Board and an Employers' Group means that our industrial partners provide input into the ongoing development and review of our courses. And they also contribute to some teaching through guest lectures, hosting and supervising projects, as well as providing funding.

Careers

Alongside the specific content of our courses, you will be able to enhance your transferable professional skills, which are vital for future career development. Our courses incorporate training in presentation skills, scientific writing, project management, intellectual property awareness, team working and applying research methodology.

Not only are our courses excellent for career development, with many graduates taking top positions in industry and government, they are also excellent preparation for further study in the form of a PhD.

Engineering Careers Fair

We hold an annual Engineering and Computing Careers Fair attracting over 30 graduate recruiters including organisations such as Atkins, AECOM, Balfour Beatty, BP, Deloitte, Ernst & Young, Jaguar Land Rover, Procter & Gamble, Network Rail and Thales, to name but a few. The fair gives you the chance to explore the opportunities available to you after graduation.

Careers Centre

Our on-campus Careers Centre is one of the largest in the country. It offers an excellent range of services and has a great relationship with graduate recruiters. The Careers Centre can help you to improve your CV and complete job applications and also holds training events and workshops to help you with your career progression.

More information on the Careers Centre can be found at

www.careerweb.leeds.ac.uk

Learning and Assessment

All of our masters courses operate on a credit-based modular system. A standard module is worth 15 credits and your research/ professional project is worth between 60 - 75 credits. You will need to take modules totalling 180 credits. You will study the taught modules and undertake preparatory work for the research project in the first two semesters, and devote the summer to your research project.

Course work assignments, such as group presentations, reports, essays, and practical work, are a significant part of the course and contribute towards the module assessment. Examinations may also be included as part of the assessment. Your research project will be assessed by dissertation and oral presentation.

Research/professional project

The project is possibly one of the most satisfying parts of your course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and be assigned a project supervisor. Some of the projects are formally linked to industry and so, depending on which masters course you choose to study, you could spend time working at the collaborator's site during the summer semester.

In the School of Mechanical Engineering for example, you can become involved in projects linked to the design, construction and testing of the Formula Student race car.

For more examples of recent research/professional projects please visit the individual course pages.

Duration

Our masters courses are undertaken on a full-time basis for 12 months from September to September. Some courses are available on a part-time basis (24 months), please contact our Admissions Hub for details.

The Application Process

Due to the high demand for our courses, you should apply as early as possible. Applications from international students should be submitted by mid July, and UK applications received by mid August of the year of entry. However, there is an application deadline of 30 June if you are applying for the excellence scholarship. To be eligible for this, you will need to have an offer of a place on one of our postgraduate courses.

The easiest and quickest way to apply for a masters course is to apply online. This way you can track your application at each stage of the process. However, if you prefer you can download an application form and send it to us at the address below.

For further information visit
www.leeds.ac.uk/pgthowtoapply

Fees
For up-to-date details on fees visit
www.engineering.leeds.ac.uk/masters-courses/fees

Scholarships
Details of Faculty scholarships can be found at
www.engineering.leeds.ac.uk/scholarships

The University also offers a number of scholarships, for more information on these visit
http://scholarships.leeds.ac.uk

Entry requirements
These can be found on the individual course pages.

English language requirements
Applicants whose first language is not English, or whose bachelors degree is not from a university in an English speaking country, will need to provide evidence of proficiency in English by having attained the following or its equivalent:

IELTS – 6.5 with not less than 6.0 in listening, reading, speaking and writing.

Pre-sessional English language courses are available at our on-campus Language Centre for students who wish to improve their language skills before starting their studies. To find out more visit
www.leeds.ac.uk/languages

Contact us
If you have any queries please contact:
Engineering Postgraduate Taught Admissions Hub
Faculty of Engineering
University of Leeds
LS2 9JT
UK

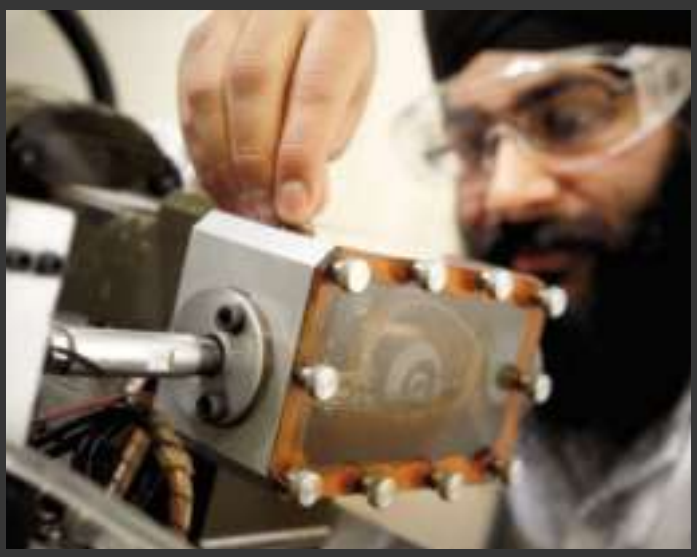
e: **msc@engineering.leeds.ac.uk**
w: **www.engineering.leeds.ac.uk/postgraduate**

Course Listing

MSc Advanced Mechanical Engineering

This course offers a broad range of advanced subjects across various engineering disciplines. Particular emphasis is placed on the application of advanced computational methods and state-of-the-art software packages to solve complex engineering problems. Through selecting modules from a range of options, the course can be tailored to meet your particular needs and interests.

On completion of this course you will be able to analyse and solve complex engineering problems using a combination of theoretical, experimental and computational techniques.



Who will benefit?

- Professional engineers already working in the industry who wish to deepen their knowledge and expertise so enabling future career enhancement and development
- graduate engineers who wish to gain a strong background knowledge in modern methods of engineering analysis, including computer-based methods
- those who would like experience of undertaking a research-led project in a leading mechanical engineering department.

Specialist facilities

- Advanced CAD facilities for design work
- a well-equipped workshop for building parts including 3D printing facilities, wire EDM and CNC machinery
- access to the latest industry standard software for computational fluid dynamics and finite element modelling of material stress analysis
- advanced measurement laboratory
- laboratory facilities for solid and fluid mechanics, erosion, corrosion, tribology, combustion, control and dynamics, robotics and optical measurement.

Typical careers

After graduating from this course, you will be in a good position to seek employment with many leading companies. Recent graduates from the School can be found in organisations such as Siemens, E-ON UK, Cummins UK, Crompton Technology Group, Bombardier Transportation, DePuy International, Bentley Motors, Jaguar Land Rover, Nissan Motor Company, Faraday Packaging Partnership, Airbus, EAS Engineering, Prodrive, Ricardo UK and Ford Motor Company.

Entry requirements

A degree equivalent to a UK upper second class honours (2:1) degree, or higher, in engineering, a physical science or mathematics.

Course content

You will study the following modules plus five of the optional modules. You will also undertake a professional project during the summer months.

Modules	Contents
Computational and Experimental Methods	Fundamental concepts of computational and experimental methods.
Energy Systems Engineering	Engineering aspects of energy conversion processes; including conventional, i.e. fossil and nuclear fuels, and renewable energies.

Optional modules

Aerodynamics with Computational Fluid Dynamics	Problem solving in the area of potential (ideal) flow theory, wing theory and computational fluid dynamic approaches to advection and diffusion-based flows.
Aerospace Structures	Methods of computer-based design and analysis of structures such as frames and shells.
Aerospace Systems and Propulsion	Gas turbines, their turbomachinery, combustion chambers and control systems.
Automotive Chassis Engineering	Important aspects of chassis systems and behaviour including suspension and steering systems, chassis structures, and noise, vibration and harshness (NVH).
Automotive Driveline Engineering	An overview of all the key elements of a driveline with particular focus given to the design of geared transmissions.
Biomaterials	Short course covering a range of topics associated with biomaterials – the emphasis here is on the life-science interface.
Biotribology	Distance learning module underpinning the science behind the successful application of engineering to joint replacements.
Combustion in Engines	The key principles of combustion processes and pollution emissions from engines, burners and explosions.
Finite Element Methods of Analysis	Principles and applications of FEM.
Functional Joint Replacement Technology	Applies the standard engineering principles of mechanics, tribology and biomaterials to the understanding of the technology used in the development of total joint replacements.
Introduction to Tribology	A broad-based introduction to the interdisciplinary scientific discipline of tribology, covering how tribology impacts on the design and operation of mechanisms and the means adopted to lubricate them.
Mechatronics and Robotics Applications	The integration of components such as actuators, mechanisms, mechanical structures, sensors and computer control/electronics into a unified form.
Rotary Wing Aircraft	The theory of vertical flight, design and analysis of helicopters, autogyros and other rotary wing aircraft and an appreciation of the extra difficulties involved when the vehicle flow is cyclic in nature.
Surface Engineering	Surface engineering technologies for the control of wear, corrosion and fatigue of engineering components.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Professional project

The professional project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Turbulent combustion (experiment, theory and modelling)
- Alternative and sustainable fuels
- Gas turbine cooling ring effectiveness
- Engine combustion

MSc Automotive Engineering

This course caters for industry's demand for highly-skilled graduates in the automotive industry in the advanced areas of analysis, design and manufacture. Traditionally this industry has been associated with high volume vehicle manufacture. However, the nature of the industry has changed over the last decade and it is now dominated by automotive component manufacturers and specialist design and consultancy houses.

During this course you will acquire the range of skills and knowledge required by these organisations. Particular emphasis is placed on the application of computational methods and software packages in automotive engineering analysis, design and manufacture.

Who will benefit?

- Professional engineers already working in the industry who wish to deepen their knowledge and expertise so enabling future career enhancement and development
- graduate engineers who wish to gain specialist knowledge and skills relevant to the automotive industry.

Specialist facilities

- Formula Student car build area including computerised engine test bays
- access to the Faculty Workshop with its high level CNC and wire EDM facilities
- brake test area
- advanced measurement laboratory
- access to the latest industry standard software for computational fluid dynamics and finite element modelling of automotive related systems and materials along with ADAMS software for suspension simulation
- state-of-the-art facilities for tribology (to study wear on engine parts)
- a 'stirred bomb' for characterising fuel ignition
- advanced engines with optical access.

Typical careers

Career prospects are excellent and with this qualification you should expect to find employment in the automotive and motor sport industries. Current graduates can be found working with Bentley Motors, BMW UK, Jaguar Land Rover, Honda, Nissan Motor Company, Renault F1 (Lotus Renault GP), Red Bull Racing and Ricardo UK. Others opt to work in the general engineering industry, remain at university for PhD study or move into a completely different field such as finance or teaching.

Entry requirements

A degree equivalent to a UK upper second class honours (2:1) degree, or higher, in engineering, a physical science or mathematics.

Course content

You will study the following modules and will undertake a professional project during the summer months.

Modules	Contents
Automotive Chassis Engineering	Aspects of chassis systems and behaviour including suspension and steering systems, chassis structures, and noise, vibration and harshness (NVH).
Automotive Driveline Engineering	An overview of all the key elements of a driveline with particular focus given to the design of the key machine elements along with some novel applications.
Combustion in Engines	The key principles of combustion processes and pollution emissions from engines, burners and explosions.
Computational and Experimental Methods	Fundamental concepts of computational and experimental methods.
Introduction to Tribology	Broad based introduction to the interdisciplinary scientific discipline of tribology, covering how tribology impacts on the design and operation of mechanisms and the means adopted to lubricate them.
Mechatronics and Robotics Applications	The integration of components such as actuators, mechanisms, mechanical structures, sensors and computer control/electronics into a unified form.
Surface Engineering	Surface engineering technologies for the control of wear, corrosion and fatigue of engineering components.
Vehicle Design and Analysis	Basic and more advanced concepts of vehicle performance including ride, handling, aerodynamics and acceleration/deceleration behaviour.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Professional project

The professional project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Regenerative braking systems – impact on fuel consumption and vehicle stability in HEVs
- Thermo-mechanical analysis of disc brake for vehicle rollaway
- Coated lightweight brake rotors
- Designing, measuring and modelling of vehicle dynamics

Formula Student race car

The Formula SAE (Society of Automotive Engineering) International and Formula Student are annual competitions based in America and Europe where students design, build, test and race an open wheeled, single seater race car. Typically cars designed at Leeds may do 0-60 mph in just over 3 seconds with the engine revving at close to 14000 rpm!

The University of Leeds was one of the first UK universities to enter the American Formula SAE competition and over the last few years has been one of the most successful teams, winning the Award for Best Analytical Approach to Engineering Design twice and coming first in the Overall Design Competition.

You can become involved in this initiative through your professional project linked to your course. These projects provide you with the opportunity to work as part of a dynamic team that has to design a new vehicle from scratch in just nine months.

A sample of recent projects includes:

- Development of a data-logging system for the SAE car
- Sensitivity of IC engine friction to design and operating parameters in a racing car
- Crashworthiness and optimisation of a bonded race car chassis using finite element applications
- Traction control on the SAE car

If you would like to learn more visit

www.racing.leeds.ac.uk

MSc Chemical Engineering

The course aims to provide you with advanced chemical engineering and process technology skills for exciting and challenging careers in the chemical and process industries. It also enables graduates in chemistry or other science/engineering disciplines to convert to a specialisation in chemical engineering. The course is accredited by the Institution of Chemical Engineers (IChemE).

The course has been designed to provide a greater depth and breadth of knowledge of aspects of advanced chemical engineering and a range of up-to-date process technologies, which enable you to design, operate and manage processes and associated manufacturing plants and to provide leadership in innovation, research and technology transfer.

For students with a non-chemical engineering background, the concepts of process design are introduced leading to a plant design project.

The research project enables you to gain experience of planning, executing and reporting a research work of the type you will undertake in an industrial or academic environment. The research projects cover wide-ranging topics in chemical engineering, colloids and interfacial engineering, multi-scale and process modelling, fine chemicals processing, minerals and waste processing, powder and formulation engineering, in-process measurement and control systems.

Who will benefit?

- Chemical engineering graduates wishing to upgrade their first degree to UK masters level degree
- graduates from science and other engineering disciplines who wish to convert to specialisation in chemical engineering
- professional engineers already working in the industry who wish to deepen their knowledge and expertise, enabling future career enhancement and development.

