Research-led, industry facing postgraduate degrees in world-class facilities: Engineering at Liverpool

Our postgraduate programmes welcome students from all over the world. We deliver knowledge and practical skills at an advanced level in specialist subjects at the cutting-edge of engineering research.

Whether in Mechanical, Manufacturing, Aerospace or Civil and Structural Engineering, you’ll be learning and contributing to knowledge at the forefront of your professional field.

Our MSc (Eng) and MPhil/PhD degrees are designed to develop your professional, research and personal skills through our excellent teaching, top quality facilities and strong technical and scientific support. Whether you are looking to enhance your engineering CV in a key area, complete the accredited study requirement for membership of your professional institution or kick start your research career in engineering science, Liverpool is the place to do it.
The University of Liverpool is a world-ranking university and a member of the Russell Group, an elite group of 24 research-intensive universities, who produce high calibre research that is respected worldwide and has a well deserved reputation for academic excellence.

The School of Engineering prides itself on developing modern professional engineers for the future.

We have received many accolades from the engineering industry who regard our graduates amongst the most employable in the world and we ensure that your learning environment reflects your future working environment.

Our teaching programmes are highly rated and this is underpinned by an extensive programme of research.

**Outstanding Facilities**

The School of Engineering has a well-deserved and highly respected reputation for its excellent experimental and computational facilities. Our £32 million redevelopment includes the state-of-the-art ‘Active Learning Labs’, a cutting-edge teaching facility, which is one of the largest and best equipped in Europe.

We have two research-standard full motion flight simulators (one of which is unique in the academic world), mechanical robotics, wind turbines, water flumes, additive layer manufacturing and many more facilities.

**Career Prospects**

Our postgraduate courses are designed to ensure students develop their expertise, communication and team working skills as well as skills in fields of research whilst increasing their employability and professional accreditation.

We provide pathways into rewarding careers and our award-winning University of Liverpool Careers and Employability Service provides a range of services to maximise your career prospects and opportunities after you graduate.

There are many opportunities to work with our industry partners and develop your knowledge, skills and experience. Some of our partners include:

- Augusta Westland
- Airbus
- National Oceanography Centre
- BAE Systems
- QinetiQ
- Unilever
- P&G
- Jaguar Land Rover
- Ford
- Arup
- National Nuclear Laboratory.

**World Leading Research**

The University of Liverpool’s School of Engineering has the second highest proportion of world-leading research in Metallurgy and Materials in the UK and is also involved with internationally recognised, ground breaking research, including the following:

- The Centre for Biomedical Engineering. The Centre for Biomedical Engineering is one of the fastest growing engineering disciplines. We have state-of-the-art biomedical facilities including new tissue engineering and biomaterials laboratories.
- Additive Manufacturing and Medical Engineering. We are the international leader in the field of Additive Manufacturing (AM) working on both AM equipment development and the production processes for the manufacture of implants. We work with the international leaders in orthopaedic implant manufacturing and world-renowned Metrology/AM equipment manufacturers to develop our ideas from laboratory to fabrication.
- Flight Science and Technology (FS&T). This is one of our five star research groups within the School of Engineering and has received over £10 million in funding for ground breaking rotor craft and wing simulations research to date.
- The Centre for Global Eco-Innovation. This is the only centre of its kind in Europe, bringing together the expertise, resources and global contacts from the University of Liverpool, University partners and international industry to develop new products, processes and services to deliver positive environmental impacts globally. Current projects in Liverpool’s School of Engineering include:
  - Development of a highly efficient and sustainable building process
  - Development of advanced controller to improve the efficiency of wind turbines
  - Improving selective laser melting methods for reduced materials use
  - Increase yield and control of final oxide mix while removing intermediate production stages
  - To develop LCS porous metals with novel structures for optimum heat exchange performance
  - Developing technology for a low-cost, power free renal therapy device.

Liverpool is a great university with a worldwide reputation for high quality research. The student body is made up of many nationalities with very different customs and traditions. I enjoy finding out about the cultural differences and seeing the students develop as the programmes progress. It is very satisfying seeing the students put the knowledge they have learnt in my lectures and labs to use in their projects to advance the subject, sometimes putting a new spin on the work that really pushes things forward and catches me out!

