School of Process, Environmental and Materials Engineering

FACULTY OF ENGINEERING

UNIVERSITY OF LEEDS

Postgraduate Masters Courses

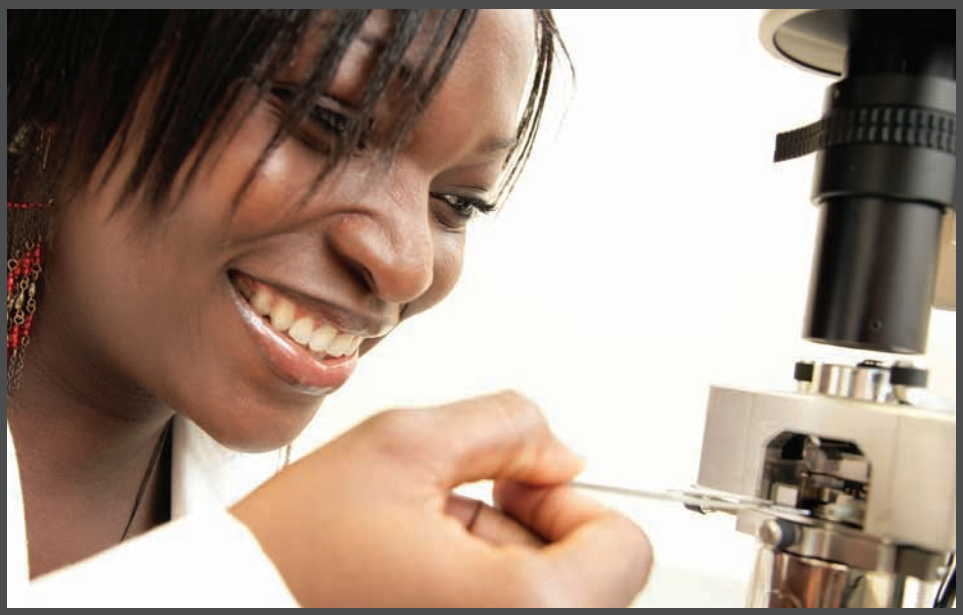
Contents

For current information on courses, fees and entry requirements please visit our website at **www.engineering.leeds.ac.uk/speme/postgraduate**

School of Process, Environmental and Materials Engineering

The School has an established international reputation in the areas of chemical engineering, mineral process engineering, fire and explosion engineering, energy and resources engineering, pharmaceutical and personal products, and the emerging area of nano-materials.

In the latest UK Government Research Assessment Exercise (RAE) the School was ranked number 3 in the UK in the general engineering category, confirming its status as one of the leading international centres for integrated process, environmental and materials engineering.



These achievements are evident in the School's high quality peer-reviewed publications, its international collaborations and prestigious Research Council awards. Research funding comes from a variety of sources, including UK Research Councils, the European Union, government agencies and industry. Highly interdisciplinary in nature, the School has well-established collaborative links with other schools in the University, and with other academic institutions and industrial organisations around the world.

Our research excellence, high levels of funding, and strong industrial connections ensure that we can invest in both the best staff, who are international leaders in their respective fields, and state-of-the-art research facilities. This wealth of expertise and investment ensures that you receive the best quality of education.

Our masters courses will allow you to further your knowledge, widen your skills base and improve your career prospects. They are also excellent preparation for those individuals wishing to undertake further, in-depth study in the form of a PhD.

www.engineering.leeds.ac.uk/speme

Why choose us?

Research intensive

Our MSc courses are delivered by academic staff who are research active and have extensive knowledge and expertise accumulated over time, many of whom are leading experts in their chosen fields of specialisation. Our research feeds directly into our teaching, which means you'll learn about the latest developments within your field from world-class academics who will challenge, encourage and support you.

First-class facilities

As you'd expect of a top-rated UK research school with around 120 postgraduate students from across the world, facilities for postgraduate study are of the highest standard.

The School is purpose built, self-contained, and offers a pleasant and friendly environment for study, with central University facilities just a few minutes' walk away. The School has an enviable range of multi-million pound facilities. The last few years have seen significant investment in new infrastructure and equipment totalling £8.5 million, including a wireless computer network, major laboratory refurbishment and a wide range of new equipment. Additionally, a further £15 million is being spent on a new state-of-the-art Energy Building designed to house all of the major research work in this area.