Typical careers

Career prospects are excellent. There is a wide range of career opportunities in the chemical and allied industries in process engineering, process design and research and development as well as in finance and management.

Entry requirements

A minimum of a UK second class (2:2) honours degree or equivalent, in chemical engineering or a related engineering or science discipline.

Course content

You will study the following modules plus two of the optional modules. You will also undertake a research project during the summer months.

Modules for chemical engineering graduates

Modules	Contents
Advanced Reaction Engineering	Covers advanced topics in reaction engineering including, non-isothermal operation and stability of reactors, non-ideal flow reactors, reactions catalysed by solids and design of packed-bed and fluidised-bed reactors, multiphase reactions and reactor design and recent advances in reaction engineering.
Advances in Chemical Engineering	Introduces the most recent developments in chemical engineering science and technology, covering topics such as colloidal science and engineering, nano science and technology, process analytical technology and non-intrusive measurement techniques.
Batch Process Engineering	Provides an understanding of the distinctive features of batch processes, the concepts and methods for scheduling and simulation batch operations, skills for selection of batch route, solvents and equipment and the design of control systems and the future directions in batch manufacturing techniques.
Computational Transfer Processes	Covers the advanced aspects of laminar and turbulent flows, turbulence modelling and develops an understanding of the computational fluid dynamics (CFD) methodology and its use in the design of process equipment. Turbulent flow problems are solved using a CFD software.
Multi-scale Modelling	Provides an overview of modelling techniques at the microscopic, mesoscopic and macroscopic length scales, e.g., molecular modelling, discrete element methods and process systems modelling. It will show how multi-scale modelling can be applied to solve practical problems via a number of case studies.
Waste Treatment and Disposal	Covers incineration, recycling of waste and processing such as pyrolysis, gasification, anaerobic digestion and composting, and waste management.

Optional modules

Advanced Energy Systems	Provides further analysis of industrial power generation both from nuclear, conventional and renewable sources.
Chemical Processing of Minerals	Provides knowledge of various hydrometallurgical systems used in the chemical, minerals and related industries, and an understanding of the chemical theories and mathematical techniques used in the design and operation of such processes.
Industrial Polymer Engineering	Designed to provide a thorough understanding of industrial polymers application through a holistic approach that integrates polymer manufacturing, polymer processing, and product application development.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

See the **next page** for modules for graduates with a non-chemical engineering background.

Modules for graduates with a non-chemical engineering background

Modules	Contents
Batch Process Engineering	Provides coverage of various aspects of batch processing of chemicals.
Chemical Reaction Processes	Provides a comprehensive introduction to types of reactions and reactors together with rate analysis and principles of design of ideal reactors.
Plant Design Project	The concepts of plant design are introduced in this project. The project is organised in line with the guidelines prescribed by the IChemE for the design project on accredited Chemical Engineering degree courses. Provides exemption from the design project requirements for corporate membership of the IChemE.
Process Chemistry and Chemical Technology	This module provides a comprehensive introduction to fine chemical industry, R&D components, process chemistry and chemical engineering fundamental concepts, unit operations, safety and quality and plant design to students with non-chemical engineering backgrounds.
Separation Processes	Provides a thorough grounding in the unit operations of distillation and absorption for binary and multi-component systems. Provides a basis for the equipment design aspects of the Plant Design Project module.

Optional modules

Advanced Energy Systems	Provides further analysis of industrial power generation both from nuclear, conventional and renewable sources.
Chemical Processing of Minerals	Provides knowledge of various hydrometallurgical systems used in the chemical, minerals and related industries, and an understanding of the chemical theories and mathematical techniques used in the design and operation of such processes.
Industrial Polymer Engineering	Designed to provide a thorough understanding of industrial polymers application through a holistic approach that integrates polymer manufacturing, polymer processing, and product application development.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Control of heat release and temperature levels in jacketed stirred tank vessels
- Pool boiling heat transfer of nanofluids
- Effect of surface wettability and spreading on nanofluid boiling heat transfer
- Aspen Plus simulation of CO_2 removal by amine absorption from power plant
- Modelling of CO_2 absorption using solvents in spray towers
- Historical data analysis using artificial neural network modelling
- Computational modelling of particulate flow
- Characterisation of sedimentation process in two-phase flow based on continuity theory using impedance tomography
- Finding a new technique for on-line monitoring of crystallisation process using an electrode probe

MSc Chemical Process Research and Development

Run jointly between the School of Chemistry and the School of Process, Environmental and Materials Engineering, this course provides advanced training to meet current and future industrial demands for skilled scientists and engineers in pharmaceutical and fine chemical process technology.

It has been developed for graduates from a variety of backgrounds for example, chemistry, chemical engineering and other related science/engineering disciplines, and enables graduates from science/engineering disciplines to convert to a specialisation in chemical process technology.

More detailed information about this course can be obtained from the Institute of Process Research and Development:

t: **0113 343 6543**
e: **iprdcourses@leeds.ac.uk**
w: **www.iprd.leeds.ac.uk**

MSc Communications Engineering

Efficient and effective high-speed communications are essential for delivering healthcare, industrial development, transport, broadcasting and a whole other myriad of services that help every country prosper and develop economically and socially. This masters course will deliver high calibre communications engineers equipped for such challenges of the 21st century.

This course is designed to meet the demand for engineers who understand modern communications techniques and the electronics that makes them work. At the physical level, it covers the propagation of radio waves and the behaviour of antennas. At the communications level, it ranges from the fundamentals of communication theory through modern modulation and coding techniques to cellular systems. At the electronics level, it complements these by dealing with the system-on-a-chip technology that implements much of modern systems. The course also benefits from a laboratory with a wide range of relevant and illustrative experiments. This course is accredited by the Institution of Engineering and Technology (IET). Visit our virtual experience website to meet some of our academic staff and students.

http://virtual.engineering.leeds.ac.uk/electronic

Who will benefit?

- Practising engineers who wish to keep up to date with new techniques of mobile telephony
- those wishing to gain a deeper understanding of both the RF and modulation/coding sides of modern communications.

Typical careers

Career prospects are excellent and graduates of this course should expect to develop careers in many branches of the communications industry including radio engineering and the mobile sector.

This is a sector characterised by increasingly specialised technologies, where up-to-date knowledge is essential and newly trained engineers are in demand. They are needed to support the continual upgrading of our communications infrastructure. This includes the migration from analogue to digital and normal to high-definition television, from second to third and third to fourth generation mobiles, and an ever-expanding range of systems such as Bluetooth, WiFi, WiMax and many others. Some of these migrations are under way, others are planned and will generate a continuing stream of employment prospects.

Entry requirements

A minimum UK upper second class (2:1) honours degree or equivalent in appropriate numerate disciplines usually electronic engineering, but others may be considered. In some special cases, if places are still available, applicants with a good lower second class (2:2) honours degree and who have relevant experience may also be considered and so should not be deterred from applying.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

For examples of recent research projects visit our website **www.engineering.leeds.ac.uk/electronic/postgraduate/projects**

Course content

You will study the following modules plus two of the optional modules (you must choose one from each list of optional modules). You will also undertake a research project during the summer months.

Modules	Contents
Antennas and Radio Wave Propagation	Covers the factors governing the design and operation of modern wireless communication systems. These include fundamentals of antenna theory and propagation, radiation patterns of antennas (including both wire and aperture antennas), propagation mechanisms (including the effects of climate on them), link budgets and antenna arrays. Diversity, diffraction, fading, beamforming and topics specific to satellite and cellular systems are also covered.
Cellular Mobile Communications Systems	Focuses on the underlying principles of cellular mobile radio for voice, data and video, the limitations and possibilities of mobile communications, signal processing requirements, the need for protocols, the principles and practices of 2-G (e.g. GSM) and 3-G (e.g. WCDMA) systems. Specific topics include the cellular concept, radio wave propagation and digital transmission in cellular systems, the GSM system, basic principles of DS/CDMA, PN codes and Walsh sequences, correlator design, the Rake receiver and the WCDMA system.
Fundamentals of Communications Theory	Covers the fundamental principles underpinning communication systems. These include mathematical analysis of system behaviour, modelling the blocks in a communication system, the Shannon and Nyquist theories, models for estimating system bit error rate, elementary principles of decision/detection theory and their use in communication receivers.
Mini Projects and Laboratory	Designed to provide experience of practical electronics and measurement techniques. Particularly suitable for students without an electronic engineering bachelor's degree. Laboratory work covers measurement and sampling techniques, RF and microwave network analysers, antenna measurements and embedded systems. You will choose two mini projects from a range including RF amplifier design and test, an infra-red data link, an embedded system and acoustic measurements in a well-equipped sound studio.
Modulation and Coding for Digital Communications	Covers modern digital modulation and demodulation (e.g. BPSK, QPSK, QAM, GMSK, OFDM), carrier and timing recovery, forward error correction and detection, including block coding, convolutional coding, Turbo codes and Monte-Carlo methods for performance evaluation.
Wireless Communications Systems Design	This module addresses communication design at many different levels. At the system level it covers microwave systems, system modelling, sub-system characterisation and the delivery of complete communications systems in the real world. The propagation level covers system noise-figure analysis, link budgets and radio propagation analysis as a system planning tool. At the circuit level it includes; RF subsystems, direct and heterodyne conversion, RF integrated circuits, the impact of RF/microwave component design on wireless communication system performance, modulation formats and their impact on circuit design, and distortion and spectral re-growth.
Optional Modules (1)	
Data Communications and Sensor Networks	Provides a knowledge and understanding of data communications and wireless sensor networks and how they are, and could be, used in a range of applications.
DSP Hardware Implementation	Develops an understanding of the fundamental principles of how DSP algorithms are implemented in practice. Provides an insight Into the operation (and limitations) of DSP chips. Gives hands-on experience of programming DSP chips. Also covers the basic principles to design and implement popular DSP algorithms taken from digital filtering, modulation, matched filtering, modems, adaptive filtering, etc.
Photonics and Communications Technologies	This module will help develop an understanding of the fundamental principles of optical fibre communication systems – including their advantages and limitations. In particular it will address the properties, advantages and disadvantages of the photonic components that are the enabling technology for future high-speed, broadband optical communications.
Optional Modules (2)	
DSP Hardware Implementation	Develops an understanding of the fundamental principles of how DSP algorithms are implemented in practice. Provides an insight Into the operation (and limitations) of DSP chips. Gives hands-on experience of programming DSP chips. Also covers the basic principles to design and implement popular DSP algorithms taken from digital filtering, modulation, matched filtering, modems, adaptive filtering, etc.
Embedded Systems Design	This module introduces students to contemporary hardware and software development tools for mobile and embedded devices.
Medical Electronics and E-Health	Provides a knowledge and understanding of how electronics and communications technology is, and could be, used in medical applications and healthcare.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

MSc Communications and Signal Processing

Mobile broadband wireless access is now the next communications revolution. As new video-rich, bandwidth-hungry services are developed the challenge to deliver the next generation broadband communications networks is becoming more profound. And at the heart of any modern communications network or device is the enabling technology of advanced digital signal processing (DSP). For example, in future 4-G systems (e.g., LTE-Advanced) precoding DSP, MIMO beamforming, advanced DSP detection, etc will all be routine.

So research is always being carried out by the world's major communication companies to develop new DSP algorithms in order that high bitrate, mobile, broadband services can be delivered (with an acceptable quality of service) to an increasing number of users within a limited bandwidth. That is the challenge!

The School of Electronic and Electrical Engineering, with its world-class research-led teaching, is ideally placed to deliver a masters course both relevant to industry and with good career prospects. One of the unique features of this course is the inclusion of a significant number of specialist industrial lectures, which ensures you can relate the theoretical and design aspects of communications and signal processing with the practical limitations of real-world constraints. In addition, the Digital Signal Processing laboratory (from Texas Instruments) gives you hands-on experience using the DSP technology that can be found in computers, cellular phones, MP3 players, etc.

We are currently seeking accreditation for this course from the Institution of Engineering and Technology (IET). Visit our virtual experience website to meet some of our academic staff and students.

http://virtual.engineering.leeds.ac.uk/electronic

Who will benefit?

- Graduates seeking to enhance their employability within the digital communications industry
- practising engineers wishing to learn about recent developments in signal processing.

Typical careers

On completing this course, you can expect to have obtained the skills that will lead to employment in any area of the communications/signal processing industry including optical networking, DSP design and implementation, cellular mobile, r.f. planning, broadband systems and general communications research and development.

Course content

You will study the following modules and will undertake a research project during the summer months.