Dr Stuart Edwardson, Lecturer
Centre for Materials and Structures
**Centres of Doctoral Training**

The University of Liverpool has been awarded significant funding as part of a government investment in postgraduate training. As one of only 24 UK universities to be involved in setting up prestigious Centres for Doctoral Training (CDT), the University of Liverpool is collaborating in the following CDTs:

- Global Risk and Uncertainty in Complex Systems and Environments
- Next Generation Nuclear
- Additive Manufacturing and 3D Printing
- New and Sustainable Photovoltaics
- Fusion Energy
- Understanding the Earth, Atmosphere and Ocean
- North West Doctorial Training Centre
- Adapting to the Challenges of a Challenging Environment (ACCE)
- Global Eco-Innovation.

These CDTs offer great opportunities for funding PhD study.

Find out more about fully funded PhD studentships at [www.liverpool.ac.uk/engineering/postgraduate-research/](http://www.liverpool.ac.uk/engineering/postgraduate-research/)

**Engineering Research Centres**

Our postgraduate programmes and world-class research groups are clustered into interdisciplinary Research Centres which cut across traditional departmental boundaries. The result is a dynamic and stimulating academic environment where you’ll be challenged by new ideas, concepts and approaches to engineering challenges.

The Centre for Materials and Structures incorporates research that is ranked second highest in the UK for world-leading research in Metallurgy and Materials. Core areas of expertise include Advanced Manufacturing, Advanced Manufacturing with lasers, Functional Materials, Bioengineering, Structural Materials and Mechanics.

The Centre for Engineering Dynamics specialises in world-class research on the dynamics of flight, fluids and structures, including Computational Fluid Dynamics (CFD), Aeroelasticity, Vibration, Flight Simulation, Non-newtonian Fluids, Turbulence, Automotive Engine Design, and Complex Systems Dynamics.

The Centre for Engineering Sustainability is excelling through our long-standing expertise in Marine Renewable Energy, Coastal and Maritime Engineering, Water Resource Engineering, Alternative Technology, and growing areas in Environmental and Sustainable Engineering.

Integrated throughout all of our research centres and working closely with various University departments is our Institute for Risk and Uncertainty. The institute leads our internationally-recognised and acclaimed research and teaching in Engineering Risk Analysis, Stochastic Modelling and Robust Design, working closely with the Virtual Engineering Centre (VEC), and many international industrial partners.

**Research Opportunities**

Postgraduate research opportunities are continually changing and developing. They may be supported by funding linked to a specific research programme, however we welcome enquiries from applicants with their own research ideas and will work with you to secure funding for your PhD studies. For more information see page 24.

**Entry Requirements**

Normally a UK 2:1 or equivalent is required for entry on to our programmes, but students graduating from a UK university with a 2:2 degree may be considered on a case-by-case basis in which relevant professional work experience and references will be taken into account. This should be in Engineering or Science with appropriate knowledge of core engineering science topics at bachelor degree level.

**International Qualifications**

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

**English Language Qualifications**

All applicants must have reached a minimum required standard of English language and are required to provide evidence of this. Qualifications accepted by the University can be found on our International webpages. Please see [www.liverpool.ac.uk/international](http://www.liverpool.ac.uk/international) for English language requirements specific to your country.

If you meet the academic requirements of the course but do not have the required level of English language, it is possible for you to come and study at the University on one of our Pre-sessional EAP programmes. Please see the English Language Centre website for further information about these programmes [www.liverpool.ac.uk/english-language-centre/pre-sessional-english-courses/](http://www.liverpool.ac.uk/english-language-centre/pre-sessional-english-courses/)

If you require additional English language training during your study, the University is able to provide tuition and arrange IELTS tests through its English Language Centre, details of which are available at [www.liverpool.ac.uk/english-language-centre/ielts](http://www.liverpool.ac.uk/english-language-centre/ielts)

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<tr>
<td>TOEFL iBT</td>
<td>88 or above with minimum scores in components as follows: Listening 21, Reading 22, Speaking 23</td>
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*Please note that you are able to apply for some of our taught programmes at a Postgraduate Certificate (PGCert) or Diploma (PGDip) level and can progress through these levels to achieve a full master’s on successful completion of each stage. Please contact the School for further information.*

**Financial Support**

Postgraduate Research Funding

The primary source of funding for research is from the EPSRC. Information on sources of funding may also be obtained by visiting the University web pages [www.liverpool.ac.uk/study/postgraduate/funding](http://www.liverpool.ac.uk/study/postgraduate/funding)

Please note that application deadlines apply to scholarships.

Postgraduate Taught Student Awards

A range of awards, scholarships and bursaries are available for those undertaking postgraduate study at the University. See [www.liverpool.ac.uk/international/money-and-scholarships](http://www.liverpool.ac.uk/international/money-and-scholarships) for more information.