The School has outstanding experimental research facilities, including advanced electron optics for nano-scale materials characterisation, preparation facilities for making and characterising particulate systems for a wide range of technological materials, facilities for advanced environmental monitoring and pollution control, and advanced energy systems, including fuel cells and combustion systems.

There are excellent computing facilities available within the School, including a 64-node Beowulf parallel computing cluster and high performance graphic workstations for molecular modelling studies. The University is also a member of the White Rose Consortium, providing access to the White Rose Grid and its immense computing power. The University library is one of the largest in the country, with over 3 million items, while its website provides access to electronic resources, including networked databases and electronic journals.

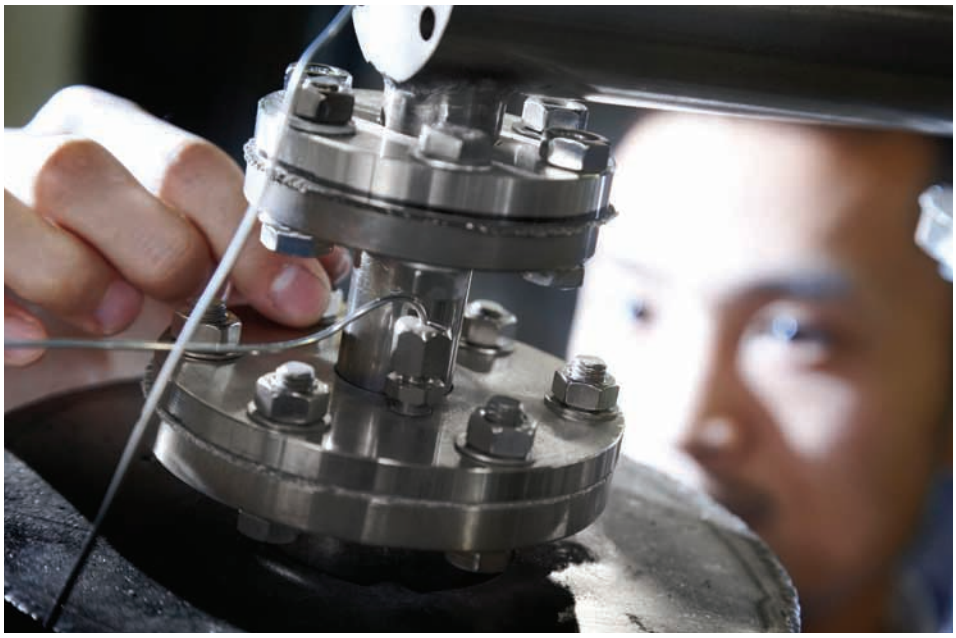
Strong industrial links

The content of each course is industrially orientated and members of staff maintain close contact with industry to ensure that material is up to date and in-line with employer needs.

An industrial advisory board ensures that industrial partners provide input into the ongoing development and review of the courses. Industrial partners also contribute to some teaching through guest lecturers, hosting and supervising projects, and funding prizes.

Our industrial partners include:

- National Nuclear Laboratory
- Procter & Gamble
- Unilever
- AstraZeneca
- GlaxoSmithKline
- AkzoNobel
- Lafarge
- Imerys
- Johnson Matthey
- Rio Tinto
- Syngenta



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. The courses incorporate training in presentation skills, scientific writing, project management, intellectual property awareness, team working and applying research methodology.

Engineering Careers Fair

We hold an annual Engineering and Computing Careers Fair attracting over 32 graduate recruiters including organisations such as Atkins, AECOM, Balfour Beatty, BP, Deloitte, Ernst & Young, Jaguar Land Rover, Procter and Gamble, Network Rail and Thales, to name but a few. The fair provides you with the chance to explore the opportunities available 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. The Careers Centre also holds training events and workshops to assist 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 MSc courses operate on a credit-based modular system. A standard module is worth 15 credits and the research project is worth 60 credits. You are required to take modules totalling 180 credits. The taught modules and preparatory work for the research project is undertaken over the first two semesters with the summer being devoted to the research project.