Modules	Contents
Broadband Wireless Networks	Introduces the basic principles of WiMax – one of the most important technologies (based upon OFDM) for mobile broadband communications, and the next big development in the modern communications revolution. Covers the basic principles of operation both from the physical (PHY) and medium access control (MAC) layers. The approach will be both analytic and descriptive. In addition, any possible limitations will be discussed as well as the economic and social aspects of its rollout.
Cellular Mobile Communications Systems	Focuses on the underlying principles of cellular mobile radio for voice, data and video, the limitations and possibilities of mobile communications, signal processing requirements, the need for protocols, the principles and practices of 2-G (e.g. GSM) and 3-G (e.g. WCDMA) systems. Specific topics include the cellular concept, radio wave propagation and digital transmission in cellular systems, the GSM system, basic principles of DS/CDMA, PN codes and Walsh sequences, correlator design, the Rake receiver and the WCDMA system.
Digital Signal Processing for Communications	Introduces the theoretical tools of digital signal processing (DSP) and shows the application of DSP in modern communication systems. The module will help you understand the realisation issues and trade-offs in practical designs. Topics covered will include time- and frequency-domain analysis for discrete-time systems; random processes and statistical signal processing; applications including speech coding, communications channel estimation, equalisation, adaptive signal processing and channel modelling.
DSP Hardware Implementation	Develops an understanding of the fundamental principles of how DSP algorithms are implemented in practice. Provides an insight into the operation (and limitations) of DSP chips. Gives hands-on experience of programming DSP chips. Also covers the basic principles to design and implement popular DSP algorithms taken from digital filtering, modulation, matched filtering, modems, adaptive filtering, etc.
Fundamentals of Communications Theory	Covers the fundamental principles underpinning communication systems. These include mathematical analysis of system behaviour, modelling the blocks in a communication system, the Shannon and Nyquist theories, models for estimating system bit error rate, elementary principles of decision/detection theory and their use in communication receivers.
Optical Communications Networks	Covers the essential elements of modern optical networks; the evaluation of WDM, optical time multiplexing and photonic packet switching. This module will also teach you to appreciate case studies and implementation scenarios and how to design virtual WDM networks; to understand the evolution of modern optical networks.
Internet Routers and Switches	Provides a basis for understanding, appreciating, and performing practical research and development in networking with a special emphasis on Internet routers and switches. It covers topics on the design, analysis and performance evaluation of a wide range of network architectures, switches and Internet routers. You will learn the architectural evolution of routers and switches, analyse their performance and hardware cost and gain insights to their limitations.
Wireless Communications Systems Design	This module addresses communication design at many different levels. At the system level it covers microwave systems, system modelling, sub-system characterisation and the delivery of complete communications systems in the real world. The propagation level covers system noise-figure analysis, link budgets and radio propagation analysis as a system planning tool. At the circuit level it includes; RF subsystems, direct and heterodyne conversion, RF integrated circuits, the impact of RF/microwave component design on wireless communication system performance, modulation formats and their impact on circuit design, and distortion and spectral re-growth.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

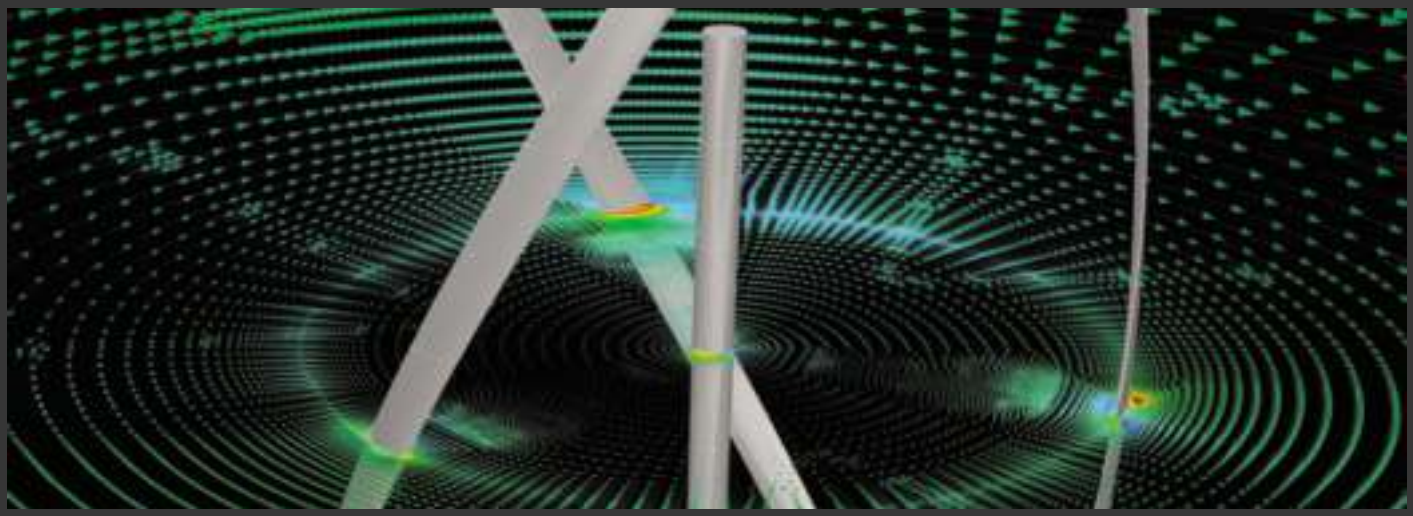
Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

For examples of recent research projects visit our website
www.engineering.leeds.ac.uk/electronic/postgraduate/projects

MSc Computational Fluid Dynamics



Computational Fluid Dynamics (CFD) has the potential and flexibility to model a diverse spectrum of engineering and physical problems. The goals of CFD are to be able to accurately predict fluid flow, heat transfer and chemical reactions in complex systems, which involve one or all of these phenomena.

CFD has developed at an incredible rate over the past decades and is now being applied to industrial applications in areas ranging from air flow over a wind turbine blade, to space shuttle aerodynamics, from combustion in a jet engine to flow and consumption of hydrogen in a fuel cell, from optimising a biomass furnace to modelling biogas production from wastewater plants, from modelling underwater landslides to modelling the spread of airborne infections around a hospital ward.

Presently CFD is being increasingly employed by many industries either to reduce manufacturing design cycles or to provide an insight into existing technologies so that they may be analysed and improved.

This course provides the high level of training required for you to be able to provide the CFD skills, experience and understanding required by industry. Taught modules are integrated with laboratory and computational work.

You will be based in the Centre for Computational Fluid Dynamics which has one of the largest CFD active postgraduate centres in Europe. The centre has broad expertise in CFD research, being a leader in the development of in-house CFD codes and in the application of a wide range of commercial CFD software.

As the Centre for CFD has strong links with Ansys who provide two of the leading commercial CFD software packages (Fluent and CFX), you will receive certified training from their senior development engineers as part of the course.

Who will benefit?

- Those wishing to expand, develop or update their specialist knowledge in computational fluid dynamics
- graduates from engineering or science disciplines who have no prior knowledge of CFD but would like to convert to a specialisation in CFD
- professional engineers already working with CFD who wish to deepen their knowledge and expertise, enabling future career enhancement and development.

Typical careers

You will be in an ideal position to take advantage of a flexible engineering job market, as well as being seen as a strong candidate by employers for a wide range of industries including construction, power generation, the environmental sector as well as other engineering disciplines.

You may choose to go on to study towards a PhD undertaking research in areas such as combustion, renewable and alternative energy, medical engineering, environmental building design, environmental research as well as a wide variety of other engineering projects.

Entry requirements

A minimum of a UK second class (2:2) honours degree or equivalent, in an engineering, physical science or mathematics discipline. No previous knowledge of CFD is required.

Course content

You will study the following modules and will undertake a research project during the summer months.

Modules	Contents
Advanced Commercial Software	You will gain experience and expertise in using a range of the state-of-the-art CFD codes and associated meshing, post processing and visualisation tools that are currently industry standard (including Ansys Fluent, CFX, Comsol, CFD Ace, Gambit, Design Modeller, Tecplot). You will learn how to create high-quality meshes and gain an understanding of the implications of using a range of different meshing strategies and CFD solvers.
Finite Differences and Control Volume	The module introduces students to writing down finite-difference equations which are consistent with the governing equations and explores techniques that will allow you to test them for stability and convergence. You will develop a sound knowledge of the control volume methods for the numerical simulation of incompressible fluid flow.
Finite Elements and Boundary Elements	Covers the essential mathematical formulation of the BEM with emphasis on explaining the numerical method for elliptic (steady-state) and parabolic (unsteady-state) equations. Within the Finite Element aspect of the module you will investigate its implementation for basic CFD problems and develop a broad overview of how the FEM is used in state-of-the-art CFD software.
Incompressible Flow	Delivers the fundamentals for fluid flow modelling. This includes Lagrangian and Eulerian coordinate systems; solving simple kinematic problems to establish particle paths and streamlines; developing an understanding of the Continuity Equation and the introduction of the stream function from a physical aspect. You will learn how to establish Euler's Equation and when it can be integrated up to produce Bernoulli's Equation (energy equation). You will gain a critical awareness of traditional techniques which are capable of validating computational models of flow, temperature and concentration fields.
Reaction Fronts and FORTRAN	Provides an understanding of the nature of flames and the physical mechanisms governing reactive flows. The emphasis is on modelling and is aimed at making you proficient in recognising and using the basic fluid dynamics conservation laws of continuity, momentum, energy and species. You will be introduced to FORTRAN in order for you to develop your own codes.
Scientific Computation	Computational methods and the importance of reliability, efficiency and accuracy. Principles of parallel programming on distributed memory architectures and the application to scientific computing problems.
Turbulent and Two phase Flow	This module covers two critical areas of CFD: **Multiphase flow** – Provides an overview of various techniques for analysing multiphase flows, and demonstrates how they can be applied to a variety of practical problems. **Turbulence** – An introduction to fluid instability, turbulence phenomena and turbulence modelling techniques, and their application to turbulence simulations. As part of this you will gain experience and understanding of RANS (Reynolds Averaged Navier-Stokes) models, including eddy viscosity models and Reynolds stress models, DNS (Direct Numerical Simulation), and LES (Large Eddy Simulation).

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

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The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Evaluating efficiencies for concentrated solar thermal plants modelling of reacting fluid flow and heat transfer in fuel cells
- Computational Fluid Dynamics modelling for distributed micro-power generation (vertical wind turbines)
- CFD modelling of the near field behaviour of turbulent lazy plumes
- Optimising the production of biogas in anaerobic digester using CFD
- CFD modelling of the Coanda effect when ventilating the lungs during an operation

MSc Digital Communications Networks

Responding to the increasing development of networks and mobile Internet applications. The communications sector has dramatically changed in just the last 5 years with a true information revolution made possible by the mobile internet, smart phones and associated applications such as social media, commerce and digital media..

This new masters course in Digital Communications Networks is responding to the increasing development of networks and mobile Internet applications, rather than traditional physical layer (hardware design) focus. Students will study traditional communications theory but will also take modules dealing with network security and the protocols for high-speed switches and routers. The inclusion of a Digital Media Laboratory/iPhone Apps is also an extremely marketable feature of this course. This module will give the student hands-on experience for mobile Internet technology that can be found and applied in computers, cellular phones, MP3 players, etc.

Other modules will target new developments in data-centric networking and the growing trend in cloud computing and online services, for example web-search, video content hosting and distribution, social networking and large-scale computations. This ensures that students will graduate with both specialist in-depth knowledge but also with a broad range of skills and applications that will be in demand over a wide range of disciplines - from the traditional communications industries to banking, finance and commerce.

We are currently seeking accreditation for this course from the Institution of Engineering and Technology (IET). Visit our virtual experience website to meet some of our academic staff and students.

http://virtual.engineering.leeds.ac.uk/electronic

Who will benefit?

- Graduates seeking to enhance their employability within the digital communications industry
- practising engineers wishing to learn about recent developments in WiMax and broadband communications.

Typical careers

Career prospects are excellent. There is a wide range of career opportunities in all aspects of the communications industry and the skills learned here will also be generic to allow employment in other sectors such as finance, banking, general manufacturing, etc.. Some graduates also choose the path of academic research and therefore subsequently undertake a PhD.

Entry requirements

A minimum UK upper second class (2:1) honours degree or equivalent in appropriate numerate disciplines usually electronic engineering, but others may be considered. In some special cases, if places are still available, applicants with a good lower second class (2:2) honours degree and who have relevant experience may also be considered and so should not be deterred from applying.

Course content

You will study the following modules and will undertake a research project during the summer months.

Modules	Contents
Data Communications and Sensor Networks	Provides a knowledge and understanding of data communications and wireless sensor networks and how they are, and could be, used in a range of applications.
Digital Media Engineering	This module provides in-depth coverage of issues relating to the recording, transmission, storage and replaying of multimedia content. The syllabus includes: DRM formats and their impact for revenue generation within the field of content distribution, property rights and licensing protection, differentiate supply chain services for pushing digital content within video, music and gaming industries, quantify storage requirements, scaling strategies and control methodologies for digital production management. You will learn how modern system-on-chip technology is employed for the processing of digital signals and how content is broadcast or distributed securely using broadband and wireless networks.
Internet Routers and Switches	Provides a basis for understanding, appreciating, and performing practical research and development in networking with a special emphasis on Internet routers and switches. It covers topics on the design, analysis and performance evaluation of a wide range of network architectures, switches and Internet routers. You will learn the architectural evolution of routers and switches, analyse their performance and hardware cost and gain insights to their limitations.
Electronics Industry Dissertation	This module develops a detailed understanding of the global electronics industry. The topic of the dissertation is to be agreed with the Module Leader, with examples being an essay on a particular aspect of the electronics industry, a proposal for research funding, a business plan, or a manufacturing/outsourcing plan.
Optical Communication Networks	Covers the essential elements of modern optical networks; the evaluation of WDM, optical time multiplexing and photonic packet switching. This module will also teach you to appreciate case studies and implementation scenarios and how to design virtual WDM networks; to understand the evolution of modern optical networks.
Cellular Mobile Communication Systems	Focuses on the underlying principles of cellular mobile radio for voice, data and video, the limitations and possibilities of mobile communications, signal processing requirements, the need for protocols, the principles and practices of 2-G (e.g. GSM) and 3-G (e.g. WCDMA) systems. Specific topics include the cellular concept, radio wave propagation and digital transmission in cellular systems, the GSM system, basic principles of DS/CDMA, PN codes and Walsh sequences, correlator design, the Rake receiver and the WCDMA system.
Mobile Applications Development	This module provides students with practical experience of software development on mobile platforms for interfacing with communications networks. The module will focus on one design environment and operating system but students will learn general principles so that they are able to apply their learning to other types.
Network Security	This module will cover the fundamental concepts, architectures, and protocols related to network security. This module will help you understand the major security issues in today's communication networks; the fundamental principles of cryptography; symmetric versus asymmetric cryptosystems; security issues on various layers of communication network; standard techniques in data encryption and message authentication; the use mathematical techniques, such as hash function, in cryptography to design/analyse security applications and how to implement different security protocols on relevant software platforms.

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Research project

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The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

For examples of recent research projects visit our website
www.engineering.leeds.ac.uk/electronic/postgraduate/projects

MSc Electrical Engineering and Renewable Energy Systems

Renewable energy and reduction of carbon emissions are top of the global agenda. This course addresses the fundamentals of renewable energy and how solar, wind, wave and other such energy sources can be efficiently integrated into practical power systems. This is an advanced course in the area of electrical engineering applied to renewable energy systems. It is distinctive in that it provides a strong core of power electronic converters, machines and control backed up with modules on power generation and electronic conversion with renewable energy sources.