International Students

The University of Liverpool administers and participates in many scholarship schemes for international students with the majority of the scholarships being awarded on the basis of academic merit rather than hardship. Students must normally hold an offer of a place on a course before they can apply. More details of all of these awards are listed on [www.liverpool.ac.uk/international/money-and-scholarships/scholarships](http://www.liverpool.ac.uk/international/money-and-scholarships/scholarships)

**Contacting the School of Engineering**

Postgraduate Admissions Tutor

T: +44 (0)151 794 4902

E: pgeng@liverpool.ac.uk

[www.liverpool.ac.uk/engineering](http://www.liverpool.ac.uk/engineering)
A postgraduate experience is not only an excellent way to enhance your prospects. It will also help you to stand out from the crowd as well as show your commitment and dedication. It demonstrates your ability to think independently and work towards goals.

Goran Mahmud  
PhD Engineering
# Programmes at a Glance

<table>
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<th>Part-time</th>
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<td>Biomedical Engineering MSc (Eng)</td>
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<tr>
<td>MPhil</td>
<td>1-4y</td>
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Please note that, as part of every effort to ensure the best possible student experience, the University regularly reviews its portfolio to offer research-driven, distinctive and challenging programmes of study. For the very latest developments on all our postgraduate programmes for 2017 entry, visit [www.liverpool.ac.uk/study/postgraduate](http://www.liverpool.ac.uk/study/postgraduate)
A postgraduate degree in Advanced Aerospace Engineering is the basis for a career in a profession that offers an extremely wide choice of employment opportunities. Graduates will also understand the Engineer’s role within industry in the UK, Europe and the rest of the world. The programme is suitable for people with an Engineering background wishing to gain a master’s level qualification for a professional career route or those with a physical science background seeking to change disciplines to broaden their employment opportunities.

### Programme Outline

The core modules in Advanced Aerospace Engineering focus on developing your ability to analyse and compute aerodynamic characteristics, 3D and linear aerodynamic effects. The modules give you the knowledge and skills to integrate technical insight and manage projects to tackle ‘whole aircraft’ issues in the industry. You will have access to our state-of-the-art research standard, full motion flight simulators (one of which is unique within the academic world), wind tunnels and the Virtual Engineering Centre, one of the UK’s leading virtual facilities.

### Module Details

#### Compulsory

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Title</th>
<th>Credit Value</th>
<th>Semester</th>
<th>Exam: CW (Course Work)</th>
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<td>Aerodynamics</td>
<td>15</td>
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<td>AERO405</td>
<td>Flight Handling Qualities</td>
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<td>AERO415</td>
<td>Aeroelasticity</td>
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<td>AERO416</td>
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<td>AERO417</td>
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#### Optional

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<td>AERO319</td>
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<tr>
<td>AERO414</td>
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<td>AERO430</td>
<td>Advanced Guidance Systems</td>
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<td>ENGG304</td>
<td>Risk and Uncertainty: Numerical Applications</td>
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<td>ENGG414</td>
<td>Structural Optimisation</td>
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<td>ENGG419</td>
<td>Advanced Fluid Mechanics</td>
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<td>MATH492</td>
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<td>MATS511</td>
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<td>MECH428</td>
<td>IC Engines</td>
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<td>MECH452</td>
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#### Research Project

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Please note module information is correct at time of publication. However, modules are subject to change. Please check our website for the latest information.
Compulsory
Aerodynamics AERO316
The module aims to help you to develop the ability to understand qualitatively and to predict quantitatively the flow over an aerofoil at all speeds.

Flight Handling Qualities AERO405
The aim of this module is to equip you with the skills and knowledge required to understand fundamental aircraft handling qualities and related ‘whole aircraft’ problems in industry. On successful completion of the module, you should be able to demonstrate knowledge and understanding of:
- A range of handling qualities requirements for different classes of aircraft and different missions
- The way in which different aircraft design parameters affect handling qualities
- The use of HQ rating scales.

Aeroelasticity AERO415
This module builds upon your existing knowledge of structural analysis methods and aerodynamics to enable static and dynamic aeroelastic analysis of low-degree-of-freedom systems by analytical and numerical methods.

Advanced Aerodynamics AERO416
This module will help you to develop the ability to analyse and compute the aerodynamic characteristics of an aircraft configuration.