Course work assignments are a significant part of the course and contribute towards the module assessment. Summative examinations may also be included as part of the assessment. Assignments may include group presentations, reports, essays, or practical work. The research project is assessed by dissertation and oral presentation.

All of the MSc courses can be undertaken on a full-time basis (one calendar year – September to September) The MSc in Fire and Explosion Engineering can also be taken on a part-time basis, with a maximum of 3 years duration after a September start.

Research project

The project is possibly one of the most satisfying parts of the course. It gives you the opportunity to take what you have learnt and apply it to a real project, which is your own piece of research and can be used to explore and develop specific interests.

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.

Continuing professional development

Some modules on the courses can also be taken as individual short courses. This is ideal if you want to undertake Continuing Professional Development but your work and other commitments mean that you are not able to take time out for the full-time Masters programmes. For further information visit **www.engineering.leeds.ac.uk/short-courses**

The application process

Due to the high demand for our courses, we advise applying early. Applications from international students should be submitted by mid July and UK applications by early September of the year of entry. However, there is an application deadline of 30 June relating to the excellence scholarship and to be eligible for this, applicants need to have an offer of a place on one of our postgraduate courses.

For further information about applying for postgraduate study visit **www.leeds.ac.uk/pgthowtoapply**

Fees

For up-to-date details on fees please contact our Postgraduate Admissions Team or visit **www.engineering.leeds.ac.uk/masters-courses/fees**

Scholarships

We are part of the Faculty of Engineering, which offers a range of scholarships. Details can be found at **www.engineering.leeds.ac.uk/scholarships** or by contacting the Postgraduate Admissions Team. The University also offers a number of scholarships, for more information on these visit **http://scholarships.leeds.ac.uk**

English language requirements

Applicants whose first language is not English, or whose Bachelor's degree is not from a university in an English speaking country, are required 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 the Language Centre for students who wish to improve their language skills prior to commencing their studies, to find out more visit **www.leeds.ac.uk/languages/intro**

Contact us

If you have any queries please contact:

Postgraduate Admissions Team
School of Process, Environmental and Materials Engineering
University of Leeds
Leeds LS2 9JT, UK

t: +44 (0)113 343 2343

e: tpgspemeadmissions@leeds.ac.uk

w: **www.engineering.leeds.ac.uk/speme**

Visit us

You are welcome to visit us, please contact the Postgraduate Admissions Team on

t: +44 (0)113 343 2343

Postgraduate masters courses:

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?

This course will appeal to:

- 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.

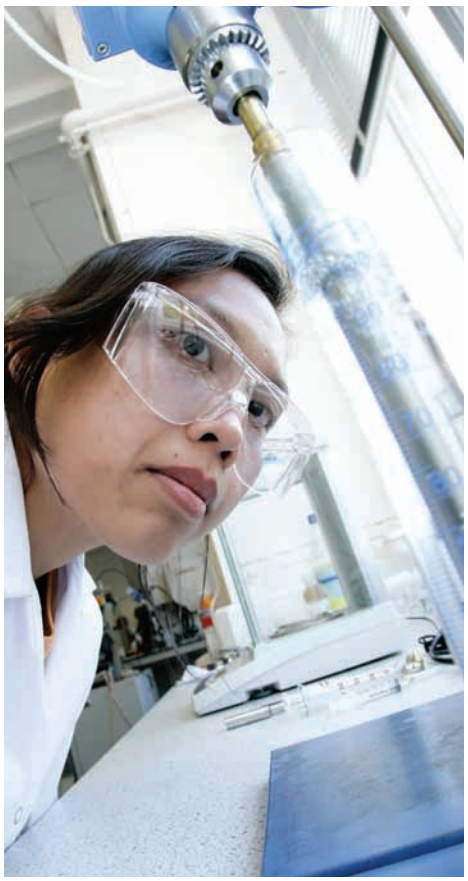
Typical careers

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.

For English language requirements see page 7.