The course offers a unique set of modules in the efficient generation and use of electricity from solar, wind and wave power. The integration of renewable generators into micro grids, with stability analysis and active power management, is also covered. The design of power electronics is treated in depth, including conventional and emerging converter topologies and semiconductor power devices.

You will undertake substantial elements of practical work giving you confidence with hardware implementations using electric drives, microcontroller control and electronic conversion circuits. Project work is highly rewarding and conducted in a research-led environment, with selected students having the opportunity to carry out an industrial placement for their project. This course is accredited by the Institution of Engineering and Technology (IET). Visit our virtual experience website to meet some of our academic staff and students.

http://virtual.engineering.leeds.ac.uk/electronic

Who will benefit?

- Graduates wishing to develop a career in electrical engineering applied to renewable energy systems
- practising engineers who wish to study the latest techniques in the engineering of renewable energy systems and efficient power converters, machines and control systems.

Typical careers

Renewable energy and efficient power conversion systems are of immense importance worldwide and graduates of this course can expect to find jobs in a wide variety of industries including the electronics, automotive, transport, construction, industrial automation, energy, oil and environmental sectors.

Graduates of this course will be well placed to develop practical solutions to the problem of integrating renewable energy systems into established electricity distribution networks. They should be able to contribute to strategic planning, systems implementation and operation of sustainable power generation systems.

Entry requirements

A minimum UK upper second class (2:1) honours degree or equivalent in appropriate numerate disciplines usually electronic engineering, but others may be considered. In some special cases, if places are still available, applicants with a good lower second class (2:2) honours degree and who have relevant experience may also be considered and so should not be deterred from applying.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

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Course content

You will study the following modules plus two of the optional modules. You will also undertake a research project during the summer months.

Modules	Contents
Control Systems Design	This module covers the analysis and design of control systems. Knowledge and understanding of linear systems is developed to enable analysis of control systems using analytical techniques and computer tools.
Electric Drives	Describes electrical machines and the fundamental principles of their control to enable you to engineer complete drive systems for control of torque and speed. Classical machines that are covered include the three-phase induction machine in generating and braking modes, with variable frequency and variable-voltage methods for speed control.
Electric Power Generation by Renewable Sources	This module provides you with a knowledge and understanding of power generation technology from renewable sources, particularly wind and solar power. It describes how renewable energy sources can be employed and how they are integrated into electricity systems. It covers the control and management of photovoltaic and wind power generation systems comprising power converters and energy storage components. You will learn about the control of micro-grid, including active and reactive power control and harmonic elimination. The module is supported by practical examples and case studies.
Grid-Connected Microgeneration Systems	An introduction to how small renewable sourced powered generators can be integrated into the grid. Issues relating to the interconnection of renewable sources and control and protection methods will be explored.
Micro-grid Laboratory	This module offers an opportunity to consolidate your understanding of grid-connected renewable energy generation systems, and to develop your skills in modelling, designing and controlling such systems. Topics covered will complement the materials studied in Electric Power Generation by Renewable Sources and Grid-Connected Microgeneration.
Mini Projects and Laboratory	Designed to provide experience of practical electronics and measurement techniques. Particularly suitable for students without an electronic engineering bachelor's degree. Laboratory work covers measurement and sampling techniques, RF and microwave network analysers, antenna measurements and embedded systems. You will choose two mini projects from a range including RF amplifier design and test, an infra-red data link, an embedded system and acoustic measurements in a well-equipped sound studio.

Optional modules

Advanced Energy Systems	This module describes the full range of electricity generation techniques including the principles of coal, oil and nuclear power stations. It covers fluidised bed combustion and combined cycles for power generation that are taught include fission reactor theory, neutron diffusion and moderation, reactor heat transfer, reactor dynamics and reactor safety. An introduction to tidal and wave power systems is given, including prospects for increased use of renewable sources.
Climate Change: Impacts and Adaptation	Gives an overview of climate change impact assessment and predictions, and key concerns and strategies of adaptation to climate change.
Climate Change Mitigation	Outlines the relative significance of main sources of greenhouse gases and the potential, technologies and strategies for reducing them.
Climate Change: Physical Science Basis	Introduces the students to the physical science base on climate change. Includes sessions on the global climate system, carbon cycle, radiative forcing, past climates, climate modelling, climate predictions, and the handling of uncertainty in climate change research.
Power Electronics and Drives	Covers FET, IGBT and MOSFET switches: characteristics, limitations, fields of use, switching loss and thermal behaviour. Switched-mode power supplies with transformer insulation, forward and flyback converters. Dynamics of induction motor drives, adjustable frequency induction motor drives, brushless d.c. motor, stepping motor and switched-reluctance motor drive systems are also covered.
Sustainable Energy Processes	This module begins with the basics of renewable energy processes and progresses to detailed theory and current developments of the main resources. You will develop a sound knowledge of the underlying principles of the main renewable energy technologies and in the production of biofuels and sustainable hydrogen and you will learn about the drivers of sustainable energy and the environmental issues associated with this.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

MSc Electronic and Electrical Engineering

Commercial products today combine many technologies, and industry is increasingly interdisciplinary. As a result there is a demand from employers for engineers with a broad knowledge but also with a deep understanding of several subjects. This course meets this demand and has been developed to provide engineers with an interdisciplinary knowledge base in modern electronics, including power, communications, control and embedded processors.

This course is designed to give engineers a broad grasp of a range of inter-locking disciplines. It will appeal to people with a wide range of interests in electronics and communications, people who are generalists as well as specialists. It will suit those who are interested in modern communications techniques, radio propagation, cellular mobile systems, control systems, power and drives, and modern system-on-a-chip technology. This course also has an associated laboratory module with a wide range of relevant and illustrative experiments. This course is accredited by the Institution of Engineering and Technology (IET). Visit our virtual experience website to meet some of our academic staff and students.

http://virtual.engineering.leeds.ac.uk/electronic

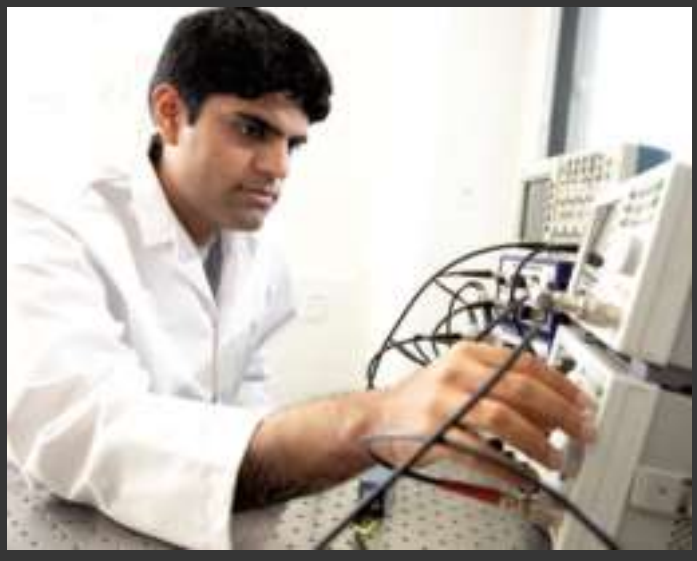
Who will benefit?

- Graduates wishing to convert to develop a career in electronic and electrical engineering
- practising engineers who wish to develop a depth of knowledge across a broad cross-disciplinary range of electronics.

Typical careers

Graduates of this course can expect to find jobs where industry needs a breadth of knowledge matched by a depth in certain areas. Such people will be well equipped to integrate and co-ordinate the stands of a cross-disciplinary project and manage the interfaces between specialities.

Such engineers would expect to progress to project management in companies working at the cutting edge of modern multi-faceted systems.



Entry requirements

A minimum UK upper second class (2:1) honours degree or equivalent in appropriate numerate disciplines usually electronic engineering, but others may be considered. In some special cases, if places are still available, applicants with a good lower second class (2:2) honours degree and who have relevant experience may also be considered and so should not be deterred from applying.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

For examples of recent research projects visit our website

www.engineering.leeds.ac.uk/electronic/postgraduate/projects

Course content

You will study the following modules plus six of the optional modules (you must choose two from the first list and four from the second list of optional modules). You will also undertake a research project during the summer months.

Modules	Contents
Electronics Industry Dissertation	This module develops a detailed understanding of the global electronics industry. The topic of the dissertation is to be agreed with the Module Leader, with examples being an essay on a particular aspect of the electronics industry, a proposal for research funding, a business plan, or a manufacturing/outsourcing plan.
Mini Projects and Laboratory	Covers a range of circuits, systems and laboratory equipment.

Optional Modules (1)

Control Systems Design	This module covers the analysis and design of control systems. Knowledge and understanding of linear systems is developed to enable analysis of control systems using analytical techniques and computer tools.
Data Communications and Sensor Networks	Provides a knowledge and understanding of data communications and wireless sensor networks and how they are, and could be, used in a range of applications.
Digital Media Engineering	This module provides in-depth coverage of issues relating to the recording, transmission, storage and replaying of multimedia content. The syllabus includes: DRM formats and their impact for revenue generation within the field of content distribution, property rights and licensing protection, differentiate supply chain services for pushing digital content within video, music and gaming industries, quantify storage requirements, scaling strategies and control methodologies for digital production management. You will learn how modern system-on-chip technology is employed for the processing of digital signals and how content is broadcast or distributed securely using broadband and wireless networks.
Electric Power Generation by Renewable Sources	This module provides you with a knowledge and understanding of power generation technology from renewable sources, particularly wind and solar power. It describes how renewable energy sources can be employed and how they are integrated into electricity systems. It covers the control and management of photovoltaic and wind power generation systems comprising power converters and energy storage components. You will learn about the control of micro-grid, including active and reactive power control and harmonic elimination. The module is supported by practical examples and case studies.
Wireless Communications Systems Design	This module addresses communication design at many different levels. At the system level it covers microwave systems, system modelling, sub-system characterisation and the delivery of complete communications systems in the real world. The propagation level covers system noise-figure analysis, link budgets and radio propagation analysis as a system planning tool. At the circuit level it includes; RF subsystems, direct and heterodyne conversion, RF integrated circuits, the impact of RF/microwave component design on wireless communication system performance, modulation formats and their impact on circuit design, and distortion and spectral re-growth.

Optional Modules (2)

Antennas and Radio Wave Propagation	Covers the factors governing the design and operation of modern wireless communication systems. These include fundamentals of antenna theory and propagation, radiation patterns of antennas (including both wire and aperture antennas), propagation mechanisms (including the effects of climate on them), link budgets and antenna arrays. Diversity, diffraction, fading, beamforming and topics specific to satellite and cellular systems are also covered.
Digital Design for System-on-Chip	Introduces the basic design principles of digital signal processing systems using VLSI technologies. With silicon feature size below 100nm and densities reaching 1 billion transistors per chip, many complex systems can now be implemented on a single chip. Using Altera Quartus, ModelSim and Mentor Graphics EDA design tools, students learn the academic foundations of complex system design through practical assignments.
DSP Hardware Implementation	Develops an understanding of the fundamental principles of how DSP algorithms are implemented in practice. Provides an insight Into the operation (and limitations) of DSP chips. Gives hands-on experience of programming DSP chips. Also covers the basic principles to design and implement popular DSP algorithms taken from digital filtering, modulation, matched filtering, modems, adaptive filtering, etc.
Embedded Systems Design	This module introduces students to contemporary hardware and software development tools for mobile and embedded devices.
Medical Electronics and E-Health	Provides a knowledge and understanding of how electronics and communications technology is, and could be, used in medical applications and healthcare.
Power Electronics and Drives	Covers FET, IGBT and MOSFET switches: characteristics, limitations, fields of use, switching loss and thermal behaviour. Switched-mode power supplies with transformer insulation, forward and flyback converters. Dynamics of induction motor drives, adjustable frequency induction motor drives, brushless d.c. motor, stepping motor and switched-reluctance motor drive systems are also covered.

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MSc Embedded Systems Engineering

The huge growth of processing power, now available in small power efficient packages has fuelled the digital revolution. All sectors of the economy have been touched by the digital revolution.

From the consumer electronics industry we have seen MP3 players, PDA devices, HDTV and games consoles. The car industry has seen tremendous developments in adaptive control, engine management and GPS. Advances in Personal Communications have given rise to WiFi and GSM networks. Medical and Process Industries now have sensing and imaging technologies that can visualise three dimensionally in real-time. Banking and commerce require secure online transactions which are only possible through encryption algorithms encoded within embedded systems.

The growth of tools and techniques within this sector has led to a significant skills shortage, particularly for those trained at the highest level.

This is a practically-orientated and advanced course in the area of electronics design and applications. It is distinctive in that it provides a strong digital technology core backed up with applications-led modules. Examples of these applications include medical and electronics, e-health, intelligent building design, automotive electronics, retail and commerce.

This broad coverage of diverse applications cannot be found in any comparable courses in the UK. This is beneficial to you as it prepares you for a range of careers in industry.

Another feature of the course is the substantial amounts of practical work, giving you the confidence with software and digital hardware implementations using microcontrollers, FPGA, DSP devices and general system-on-chip the methodology.

This course is accredited by the Institution of Engineering and Technology (IET). Visit our virtual experience website to meet some of our academic staff and students.

http://virtual.engineering.leeds.ac.uk/electronic

Who will benefit?

- Graduates who have been working in the electronics industry but who wish to re-skill and further their career
- recent graduates wishing to become specialised in embedded systems
- graduates who would like to update their qualifications
- lecturers and teachers in the field of embedded systems engineering.

Typical careers

Embedded systems are ubiquitous in engineering and graduates are likely to find employment in a wide and diverse range of industries including: communications, automotive, transport, construction, industrial, automation, energy and environmental monitoring. Recent graduates have found employment with IBM, BAE Systems, Pace Micro Technology, ARM Inc, and Motorola.

Entry requirements

A minimum UK upper second class (2:1) honours degree or equivalent in appropriate numerate disciplines usually electronic engineering, but others may be considered. In some special cases, if places are still available, applicants with a good lower second class (2:2) honours degree and who have relevant experience may also be considered and so should not be deterred from applying.

Course content

You will study the following modules and will undertake a research project during the summer months.