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 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.
Optional modules	
Advanced Energy Systems	Provides further analysis of industrial power generation both from nuclear, conventional and renewable sources.
Advanced Mathematical Techniques	Covers analytical and numerical methods for solving differential equations encountered in engineering applications, apply methods of bifurcation theory to a variety of process engineering problems.
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.
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.

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.
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.
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.
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 research 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:

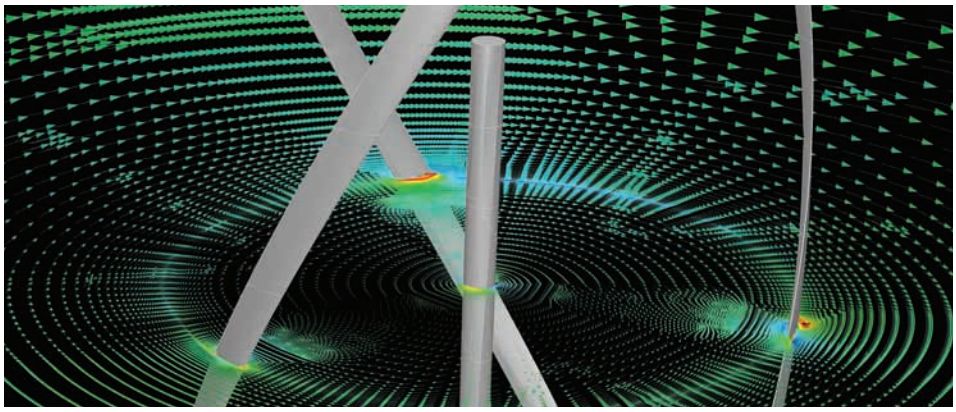
t: 0113 343 6543

e: iprdcourses@leeds.ac.uk

w: **www.iprd.leeds.ac.uk**

MSc 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.



Velocity profile around the turbine blades of a novel vertical axis wind turbine being developed in conjunction with the Centre for CFD.

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?

This course will appeal to:

- 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.

For English language requirements see page 7

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.
Advanced Parallel Scientific Computing	Provides an understanding of the role of computational methods in Scientific Computing and the importance of reliability, efficiency and accuracy. You will gain an understanding of the principles of parallel programming on distributed memory architectures and the application to Scientific Computing problems.
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.
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 research 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 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?

This course will appeal to:

- 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 MSc 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.

For English language requirements see page 7.

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
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.
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.
Control of Air Pollution	Delivers the principles and engineering design aspects of the processes control of air pollution from stationary industrial sources.
Engine Emissions Measurement	Covers the principles of exhaust gas analysis, engine emissions regulations and measurement requirements.
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

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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 research 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 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?

This course will appeal to:

- 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.

For English language requirements see page 7.

Course content

The majority of the taught modules are delivered as intensive one-week courses and are formally assessed within a period of typically five to eight weeks. One module is available by e-learning; over a period of approximately ten weeks. This course delivery method enables the programme to run on a full-time and part-time basis simultaneously.

You will study the following two modules plus three of the optional modules. You will also undertake a research project which offers you the opportunity to explore, in greater depth, a topic of your choice within your chosen subject.

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 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 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 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 research 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 Pharmaceutical Science and Engineering

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

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?

This course will appeal to:

- 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.

For English language requirements see page 7.

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.
Chemical Reaction Processes	Provides an introduction to types of reaction and reactors, rate analysis and design principles.
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.
Optional modules	
Advances in Chemical Engineering	Covers the most recent developments in chemical science and engineering particularly in the following aspects: advances in process intensification; advances in process analytical technology; advances in colloidal sciences and engineering; and advances in non-intrusive measurement techniques.
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.
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.
Physical Organic Process Chemistry	Provides a detailed knowledge of physical organic chemistry, and its relevance to fine chemical and pharmaceutical manufacture.

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 research 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

Research degrees

Our international reputation for research makes our School 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.

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 School; however co-supervisors may be from another discipline, another institution or even industry depending on the project and funding source.

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.

Research activity within the School of Process, Environmental and Materials Engineering is organised into three research institutes; the Energy and Resources Research Institute, the Institute for Materials Research, and the Institute of Particle Science and Engineering.