Modules	Contents
Data Communications and Sensor Networks	Provides a knowledge and understanding of data communications and wireless sensor networks and how they are, and could be, used in a range of applications.
Digital Design for System-on-Chip	Introduces the basic design principles of digital signal processing systems using VLSI technologies. With silicon feature size below 100nm and densities reaching 1 billion transistors per chip, many complex systems can now be implemented on a single chip. Using Altera Quartus, ModelSim and Mentor Graphics EDA design tools, students learn the academic foundations of complex system design through practical assignments.
Digital Media Engineering	This module provides in-depth coverage of issues relating to the recording, transmission, storage and replaying of multimedia content. The syllabus includes: DRM formats and their impact for revenue generation within the field of content distribution, property rights and licensing protection, differentiate supply chain services for pushing digital content within video, music and gaming industries, quantify storage requirements, scaling strategies and control methodologies for digital production management. You will learn how modern system-on-chip technology is employed for the processing of digital signals and how content is broadcast or distributed securely using broadband and wireless networks.
Digital Signal Processing for Communications	Introduces the theoretical tools of digital signal processing (DSP) and shows the application of DSP in modern communication systems. The module will help understand the realisation issues and trade-offs in practical designs. Topics covered will include time- and frequency-domain analysis for discrete-time systems; random processes and statistical signal processing; applications including speech coding, communications channel estimation, equalisation, adaptive signal processing and channel modelling.
DSP Hardware Implementation	Develops an understanding of the fundamental principles of how DSP algorithms are implemented in practice. Provides an insight into the operation (and limitations) of DSP chips. Gives hands-on experience of programming DSP chips. Also covers the basic principles to design and implement popular DSP algorithms taken from digital filtering, modulation, matched filtering, modems, adaptive filtering, etc.
Embedded Systems Design	This module introduces students to contemporary hardware and software development tools for mobile and embedded devices.
Medical Electronics and E-Health	Provides a knowledge and understanding of how electronics and communications technology is, and could be, used in medical applications and healthcare.
Mini Projects Laboratory	Designed to provide experience of practical electronics and measurement techniques. Particularly suitable for students without an electronic engineering bachelor's degree. Laboratory work covers measurement and sampling techniques, RF and microwave network analysers, antenna measurements and embedded systems. You will choose two mini projects from a range including RF amplifier design and test, an infra-red data link, an embedded system and acoustic measurements in a well-equipped sound studio.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

For examples of recent research projects visit our website **www.engineering.leeds.ac.uk/electronic/postgraduate/projects**

MSc Energy and Environment

We are all increasingly aware that our present and future energy demands, and particularly our over-reliance on fossil fuels, contribute to global warming and can destabilise world economies. The impacts of climate change are becoming visible throughout the world, with receding glaciers, changing weather patterns, coastlines and ecosystems. The links between climate change and poverty and human health are a significant future concern.

Gas and oil prices have recently been very unstable, and whilst world energy demand carries on increasing, it is likely that production will peak during the next decade. Urban populations are also continuing to grow, bringing with them waste disposal problems, traffic congestion and greater power, heating and refrigeration needs, as well as fire and explosion hazards.

As a response to this we are now seeing changing energy policies worldwide, geared towards encouraging energy autonomy by developing renewable energies and recycling initiatives as well as implementing low carbon technologies. The UK Climate Change Bill will be a driver for change. At the same time pollution control guidelines and emission regulations have tightened both within the EU and world-wide. There will be an increasing demand for graduates with an understanding both of the environmental impacts of energy technology choices as well as the technical expertise to further develop them.

This course is one of a handful of courses in the UK university sector that provides graduates from diverse engineering, scientific and technical backgrounds with an expertise in new energy technologies, solid waste recycling, air and water pollution, and fire and explosion protection. The course is accredited by the Energy Institute.

Who will benefit?

- Graduates from science, mathematics and other engineering disciplines who now wish to specialise in energy and environment
- professional engineers already working in the industry who wish to deepen their knowledge and expertise, enabling career enhancement and development.

Typical careers

The need for all businesses and industrial companies to reduce their greenhouse gas emissions will be a major driver within future development. The demand for graduates with the skills offered by the course is therefore high.

Typically, graduates of this course are likely to go on to work in senior posts with high levels of responsibility in energy and environmental consultancies, energy specialists, architectural firms, environmental departments of local authorities, government agencies, major funding bodies, large industrial companies and emerging businesses in the renewable sector. Some graduates choose the path of academic research and so subsequently undertake a PhD.

Entry requirements

A minimum of a UK second class (2:2) honours degree or equivalent, in an engineering, physical science, or mathematics discipline.

Course content

You will study the following modules plus two of the optional modules. You will also undertake a research project during the summer months.

Modules	Contents
Atmospheric Processes	Covers atmospheric chemistry and the meteorological factors relevant to air quality issues. Provides an introduction to mathematical modelling of the dispersion of air pollutants and typical software packages used in industry.
Climate Change Control Technology	Covers all aspects of climate change from the main contributing emissions, to carbon audits, to policy and technical initiatives to reduce greenhouse gases.
Control of Air Pollution	Delivers the principles and engineering design aspects of the processes control of air pollution from stationary industrial sources.
Pollution Sampling and Analysis	Covers an expert analysis of energy/environment relevant chemical species and their properties. Three laboratory practical assignments of one-day duration are built into this module.
Sustainable Energy Processes	Provides a sound knowledge of the underlying principles of the main renewable energy technologies and the production of biofuels and sustainable hydrogen, including associated design features and calculations.

Optional modules

Advanced Energy Systems	Provides further analysis of industrial power generation both from nuclear, conventional and renewable sources.
Energy Management and Conservation	Provides students with the knowledge and skills required for efficient utilisation and management of energy services in industrial and commercial situations.
Waste Treatment and Disposal	Covers incineration, recycling of waste and processing such as pyrolysis, gasification, anaerobic digestion and composting, and waste management.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Potential of marine biomass for production of chemicals and biofuels
- Influence of particle size on the analytical and chemical properties of Miscanthus energy crop
- Assessing the exposure of commuters to traffic generated particles: a comparison of transport options
- Location of solar farms under climate change
- Steam reforming of waste pyrolysis oils for sustainable hydrogen production

MSc Engineering Project Management

Many engineering projects are now undertaken by multidisciplinary teams who are responsible for the whole project life cycle in a multi-project or programme management environment. Typically, these projects are becoming increasingly complex. As a result, team members are expected to have a range of project management skills including contractual knowledge, financial engineering competency and strategic awareness.

The course covers the entire project management process from inception and feasibility, engineering, procurement and implementation, through to commissioning and operation. Particular emphasis is placed on financial, planning and management aspects of the project life cycle.

Who will benefit?

Engineers, technologists and managers, who want to develop and enhance their project and programme management skills. This course will develop the expertise necessary for improved business delivery of projects and programmes in an engineering environment, perhaps in construction, oil and gas, petrochemical or process industries. In order to ensure relevance with industry the course has also been developed to comply with international standards and both the APM and PMI Bodies of Knowledge.

Key outcomes

Upon successful completion of the course, you will have:

- A higher level of generic and transferable management skills
- a better understanding of the principles of project management within an engineering environment
- familiarisation with engineering problems encountered and the techniques used in the appraisal and implementation of projects
- a positive attitude to the setting and achieving of realistic performance targets
- a better understanding of working in project structures, with a variety of procurement routes and an emphasis on collaborative working throughout the project life cycle.

Typical careers

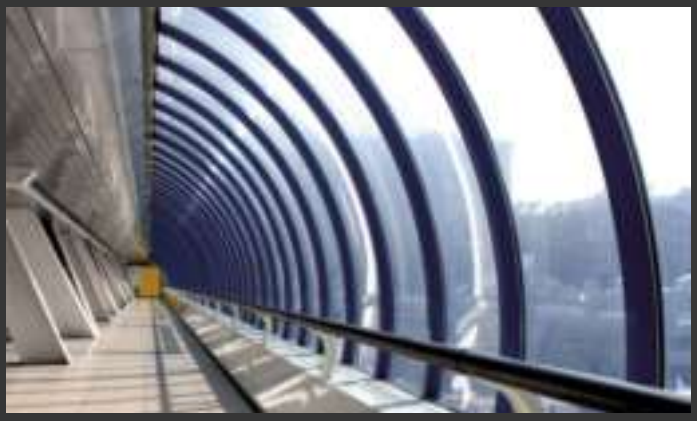
Many of our previous graduates now work as project managers for construction companies, in consultancy or for large client organisations. Alternatively, you may choose to continue to work as an engineer or general manager, but with an increased input into the project work of an organisation.

Chartered Engineer status

This degree is accredited as meeting the requirements for Further Learning for a Chartered Engineer (CEng) for candidates who have already acquired an Accredited CEng (Partial) BEng (Hons) undergraduate first degree.

Entry requirements

A degree equivalent to a UK second class (2:2) honours degree, or higher, in an engineering or technological discipline. A managerial or economic discipline will be considered providing applicants have 2 years relevant work experience in an engineering environment. Consideration will be given to professionally qualified and experienced candidates without formal qualifications.



Course content

You will study the following modules and will undertake a research project during the summer months.

Modules	Contents
Advanced Project Management	Takes the key aspects of project management to an advanced level, fully embracing complexity and uncertainty.
Funding for Projects	Addresses the current methods of financing major national and international projects, provides a review of funding practice and policy, review of relevant appraisal methods, public sector finance, private sector finance, concession contracts, UK Private Finance Initiative, allocation of risk and private finance in developing countries.
Procurement Management	Introduction to procurement management, alternative procurement strategies, partnering, client supply chain management and procurement, contracting strategies, procuring multi-projects and a programme of projects.
Project Management	Covers the major concepts of project management and the role of the project manager, appreciation of investment appraisal, risk techniques and planning techniques.
Risk Management	Covers risk management theory, risk management processes, Monte-Carlo simulation, risk registers and uncertainty and opportunity management.
Strategic Management in Construction	Addresses the strategic planning process, change, culture, organisational learning, international business strategy, alliances and joint ventures, international marketing and knowledge management.
Value Management	This module is a double weighted module and introduces value engineering (VE) and value management (VM) through its operation at the outline Sketch and Scheme/Schematic Design stages of a project. The concept of the client value system is introduced, the design of VM and VE studies and the approaches to teams and facilitation are explored.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Uncertainty management
- Relational contracting and alliances
- Management of multiple projects
- Financing of public private partnerships
- Management of mega projects

MSc Environmental Engineering and Project Management

This course provides consultants, operators, regulators and managers with the professional skills and training to contribute to the provision of environmentally sound and economically sustainable systems in the fields of clean water supply, wastewater treatment, and the management of solid waste, including wastes from the oil industry.

Environmental Engineering and Project Management is intended for those that find themselves in management positions with little knowledge or experience of the management techniques necessary to manage the range of projects for which they have responsibilities.

In addition, it is appropriate for people who have a background in management but feel that they lack up-to-date technical knowledge in the rapidly changing field of Environmental Engineering.

Who will benefit?

Graduates interested in providing engineering solutions to environmental problems facing the world. It is suitable for consultants, operators, regulators and managers and those wishing to develop their career within this field.

Key outcomes

Upon successful completion of the course you will have:

- An understanding of engineering approaches to achieving environmental improvement
- an awareness of best practice techniques for process design
- a better understanding of the specialist project management skills required in a global and multidisciplinary environmental engineering industry
- the ability to evaluate and apply new management skills in the workplace
- the ability to integrate and apply theoretical concepts, ideas, tools and techniques in practice.

Typical careers

Graduates from this course are in demand from a number of professions. Upon graduation you can expect opportunities from consulting and contracting engineers, water companies, utility companies and regulators as well as other environment-related companies.

Chartered Engineer status

This degree is accredited as meeting the requirements for Further Learning for a Chartered Engineer (CEng) for candidates who have already acquired a Accredited CEng (Partial) BEng(Hons) or an Accredited IEng (Full) BEng/BSc (Hons) undergraduate first degree by the Joint Board of Moderators under licence from the UK regulator the Engineering Council.

Entry requirements

A degree equivalent to a UK second class honours (2:2) degree, or higher, in engineering or a science-based subject. Consideration will be given to applicants with equivalent academic or professional qualifications in an engineering or natural science subject. Given the nature of the course and the broad range of skills required by professionals working in these topic areas, students with degrees from other disciplines (e.g. social sciences, economics), and a proven track record in work, will also be considered.

Course content

You will study the following modules, all of which are taught through intensive teaching over periods of either one, two or four weeks. You will also undertake a research project during the summer months.

Modules	Contents
Advanced Water Engineering	Introduces the key components of a water supply system including what the key issues are in a water supply system, how to design and maintain a system and issues facing water supply systems in the future.
Environment and Health Management	Understand how legislation is applied to protect environment and health, the role of public health engineers in developing technologies to ensure legislatory compliance and recognise organisms that have a major impact on our environment, soft positive and negative.
Integrated Water Resources Management	Covers water issues across the world including integrated water resources management, flood risk management, methods and tools for management and future developments.
Natural Wastewater Treatment and Reuse	Provides a strong base in low-cost technologies for delivering engineering solutions to sanitation, wastewater treatment and wastewater reuse in low-income countries, small communities and peri-urban areas.
The Management of Projects	Covers the major concepts of project management and the role of the project manager, projects appreciation of investment appraisal, risk techniques and planning techniques.
Wastewater and Organic Waste Management	Covers wastewater collection systems legislation including EU Urban Wastewater Treatment Directive and Freshwater Fisheries Directive, inlet works (screens, grit removal, FOG, flow measurement), design and operation of primary sedimentation tanks and the biological treatment in the activated sludge process.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Potential impacts of climate change for wastewater treatment
- Membrane bioreactors for industrial applications
- The use of recycled glass in wastewater treatment
- Settlement of activated sludge and the influence of ballasted settlement aids
- Enhancing energy yields from organic wastes by simultaneous hydrogen and methane recovery
- Treatment options for oily wastes generated by the oil industry

MSc Fire and Explosion Engineering

Fire is the major destroyer of property and an obvious threat to human, animal and plant life. In fact, fires and explosions cause 1% of the global burden of injury and 300,000 deaths per year world-wide, destroying cities, families, workplaces, workforce and wildlands. The loss of human life is not the only outcome of fire and explosion. In the UK alone, the financial cost and safety provision amount to an estimated £6 billion per year, accounting for 1% of annual GDP. As a consequence, there is a growing need, nationally and internationally, for qualified professionals to design fire and explosion protection systems within a legislative framework that is complex and fast-changing.

This course has been developed to meet this growing need, covering both foundation and advanced aspects of fire and explosion engineering education and training. Increasingly orientated to performance-based Standards, the industry needs professionals with a good level of scientific understanding, the ability to work in multidisciplinary teams and an excellent grasp of the evolving legal environment. This course develops expertise in these areas and is accredited by the Energy Institute.

This course can be taken on a part-time basis over 3 years.

Who will benefit?

- Graduates from science, mathematics and other engineering disciplines who now wish to specialise in fire and explosion engineering
- professionals already working in the industry who wish to deepen their knowledge and expertise, enabling future career enhancement and development.

Typical careers

Career destinations for graduates of this course are diverse and include opportunities in fire and explosion consultancies, civil and architectural engineering companies, the chemical and oil and gas industry, fire and explosion protection equipment manufacturers, government bodies, local authority fire safety and planning offices, specialist research and testing labs and insurance companies.

Entry requirements

A minimum of a UK second class (2:2) honours degree or equivalent, in an engineering, physical science or mathematics discipline. Non-graduate applicants may be considered if they have sufficient relevant professional experience or qualifications.

Course content

You will study the following modules plus two of the optional modules. You will also undertake a research project during the summer months.

Modules	Contents
Explosion Prediction and Mitigation	Provides an in-depth understanding of turbulent combustion and of the development of vapour cloud explosions in congested process plant and also inside complex vessels. The module also covers the established and developmental methodologies in the prediction of the explosion pressure pulse and the effects of this on structures.
Fire Dynamics and Modelling	Covers the basics and principles of fire science; heat transfer, flame spread, fire products and related toxicity and smoke movement. You will complete fire hazard calculations and will be introduced to zone fire modelling software.
Fire Safety Design	Provides the opportunity to approach a real design problem in a systematic and thorough way, and to apply logical reasoning firmly based on engineering science. Provides an understanding of modern techniques of fire protection design including sprinklers, pressurisation, smoke venting, automatic fire detectors, means of escape and emergency lighting systems. You will apply these techniques to a 'real life' situation by developing a fire safety strategy which includes fire engineering principles.

Optional modules

Accident Investigation	Provides a large part of the scientific knowledge and understanding needed in Fire Investigation within the framework of the current legislation. This module is delivered by a large team of practitioners and academics, all experts in their particular fields of contribution.
Fire and Safety Law	Covers UK and European legislation in the fields of fire, safety, and hazardous materials. Also provides an understanding of how this is implemented through the detailed analysis of case studies.
Fire Risk Assessment and Management	Covers risk assessment concepts, techniques and the data required for an evaluation of fire risk in most buildings/facilities. Qualitative risk evaluation is covered in detail and a number of quantitative 'tools' are introduced and illustrated, some with case studies. This module is delivered by e-learning.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Aircraft fuel tank vapour/air explosions
- Investigation of air starved fires using the cone calorimeter
- Venting of gas explosions; venting using gases of different reactivity
- Studies on the dry film thickness of intumescent coatings for structural steel sections
- Effect of heating rate on polymer decomposition kinetics
- Smoke behaviour and movement in extreme environments

MSc International Construction Management and Engineering

This course has been created to help construction professionals become more effective by developing and refining the generic and specialist construction project management skills required in the construction industry. It will prepare you for the challenges of a changing and dynamic global construction industry. The course covers the construction process from inception and feasibility, design, contract and construction, through to commissioning, operation and maintenance.

Particular emphasis is placed on the financial, planning and management aspects of the whole life cycle. The flexible nature of the course offers you the opportunity to strengthen existing technical and engineering skills.

Who will benefit?

This course is designed to develop and enhance the skills of civil engineers and other construction professionals who are committed to developing and enhancing their whole life construction management skills.

Key outcomes

Upon successful completion of the course you will have:

- A better understanding of the specialist management skills required in a global and multidisciplinary construction industry
- a higher level of generic and transferable management skills
- the ability to evaluate and apply new management skills in the workplace
- the ability to integrate and apply theoretical concepts, ideas, tools and techniques in practice
- the opportunity to further develop the engineering skills needed for the construction industry.

Typical careers

The course is highly regarded within the construction industry and many graduates go on to take positions as construction managers. Opportunities also exist with multidisciplinary consulting organisations. Many of our graduates return to work for government agencies and other large client organisations, often in more senior roles.

Chartered Engineer status

This degree is accredited as meeting the requirements for Further Learning for a Chartered Engineer (CEng) for candidates who have already acquired an Accredited CEng (Partial) BEng (Hons) undergraduate first degree.

Entry requirements

A degree equivalent to a UK second class honours (2:2) degree, or higher, in civil engineering or a related subject. Industry experience is preferable. Consideration will be given to professionally qualified and experienced candidates.

Course content

You will study the following modules plus three of the optional modules. You will also undertake a research project during the summer months.

Modules	Contents
Advanced Project Management	Takes the key aspects of project management to an advanced level, fully embracing complexity and uncertainty.
Applied Construction Management	An introduction to the UK construction industry. Covers environmental health, quality, health and safety, and supply chain management. Stakeholder relationships planning are also covered.
Procurement Management	Introduction to procurement management, alternative procurement strategies, partnering, client supply chain management and procurement, contracting strategies, procuring multi-projects and a programme of projects.
Project Management	Covers the major concepts of project management and the role of the project manager, appreciation of investment appraisal, risk techniques and planning techniques.
Whole Life Asset Management	The concept of whole life management (WLM) and best value are introduced in the context of infrastructure project management, procurement routes and the project chain value.

Optional modules

Design and Management of Structures in Earthquake Zones	Covers the fundamentals of structural dynamics and earthquake engineering, including finite elements in applied dynamics, application of engineering dynamics in practical engineering situations, evaluation criteria for earthquake damaged structures and current retrofitting methods.
Deterioration and Maintenance of Pavements	The highway network is a major economic asset of any country. This is an intensive four-day module, which is delivered largely by practising engineers. Includes the design of pavements, pavement materials, highway management, forms of deterioration and associated investigative techniques, repair and maintenance and strengthening of pavements.
Funding for Projects	Addresses the current methods of financing major national and international projects, provides a review of funding practice and policy, review of relevant appraisal methods, public sector finance, private sector finance, concession contracts, UK Private Finance Initiative, allocation of risk and private finance in developing countries.
Risk Management	Covers risk management theory, risk management processes, Monte-Carlo simulation, risk registers and uncertainty and opportunity management.
Strategic Management in Construction	Addresses the strategic planning process, change, culture, organisational learning, international business strategy, alliances and joint ventures, international marketing and knowledge management.
Value Management	This module is a double weighted module and introduces value engineering (VE) and value management (VM) through its operation at the outline Sketch and Scheme/Schematic Design stages of a project. The concept of the client value system is introduced, the design of VM and VE studies and the approaches to teams and facilitation are explored.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- New collaborative procurement systems
- Evaluation of international forms of contract
- International business strategy and globalisation
- International trends in value management
- Whole life asset management of infrastructure
- Building information modelling
- Sustainable construction processes.

MSc Medical Engineering

Medical engineering is the application of engineering principles and techniques to medicine. It combines the design and problem solving skills of engineering with medical and biological sciences to contribute to medical device solutions and interventions for a range of diseases and trauma. This exciting and challenging course provides you with a broad coverage of this rapidly expanding field whilst at the same time allowing a degree of specialisation through the provision of optional modules.

Particular emphasis is placed on inter-professional training and the multidisciplinary nature of the discipline, enabling you to successfully complete complex tasks at the increasingly important interface between engineering and the life sciences.

Who will benefit?

- Graduate engineers or scientists who wish to gain a postgraduate qualification in medical engineering before pursuing a career in either the medical devices sector or health service
- a range of personnel already involved in medical engineering including engineers, sales and marketing staff and regulatory personnel, who wish to enhance their career prospects
- orthopaedic or neuro-surgeons with an interest in the engineering aspects of their specialisation
- candidates who wish to pursue research work in this sector but do not have the prerequisite background.

Specialist facilities

- Europe's largest collection of multi-axis simulators for hip, knee and spine testing
- a suite of microCT equipment for characterising bone geometry and morphology
- bioreactors for tissue engineering and assessing material compatibility
- advanced computer simulations of spine and articulating joints
- cardiac imaging and modelling.

Typical careers

Career destinations are diverse and include medical engineering within industrial or public sector organisations, regulatory affairs and sales and marketing.

Entry requirements

A degree equivalent to either: a UK upper second class honours (2:1) degree or higher, in engineering, a physical science or mathematics; or a medical degree or allied subject with a background in orthopaedics.

Course content

You have the opportunity to select modules from a range of delivery styles including distance learning, short courses and more traditional semester-long modules, enabling part-time students with busy life or work schedules to have a more flexible approach to their learning.

You will study seven of the following modules and will undertake a professional project during the summer months.

Modules	Contents
Basic Orthopaedic Engineering	An introductory short course module designed for clinical or biological personnel.
Biomaterials	Short course covering a range of topics associated with biomaterials – the emphasis here is on the life-science interface.
Biotribology	Distance learning module underpinning the science behind the successful application of engineering to joint replacements.
Computational and Experimental Methods	Basic concepts of computational and experimental methods.
Functional Joint Replacement Technology	Applies the standard engineering principles of mechanics, tribology and biomaterials to the understanding of the technology used in the development of total joint replacements.
Introductory Medical Device Engineering	Distance learning module for students with experience of the underpinning engineering required for a career in this sector.
Research Methods	Short course focusing on the skills required for the development of a successful career in industry or academia including imaging, computational modelling and statistics.
Spinal Biomechanics and Instrumentation	Distance learning module delivering the underpinning biomechanics required to understand the new innovations in spinal surgery.
Tissue Engineering	Leading edge short course providing the student with the fundamentals of the rapidly expanding field of Tissue Engineering.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Professional project

The professional project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Investigating aspects of wear in total disc replacements
- Finite element analysis of tissue engineered structures
- Determining properties of bone and cement augmentation in vertebroplasty
- Cartilage tribology

MSc Nanotechnology and Advanced Electronic Devices

This course will advance your knowledge to the cutting edge of nanotechnology, nanoelectronics, high-speed (terahertz) and quantum optoelectronic device research. It is particularly suited to you if you have an electronic engineering or physical science background and want to pursue a career in research.

The course is derived directly from the research of the School's highly successfully world-class research Institute of Microwaves and Photonics (IMP). In recent years the research of the IMP has developed to include high frequency (terahertz) sources and systems, quantum optoelectronics (including infrared and terahertz lasers and photodetectors), molecular and bio-nanoelectronics.

The internationally recognised research leaders in IMP developed this course to develop tomorrow's scientists and engineers who will drive forward future innovation in the electronics and communications industries. This course is accredited by the Institution of Engineering and Technology (IET). Visit our virtual experience website to meet some of our academic staff and students.

http://virtual.engineering.leeds.ac.uk/electronic

Who will benefit?

- Graduates wishing to develop a career in the applications of nanotechnology to electronics
- electronic engineering graduates seeking to learn about the future of the subject
- practising engineers who wish to keep up to date with new technologies
- those wishing to gain deeper knowledge and understanding of modern communications and nanotechnology.

Typical careers

This course will allow you to pursue a career in research either in a university environment through a PhD or through the research and development arm of a high-tech. electronics, communications or computing company.

Entry requirements

A minimum UK upper second class (2:1) honours degree or equivalent in appropriate numerate disciplines usually electronic engineering, but others may be considered. In some special cases, if places are still available, applicants with a good lower second class (2:2) honours degree and who have relevant experience may also be considered and so should not be deterred from applying.

Course content

You will study the following modules and will undertake a research project during the summer months.

Modules	Contents
Medical Electronics and E-Health	Provides a knowledge and understanding of how electronics and communications technology is, and could be, used in medical applications and healthcare.
Micro- and Nano-Electromechanical Systems	Covers how micro- and nano-electromechanical systems operate, the fabrication process and choice of materials, different approaches to implementation and how to quantify the performance of simple structures. This module provides a working knowledge of the principles of operation, physical structure, fabrication methods and properties of a range of such systems.
Molecular-Scale Engineering	Covers the basic technologies for molecular-scale engineering and molecular self-assembly, in particular the use of DNA as a means of directing the self-assembly of molecular-scale components into circuits and onto conventional semiconductor structures.
Nanofabrication and Characterisation	Provides a knowledge and understanding of advanced nanofabrication techniques and develops competence with a range of clean room processing and characterisation techniques.
Next Generation Silicon Technologies	Familiarises students with the most important aspects of silicon chip fabrication technology and the future technical challenges to be faced to ensure future progress and the proposed solutions. The Semiconductor Industry Association Technology Roadmap features in this module.
Photonics and Communications Technologies	This module will help develop an understanding of the fundamental principles of optical fibre communication systems – including their advantages and limitations. In particular it will address the properties, advantages and disadvantages of the photonic components that are the enabling technology for future high-speed, broadband optical communications.
Quantum Electronics and Spintronics	This module provides students with extensive knowledge of the design and operation of quantum and spintronic devices.
Terahertz Technology	Devices and technologies for the realisation of Terahertz systems. You will learn the principles of the main applications of Terahertz frequencies, which will allow you to determine the usefulness of Terahertz signals for a variety of applications and how to choose suitable devices and components to construct a Terahertz system.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

For examples of recent research projects visit our website
www.engineering.leeds.ac.uk/electronic/postgraduate/projects

MSc Oilfield Corrosion Engineering

Corrosion in the oil and gas sector is one of the major flow assurance issues. From an economic point of view the efficient management of corrosion ensures that oil and gas can be recovered from wells for longer. Corrosion is also a major cause of hydrocarbon leaks and so safety drives the technological advances in corrosion control. There is currently an increasingly high demand for qualified corrosion engineers with specific expertise in oilfield operations.