Energy and Resources Research Institute (ERRI)

The Energy and Resources Research Institute is a world-class centre of excellence helping to create a cleaner, greener, sustainable future. Our activity ranges from conventional and novel combustion processes, pollution monitoring and refinement, to developing biomass and hydrogen resources and processes for use in tomorrow's technologies.

International academic collaborations include the many EEC collaborative research projects within the institute, involving leading research establishments across Europe. There are additional, active worldwide research collaborations, and in addition, we have formal collaborative agreements with several local government partners and Transport for London, informing strategic planning and policy related to the environmental impacts of energy at both the local and national level.

Research areas

- Advanced Combustion Science and Engineering
- Environmental Pollution Control, Monitoring and Modelling
- Renewable Energy Systems, Future Fuels and other aspects of energy

For further information on the Energy and Resources Research Institute visit **www.engineering.leeds.ac.uk/erri**

Institute for Materials Research (IMR)

The Institute for Materials Research covers a wide range of advanced inorganic and metallic materials research, with a specific focus on developing application-specific materials through control of the interactions between processing, microstructure and properties. We have an international reputation for our expertise in carbon, electronic and photonic materials, non-equilibrium metallic processing and electron-optical characterisation techniques.

Research areas

- Functional and Nanomaterials
- Metallurgy
- Nanocharacterisation and Modelling

For further information on the Institute for Materials Research visit
www.engineering.leeds.ac.uk/imr

Institute of Particle Science & Engineering (IPSE)

The Institute was formed in 2001, based on the traditional disciplines of chemical engineering and mineral process engineering and has since then expanded rapidly in the pharmaceutical chemical engineering, the emerging area of nano-manufacturing, and most recently in the development of chemical processes in collaboration with the School of Chemistry (Institute of Process Research and Development).

Our research activities encompass colloid, nanoparticle and interfacial engineering; multi-scale and systems modelling; pharmaceutical and fine chemicals; mineral and waste processing; powder and

formulation engineering; and in-process measurement and control of process systems. Our focus is on the engineering science of particulate processes and products by applying an integrated approach to their design and manufacture from molecular level to large-scale production plants.

Research areas

- Particulate measurement systems
- Particulate systems modelling
- Manufacture of advanced particulates

For further information on the Institute of Particle Science & Engineering visit
www.engineering.leeds.ac.uk/ipse

How to apply

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

Doctoral Training Centre in Low Carbon Technologies

We also lead an EPSRC-funded Doctoral Training Centre (DTC) in Low Carbon Technologies, which brings together a cohort of postgraduate research students and their supervisors to develop innovative technologies for a low carbon future based around key interlinking themes: Low Carbon Enabling Technologies, Transport & Energy, CO_2 Storage, Climate Change & Energy Systems Research.

Our Centre is funded by the Engineering and Physical Sciences Research Council (EPSRC), a UK government agency, which invests more than £850 million a year in research and training in engineering and the physical sciences. Each year we offer a number of funded PhD studentships.

For further information visit
www.engineering.leeds.ac.uk/dtclowcarbon

About the University

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, 82% of students said they were very satisfied or satisfied with their experience at Leeds.

Our single-site campus is conveniently located, 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.

Our new £12 million gym and pool, The Edge is one of the biggest on any university campus. Featuring a 200-station fitness suite, squash courts, climbing wall, Starbucks café, steam room and sauna, plus much more, it has something for everyone. For more information visit **www.leeds.ac.uk/sports**

The diverse community of cultures studying and working within the University enriches the experience of studying at Leeds. We are committed to providing an excellent level of service and support for all our students and for international students we have extensive academic support services including a Language Centre and a Skills Centre.