This course helps satisfy this demand by providing engineers and physical scientists with skills in corrosion measurement, asset integrity assessment, corrosion prediction and corrosion management.

Who will benefit?

- Professional engineers already working in the industry who wish to deepen their knowledge and expertise so enabling future career enhancement and development
- graduate engineers and physical scientists who wish to gain specialist knowledge and skills relevant to the oil and gas sector.

Specialist facilities

- AC, DC and noise electrochemical monitoring
- scanning reference electrode
- quartz crystal microbalance
- sour facilities
- erosion-corrosion rigs
- advanced surface analysis
- commercially used software.

Typical careers

With this qualification, excellent career options are open to you to practise as a professional corrosion engineer and play a major role in ensuring the safe and efficient recovery of natural resources.

Entry requirements

A degree equivalent to a UK upper second class honours (2:1) degree, or higher, in engineering, a physical science or mathematics.

Course content

You will study the following modules plus two of the optional modules. You will also undertake a professional project during the summer months.

Modules	Contents
Advanced Oilfield Corrosion	An in-depth introduction to the corrosion processes experienced in the oilfield. Covers material selection and engineering design in an oilfield context; corrosion management strategies; basic CO2 corrosion models; and strategies for new or mature assets.
Failure Analysis	Addresses the likely causes of component failure from a knowledge of service conditions; microscopic and analytical techniques in the forensic investigation of metallurgical or materials failure; techniques to employ on the basis of the selected tests; and remedial measures to prevent recurrence of a given failure.
Metals and Alloys	The principles of physical metallurgy and their application to the design of alloys for engineering applications; the historical development of metals and alloys to satisfy the needs of different industrial sectors; the traditional limitations on the properties which may be obtained in particular metals and how metallurgists may seek to circumvent these; microstructures in a range of metals and alloys and account for their development.
Oilfield Chemistry and Corrosion	An introduction to the fundamental principles of oilfield chemistry and corrosion. Explains the properties and application of a range of chemicals used in corrosion control for oil and gas production and the principal theories of corrosion science and engineering.
Surface Engineering	Surface engineering technologies for the control of wear, corrosion and fatigue of engineering components.

Optional modules

Introduction to Tribology	A broad based introduction to the interdisciplinary scientific discipline of tribology; how tribology impacts on the design and operation of mechanisms and the means adopted to lubricate them.
Operations and Innovation Management	An introduction to operations management covering the nature and significance of operations management as an organisational practice; the role and typical responsibilities of the operations manager; and key operations management theories.
Thin Films and Surfaces	Basic concepts in the thermodynamics of surfaces; structures and phase behaviour of amphiphilic molecules; methods of preparation of molecularly thin films; the origin of the most common types of surface interactions in vapours and in simple liquids; and the principles of major analytical techniques used in the study of surfaces and ultra-thin films.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Professional project

The professional project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Crevice corrosion on cemented stems in metal on metal TJR – the effect of antibiotic in the cement
- Assessing corrosion of pipeline material in scale formation environments
- Characteristics of iron sulphide films formed in sour corrosion on pipeline steels
- Corrosion and erosion-corrosion study on pipeline welds

MSc Pharmaceutical Science and Engineering

Pharmaceutical production is an increasingly important sector within chemical engineering. This course, which is accredited by the Institution of Chemical Engineers (IChemE), will provide you with advanced training in the specialist field of pharmaceutical science and engineering.

This course provides a wide range of modules to enhance the knowledge needed for a career in the pharmaceutical engineering industry, for example pharmaceutical processes engineering, molecules of drugs in necessary dosage forms through a human body, pharmaceutical process chemistry and technology, formulation of drugs, quality analytical techniques, and physical chemistry associated with pharmaceutical processes.

As well as covering basic and advanced aspects of the domain of pharmaceutical engineering areas, you will undertake laboratory experimental practice associated with industrial pharmaceutical process research and development. If you have a non-chemical engineering background you will take options in process engineering which introduce the underlying concepts. If you have a chemical engineering background you will undertake the process engineering modules at an advanced level.

Who will benefit?

- Chemical engineering graduates wishing to upgrade their first degree to UK masters level degree
- graduates from science and other engineering disciplines who now wish to specialise in pharmaceutical engineering
- professional engineers already working in the industry who wish to deepen their knowledge and expertise, enabling future career enhancement and development.

Typical careers

Typically, graduates of the course are likely to go on to work in posts with high levels of responsibility in pharmaceutical manufacturing and R&D, fine chemical or general chemical manufacturing and R&D, departments of local authorities, governmental regulatory agencies and consultancies. Some graduates choose the path of academic research and therefore subsequently undertake a PhD.

Entry requirements

A minimum of a UK second class (2:2) honours degree or equivalent, in an engineering, physical science, or mathematics discipline.

Course content

You will study the following modules plus two of the optional modules. You will also undertake a research project during the summer months.

Modules	Contents
Batch Process Engineering	Provides an understanding of the distinctive features of batch processes in process industries, the concepts and methods for scheduling and simulation batch operations, and the differences between multi-produce and multi-purpose plants.
Drugs, Processes, Products and People	Provides a comprehensive introduction to: the technology underpinning the manufacture of pharmaceutical materials; the interactions between pharmaceutically active materials and the human body; and the organic process chemistry associated with the primary manufacture of pharmaceutical materials.
Pharmaceutical Analytical Techniques	Covers analytical techniques as methods of quantifying the quality and properties of product, including the fundamental chemistry and physics underpinning the techniques, the type of information the techniques provide and interpretation of data.
Pharmaceutical Product Formulation	Covers different dosage forms and their cultural differences and preferences, the engineering challenges in manufacturing, the unit operations in tabletting and regulatory and quality issues in secondary manufacturing.
Process Chemistry and Chemical Technology	Provides an overview and understanding of the concepts surrounding pharmaceutical and fine chemical development and manufacturing. Study on fundamental process chemistry, chemical technology and engineering science underpinning drug discovery, process development, engineering operations and plant design together with basic regulatory issues and laboratory and plant practices including safety and risk assessment. Team work and research skills are assessed through the design project.
Plant Design Project	The concepts of plant design are introduced in this project. The project is organised in line with the guidelines prescribed by the IChemE for the design project on accredited Chemical Engineering degree courses. Provides exemption from the design project requirements for corporate membership of the IChemE.

Optional modules

Case Studies in Fine Chemical and Pharmaceutical Synthesis	Provides a detailed knowledge of real-world examples of process chemistry utilising case studies from a wide variety of sources.
Chemical Reaction Processes	Provides an introduction to types of reaction and reactors, rate analysis and design principles.
Organic Synthesis for Fine Chemical and Pharmaceutical Synthesis	Provides knowledge of the required range of organic chemistry and synthetic transformations needed to understand fine chemical and pharmaceutical synthesis.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Investigation on the absorption of Ibuprofen onto spin coated polypropylene films by optical reflectivity
- Scale-up of industrial crystallisation for a co-crystal system
- A measurement of the thermal behaviour for crystallisation of methyl stearate in methyl oleate
- Particle breakage under shear deformation
- Flowability of Cohesive Powders: an Experimental and Computational Investigation of Surface Energy

MSc Structural Engineering

Structural engineering is at the heart of any developed or developing country. Virtually everything that you see in the modern world involves a structure of some shape or form. These include a huge variety of buildings, bridges, railways, airports, water supply systems, water treatment plants, flood defence schemes, oil and gas process plants and power stations. Many examples of construction that remain from the ancient world are also fine examples of structural engineering.

Structural engineers help to make, shape and maintain the built environment. They are professionals who enjoy innovation, a challenge, opportunities, responsibility and excitement in a varied and very satisfying career.

Structural engineering is a profession that provides a tremendous opportunity to make a real difference to people's lives and their environment. This course is a unique collaborative venture between the School of Civil Engineering, local and regional industry and the Yorkshire Branch of the Institution of Structural Engineers (IStructE). Successful completion of the course satisfies some of the IStructE IPD requirements.

During this course you will use our heavy structures laboratory, which is the largest of its kind in the north of the UK with a capability for both static and dynamic loading of full scale structures.

You will also have access to our Institute for Resilient Infrastructure, which contains leading research groups in both Structural Engineering and Materials. The synergy that exists between these groups greatly enhances the delivery and understanding of the two areas. This synergy is paramount in the better understanding of structural behaviour.

Who will benefit?

This course is designed to provide qualified civil and structural engineers with the educational base required for Chartered Structural Engineer status.

Key outcomes

Upon successful completion of the course, You will have:

- In-depth, specialist knowledge of techniques relevant to the Structural Engineering discipline
- the ability to take a proactive and self-reflective role in working and to develop professional relationships with others
- the ability to proactively formulate ideas and hypotheses and to develop, implement and execute plans by which to evaluate these
- the ability to critically and creatively evaluate current issues and research in the structural engineering discipline.

Typical careers

Upon completion of the course you will have greatly enhanced your ability to obtain status as a Chartered Structural Engineer. You may expect to find employment in the major structural engineering consulting practices. Opportunities also exist with multidisciplinary consulting organisations. If you are taking the course on a part-time basis, you will return to your existing jobs with enhanced potential for progression.

Chartered Engineer status

This degree is accredited as meeting the requirements for Further Learning for a Chartered Engineer (CEng) for candidates who have already acquired a Accredited CEng (Partial) BEng(Hons) or an Accredited IEng (Full) BEng/BSc (Hons) undergraduate first degree by the Joint Board of Moderators under licence from the UK regulator the Engineering Council.

Entry requirements

Entry requirement for recent graduates

A degree equivalent to a UK upper second class honours (2:1) degree or higher in civil engineering or a related subject. Applicants are required to provide a statement detailing their experience in structural engineering including structural analysis, the design of reinforced concrete and steelwork structures and foundations.

Entry requirement for graduates with at least 3 years relevant work experience

A minimum of a degree equivalent to a UK second class honours (2:2) degree in civil engineering or a related subject, or associate membership of an appropriate professional engineering institution. Applicants are required to provide a statement detailing their experience in structural engineering, structural analysis, the design of reinforced concrete and steelwork structures and foundations.

Course content

You will study the following modules and will undertake a research project during the summer months.

In semester one the modules are taught over an 11-week period and are timetabled to allow attendance at the University on a 1 or 2 days per week basis. Semester two modules marked * are taught over a continuous 4-day period. In all cases, the teaching is reinforced by periods of directed study. In many of the modules the teaching is enhanced by specialist lectures delivered by practising engineers.

Modules	Contents
Advanced Concrete Design*	Covers alternative methods of design for reinforced concrete slabs and design guidance used in current codes of practice.
Advanced Steel and Composite Design	Introduces the concept of advanced steel design and composite construction and their applications in engineering. Provides a basic means for design and analysis of steel and composite structures and familiarises students with a range of typical processing techniques.
Advanced Structural Analysis	Covers the latest developments, particularly the applications of computational methods in structural analysis. The review of fundamental principles of structural analysis will bring the students with various knowledge backgrounds to a common level.
Design and Management of Structures in Earthquake Zones*	Covers the fundamentals of structural dynamics and earthquake engineering, including finite elements in applied dynamics, application of engineering dynamics in practical engineering situations, evaluation criteria for earthquake damaged structures and current retrofitting methods.
Design Optimisation*	Provides an understanding of the scientific principles of design optimisation and the ability to arrive at an improved design for an engineering system that satisfies given requirements.
Foundation Engineering	Provides an understanding of the behaviour of soil to cover the range of foundations available for structures, including shallow and deep piles. Also covers the analysis and construction of foundations, with emphasis on finite element analysis. Soil improvement will also be covered.
Structural Engineering Design Project	This module requires the student to develop concept and detailed structural engineering design solutions to meet the requirements of a site-specific client's brief. The results of the design activity are presented in the form of a written report and drawings with supporting calculations and, where applicable, computational output.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Dynamic shear resistance of collar jointed masonry panels
- A computational study of the effect of spandrel wall connectivity on the behaviour of masonry arch bridges
- Progressive collapse of buildings under impact loads
- Dynamic performance of a structural T-joint

MSc Tribology and Engineering Interfaces

Tribology and the design of engineering interfaces has been an area of research in the School of Mechanical Engineering for over a century. Tribology is the science and engineering of interacting surfaces in relative motion. It includes the study and application of the principles of friction, lubrication and wear.

This course provides training in tribology and the application of tribological principles to the development of engineering interfaces for a wide range of different engineering systems. The core components of tribology, such as lubrication, contact mechanics, wear, surface engineering and surface characterisation will be central to the course with optional modules available specialising in the research-led fields of engine tribology and biotribology.

Industry has been actively involved in driving the development of this course, which means you will learn material that is in-line with employer needs. Seminars from industrial companies are incorporated in the course to provide you with a broader understanding of the tribology challenges facing industry.

Who will benefit?

- Professional engineers already working in industry who wish to deepen their knowledge and expertise so enabling future career enhancement and development
- graduates who wish to gain a strong background knowledge in Tribology (friction, wear and lubrication) and engineering interfaces
- those who would like experience of undertaking a research-led project in a leading mechanical engineering department
- graduates who wish to build a strong basis from which they can develop their research career (i.e. preparation for PhD studies).

Specialist facilities

- Engine Tribology – fired and motored engine testing, ring pack and liner sampling, engine friction measurements, motored camshaft rigs, viscometers, reciprocating, rotating, and fretting bench top tribometers
- Biotribology – hip joint, pendulum friction and force/displacement controlled knee simulators
- Surface Analysis and Engineering – microindenter, nanoindenter, AFM, XPS, Mini-SIMS, interferometer, FT-IR microscopy, magnetron sputtering, heat treatment facilities
- micro/nanofluidics
- PVD coating deposition system (arc, sputtered, plasma assisted CVD and microwave technologies)
- High Performance Computing – Beowulf cluster with 52 CPUs, 1000GB of RAM and fibre-optical interconnects.

Typical careers

With this qualification, excellent career options are open to you in the automotive, manufacturing, lubricant, or component (bearing, gear, seal, etc) industries. It will also put you in a good position to pursue a research career (i.e. preparation for PhD studies).

Entry requirements

A degree equivalent to a UK upper second class honours (2:1) degree, or higher, in engineering, a physical science or mathematics.

Course content

You will study the following modules plus three of the optional modules. You will also undertake a professional project during the summer months.

Modules	Contents
Engine Tribology	In depth tribological understanding of the major frictional components of the reciprocating internal combustion engine (bearings, piston assembly and valve train).
Introduction to Tribology	Introduction to the interdisciplinary scientific discipline of tribology, focusing on understanding of real surfaces, friction and wear phenomena and lubrication regimes.
Lubrication and Lubricants	Lubrication theory and its application to study real, industrial, engineering systems where lubrication is critical to the systems' performance. Lubrication regimes, lubricant physical and chemical properties, greases, etc.
Surface Engineering	Surface engineering technologies for the control of wear, corrosion and fatigue of engineering components.

Optional modules

Biotribology	Distance learning module underpinning the science behind the successful application of engineering to joint replacements.
Computational and Experimental Methods	Fundamental concepts of computational and experimental methods.
Failure Analysis	Addresses the likely causes of component failure from a knowledge of service conditions; microscopic and analytical techniques in the forensic investigation of metallurgical or materials failure; techniques to employ on the basis of the selected tests; and remedial measures to prevent recurrence of a given failure.
Operations and Innovation Management	An introduction to operations management covering the nature and significance of operations management as an organisational practice; the role and typical responsibilities of the operations manager; and key operations management theories.
Thin Films and Surfaces	Basic concepts in the thermodynamics of surfaces; structures and phase behaviour of amphiphilic molecules; methods of preparation of molecularly thin films; the origin of the most common types of surface interactions in vapours and in simple liquids; and the principles of major analytical techniques used in the study of surfaces and ultra-thin films.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Professional project

The professional project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

The masters professional projects will be highly guided by our industrial partners, addressing real industrial application problems.

MSc Water, Sanitation and Health Engineering

This course is for consultants, professionals working in international development and public health workers. It will provide you with an in depth understanding of how to deliver effective modern water supply, sanitation and other public health interventions in urban and rural areas in low-income and transitional economies. It has a strong focus on the development of practical and policy skills and addresses the critical future challenges of climate change, population growth and urbanisation. Particular emphasis is placed on developing your understanding of technical interventions in water supply, sanitation and solid waste management.

Research undertaken by our Pathogen Control Engineering Institute, which is world renowned for its pioneering work in developing countries, feeds directly into this course. The Institute undertakes research in all aspects of the built environment in which the presence of pathogens influences design, including water treatment, solid waste and airborne transmission of disease.

Staff teaching on this course have close working links with a number of key institutions in the field of international development including: UNICEF, the World Bank, the World Health Organisation, the Water Supply and Sanitation Collaborative Council, WaterAid, World Vision, the Bill and Melinda Gates Foundation and the African Development Bank. This course is run in conjunction with the Nuffield Centre for International Health and Development, one of the UK's pre-eminent public health research centres.

Who will benefit?

The course will appeal to engineers who now wish to specialise in public health engineering and to professionals already working in the industry who wish to deepen their knowledge and expertise, enabling future career enhancement and development.

Key outcomes

Upon successful completion of the course you will have:

- An understanding of international public health theory and policy
- an appreciation of the context and practicalities involved in designing and delivering public health programmes in countries of the global south
- an understanding of engineering approaches to improve public health
- a better understanding of the specialist project management skills required in a global and multidisciplinary environmental engineering industry
- specialist technical knowledge and skills in water supply, sanitation and solid waste management
- the ability to integrate and apply theoretical concepts, ideas, tools and techniques in practice.

Typical careers

On graduation you will be ideally placed to take up a senior position in public health ministries, utility companies, local government and private consultancy in countries of the global south or work with international development agencies and international non-governmental organisations (NGOs).

Entry requirements

A minimum of a 2:2 honours degree, or equivalent, in an engineering, public health or international development-related subject. Consideration will be given to applicants with equivalent academic or professional qualifications in an engineering or natural science subject and students without formal qualifications but a proven track record in work.

Course content

You will study the following modules and undertake a research project during the summer months.

Modules	Contents
Key Issues in International Public Health	Provides an understanding of the key issues in international health. You will develop an understanding of the key players in international health, and of historical and current priorities. You will also explore key and emerging public health issues, and examine how these shape international and domestic health policy and practice.
Policy for Health and Development	Covers the current debates around health, equity and development. It also introduces critical perspectives and questions some of the ideologies and assumptions lying behind health policies and development approaches. Through an analysis of key health policy issues, the module explores the complex, messy and political world of health policy-making and planning.
Engineering for Public Health	An introduction to the principles and practice of public health engineering, providing a bridge between the arena of public health policy and the practical application of engineering to improve public health. In addition it will explore historical and current trends in water supply, sanitation, wastewater and solid waste management and introduce key technologies and approaches.
Integrated Water Resources Management	Covers water issues across the world including integrated water resources management, flood risk management, methods and tools for management and future developments.
Advanced Water Engineering	Introduces the key components of a water supply system including what the key issues are in a water supply system, how to design and maintain a system and issues facing water supply systems in the future.
Natural Wastewater Treatment and Reuse	Provides a strong base in low-cost technologies for delivering engineering solutions to sanitation, wastewater treatment and wastewater reuse in low-income countries, small communities and peri-urban areas.
Solid Waste Management	Provides an understanding of the characteristics of waste and its generation rates, waste collection including recycling, and the science and engineering aspects of landfill, biological treatment and thermal treatment options. On completion of this module you will also be able to produce outline designs for treatment plants and understand the operation and design of emission control systems for the various solid waste treatment options.

This module list is an indicative list and actual content may vary as we regularly review the content of our courses in light of new experiences and developments in the field.

Research project

The research project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and to explore and develop specific interests by applying it to your own piece of research.

The project is chosen by you and is usually associated with one of our world-class research institutes. You will work individually on a project and you will be assigned a project supervisor.

Recent projects

- Economic analysis of low-cost sanitation solutions in Soweto, South Africa (joint project with Johannesburg Water)
- Attitudes to reuse of urine and faeces from domestic sanitation (joint project with Swiss Technical Institute)
- Technical solutions to link domestic sanitation and food security in West Africa
- Differential access to water and sanitation by women-headed households in developing countries (joint project with UNICEF statistics division)

Research Degrees

Our international reputation for research makes our Faculty an ideal place to pursue a research degree, whether as preparation for a research career in industry or as the start of an academic career.

The range and scope of our research is extensive and covers all of the major engineering disciplines, including cross cutting themes such as energy, materials, medical engineering and artificial intelligence, with theoretical, experimental and modelling work underpinning all areas.

This provides an ideal platform for multidisciplinary research, enabling us to undertake high-impact research in areas recognised as providing critical global challenges. Much of our research is linked to industry, with major collaborators throughout the UK and Europe. We have also aligned our Faculty with industry sectors such as digital technologies, energy, high value chemicals and medical technologies.

All research students carry out a programme of research in a particular area under the supervision of a primary supervisor and one or more co-supervisors. Supervisors are usually staff within the Faculty; however co-supervisors may be from another discipline, another institution or even industry depending on the project and funding source.

You will have access to a broad programme of skills training and professional development to help you complete your research effectively. This will also keep you at the leading edge of developments in learning and teaching, innovation, enterprise and knowledge transfer and help you succeed in future employment.

You are assessed towards the end of your first year (second year for part-time students) through a report and oral examination; successful completion enables progression into the remaining years. At the end of the programme you will prepare a thesis which describes your research and your original contribution to knowledge which is assessed by oral examination.

Once registered specific training needs will be identified and suitable courses recommended. During the later stages of your study you will be expected to give seminars and write papers for scientific journals and conferences.

For information regarding the application process visit:
www.engineering.leeds.ac.uk/faculty/postgraduate/research-degrees

Contact us

If you require any further information please contact our Graduate School Office:

e: **phd@engineering.leeds.ac.uk**
t: **+44 (0)113 343 8000**

Coming to Leeds

The University of Leeds is one of the UK's top universities. Our degrees are well respected by employers and Universities worldwide; in the 2010 QS World University Rankings, our Employer Review score was 88%.

Established in 1904, we are part of the prestigious Russell Group – the 20 leading research universities in the UK. We are also in the top ten UK research-intensive universities. We have performed consistently well in the National Student Survey, in fact, in the latest survey, 86% of our students said they were very satisfied or satisfied with their experience at Leeds.

Our single-site campus is conveniently located, just a short 10 minute walk to the city centre, providing access to a vibrant city life and excellent local services and facilities.

We have more than 5,000 taught postgraduate students and 2,000 research postgraduate students. Students come from over 130 countries to make use of our outstanding facilities, including a major academic research library, laboratories and computing facilities.

Located at the heart of our campus, is our award-winning Students' Union, which has over 31,000 members. It is an excellent University resource that hosts postgraduate networking events and provides specialist advice on a range of issues including academic support, housing, money and finances.

The city of Leeds is a fantastic place to live and learn; it's a multi-cultural and cosmopolitan city with over 200,000 students, all enjoying the safe, friendly environment.

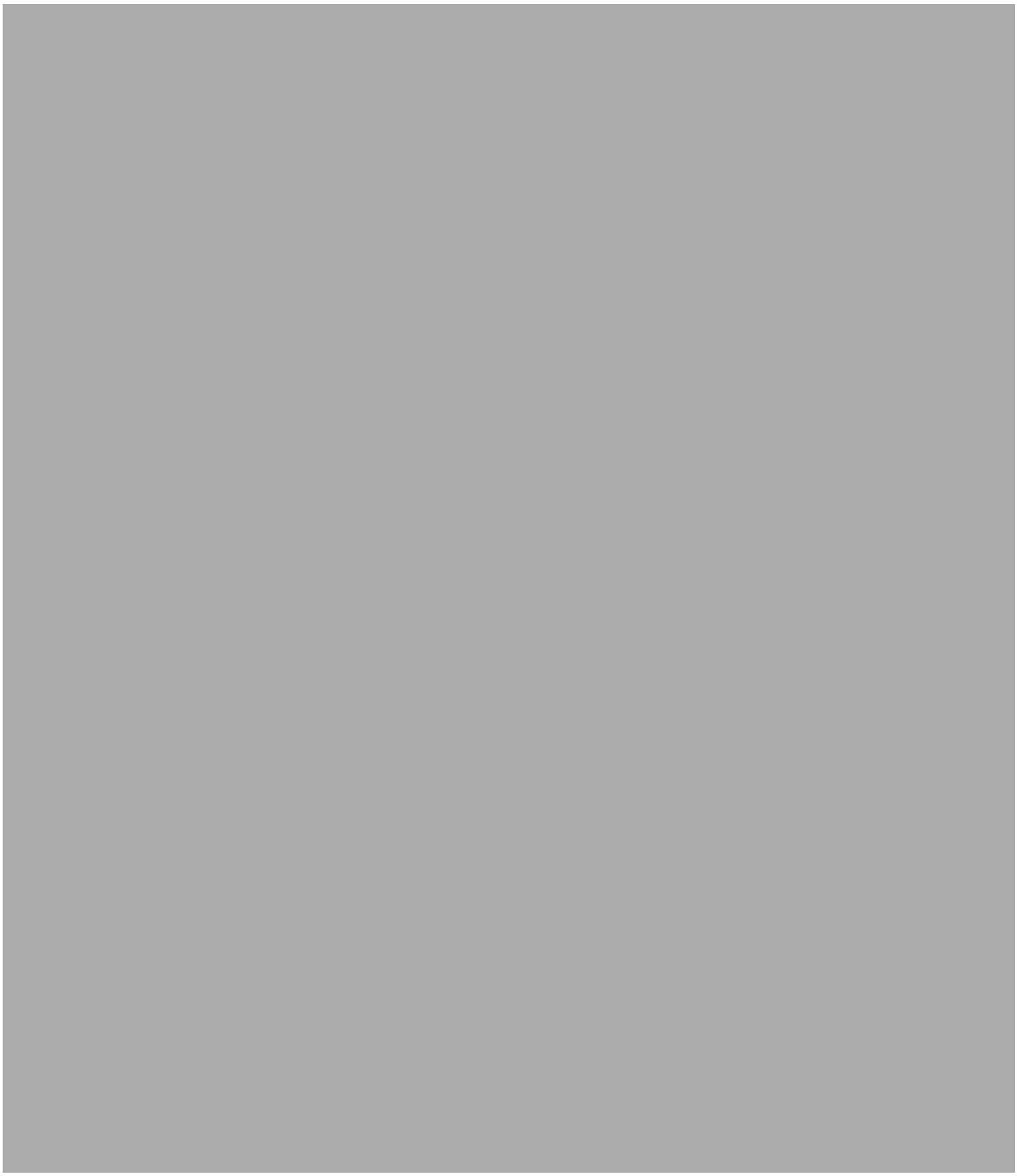
Leeds is also renowned as a major shopping destination and centre for entertainment, nightlife, the arts and leisure. Boasting over two miles of traffic-free shopping and beautiful Victorian and Edwardian arcades you'll find shops of every kind. Leeds also offers an extensive choice of places to eat and drink whatever your culinary tastes or budget. Nightlife in and around the city is known for its diversity and popularity, and offers a range of music to suit all tastes.

Located at the heart of the UK, Leeds is midway between Edinburgh and London making it an ideal centre from which to visit other parts of the country. The city can be reached easily by train from any part of the UK, and is served by Leeds Bradford International Airport, as well as having train connections from Manchester and London international airports.

Our University is one of the most popular destinations in the UK for high-quality international students. Here are some of the services that our international students benefit from:

- offices in several countries where you can get advice about the application process and pre-departure information
- meet and greet schemes at local stations
- welcome programmes on arrival
- guaranteed accommodation* for all international students who return their accommodation application form and deposit before the relevant deadlines
- an active International Centre which brings together the international community and is a source of guidance, information and support, as well as a great place to make friends
- the University's Language Centre, which offers several courses to help international students improve their language skills (although all international students must have an English language qualification, typically equivalent to IELTS 6.5).

*This guarantee applies to all single students from outside the European Union.



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