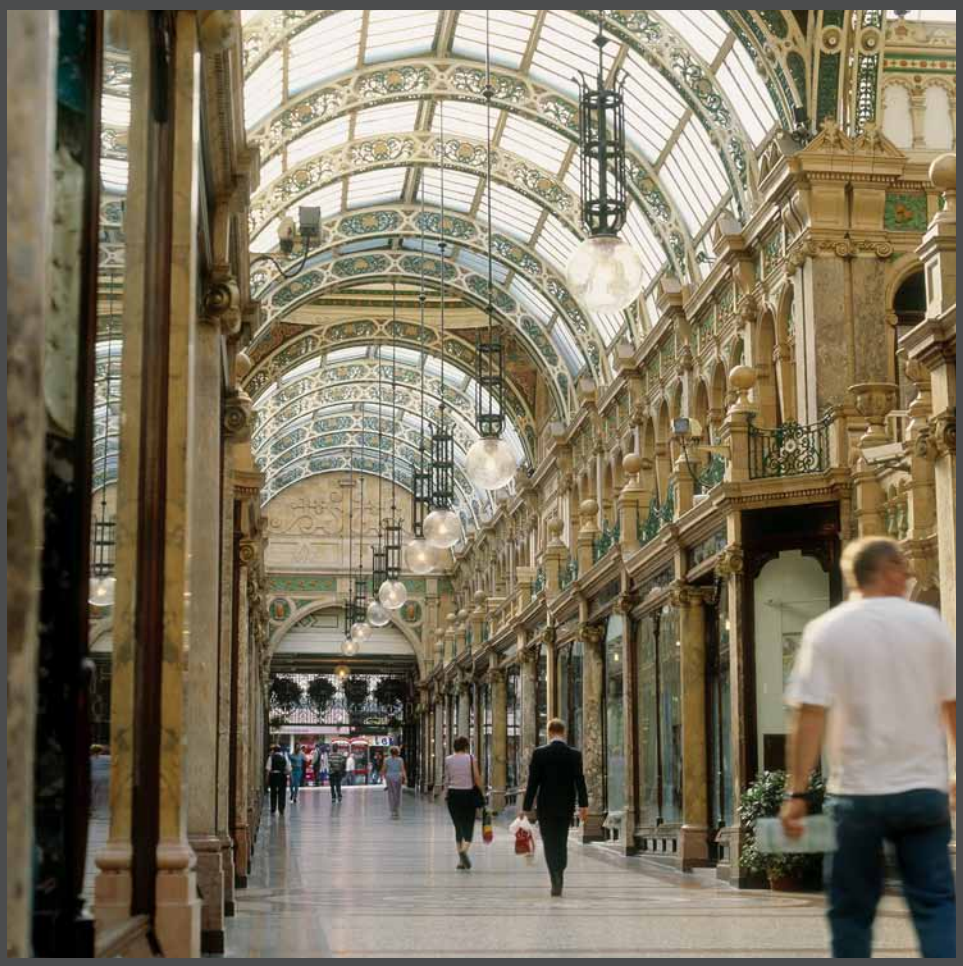
The University of Leeds is one of the most popular destinations in the UK for high-quality international students. An active International Centre brings together the international student community and is a source of information, guidance and support, as well as a great place to make new friends. International students have a guaranteed place in University accommodation throughout their studies, provided that a completed application form and deposit reaches us before the summer deadlines.* For more information visit **www.leeds.ac.uk/international**

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

About the city

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



Leeds is one of the greenest cities in Britain with more parkland than any other European city. In and around Leeds you will find many areas of natural beauty and within easy reach of the city are the national parks of the Yorkshire Dales, Peak District, Lake District and historic towns such as York, Harrogate and Bradford.

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. Leeds can be reached easily by train from any part of the UK, and is served by Leeds/Bradford International Airport, with train connections from Manchester and London International Airports.

Adapting to life in a new place can be both exciting and challenging. Finding somewhere to live where you feel comfortable will help you settle in quickly. Leeds has plenty of accommodation to choose from: residences large and small, in contemporary or traditional buildings, on campus or off campus. All of our accommodation is within easy walking distance to campus or on a frequent bus route. Living in University accommodation is one of the best ways to make new friends and help you settle into university life. For more information visit www.leeds.ac.uk/accommodation

UNIVERSITY OF LEEDS

Postgraduate Admissions Team
School of Process, Environmental and Materials Engineering
University of Leeds
Leeds LS2 9JT, UK

t **+44 (0)113 343 2343** f **+44 (0)113 343 2549**
e **tpgspemeadmissons@leeds.ac.uk**
w **www.engineering.leeds.ac.uk/speme**