Advanced Aerostructures AERO417
This module builds upon your existing knowledge of structural analysis methods and aerodynamics to enable static and dynamic analyses of simple structures with aerostructures in sight.

Aerospace Capstone Design Project AERO420
The aims of this module are:
- To develop an appreciation of the nature of the design process in Aerospace Engineering
- To appreciate the importance of teamwork and group activity to achieve a complex engineering objective
- To stimulate awareness of the marketing, costing and business dimension in the Aerospace project
- To integrate technical insight into Aerospace configurational design.

Technical Writing for Engineers ENGG596
This module develops technical writing skills to support project planning.

Research Skills and Project Planning ENGG597
This module introduces techniques for project planning and the design of scientific experiments. The purpose is to prepare you for work undertaken in your MSc (Eng) projects and includes a literature survey on the subject of the project.

Enterprise Studies MNGT414
The aims of this module are:
- To introduce you to various aspects of entrepreneurial activity
- To develop a knowledge and understanding of enterprise related concepts, legislation and current development tools
- To stimulate an appreciation of modern enterprise challenges and the importance of entrepreneurial activity in relation to organisational success.

Optional
Spaceflight AERO319
The aim of this module is to:
- Develop an understanding of the principles and challenges of space flight and the significance of space-based applications
- Develop the ability to analyse the performance of a multi-stage rocket as well as the ability to predict the trajectory of a spacecraft in orbit around the Earth or in an inter-planetary orbit.

Rotorcraft Flight AERO414
The aim of rotorcraft flight is to provide you with a firm grasp and understanding of the principles of rotorcraft aeromechanics, through lectures, tutorials, computer-based simulations and development of computer codes to explore rotorcraft aeromechanics.

Advanced Guidance Systems AERO430
This module will enable you to develop an understanding of the use of advanced guidance laws in autonomous air systems, including the interactions of airframe dynamics, sensors and control surfaces.

You’ll also understand the use of the Kalman and Extended Kalman filters in aerospace systems.

Risk and Uncertainty: Numerical Applications ENGG304
This module develops understanding and appreciation of uncertainties in engineering on a basic level. It involves the quantification of uncertainties in the input and modelling, their implementation in engineering analyses and the evaluation of the associated results in view of engineering decision making. Particular focus is on the assessment of structural reliability and associated concepts for code-compliant verification and design. The methods shown in the module have a general applicability, which is demonstrated by examples and practical applications.

Structural Optimisation ENGG414
This module is about classical optimisation and modern optimisation and their numerical methods. You will get an idea of how to optimise simple structure and get optimal solutions by analytical and numerical methods.

Advanced Fluid Mechanics ENGG419
This module will cover fluid motion in a range of problems of engineering interest. Both laminar and turbulent flows will be considered and a strong emphasis is placed on modern computational approaches (ie Computational Fluid Dynamics).

The module will be delivered via a series of lectures and assessed through three exercises (30%) and a final examination (70%).

Advanced Mathematical Methods MATH492
This module will give you an introduction to the techniques of vector and tensor calculus and to the study and solution of the partial differential equations which arise in engineering.

Composite Materials MATS511
The aims of this module are:
- To identify the types of fibres and matrices commonly used in the manufacture of composite materials
- To investigate the manufacturing techniques commonly used to produce composite structures
- To identify the commonly used NDT techniques for composites
- To use micromechanics approaches and Classical Laminate Theory to study the mechanical response of composites.

IC Engines MECH4428
The aims of this module are:
- To provide an introduction to the different types of Internal Combustion (IC) engines
- To present the engineering science background behind the operation of IC engines
- To present the principles to assess the performance of an IC engine
- To present the thermodynamic and fluid-mechanical analysis of different processes involved in IC engines.

Finite Element Analysis MECH452
This module will develop a fundamental understanding of the Finite Element method, enable you to apply the methodology to a range of problems, spanning mechanical and civil engineering, and develop skills in interpreting and understanding the physical meaning of finite element results.

Computer Aided Design MNFG604
This module will introduce you to the latest 3D tools and techniques used by designers, further develop your knowledge and understanding of integrated systems design and stimulate an appreciation of modern design and development methodologies.

Research Project
MSc Project ENGG660
On successful completion of the project, you should have developed a substantial and systematic knowledge and understanding of key aspects of the engineering or engineering-related topic of your project including the theory, recognised principles and best practice (as appropriate). Much of this knowledge will be at, or informed by, the forefront of defined aspects of the discipline.

You should also have developed a comprehensive knowledge and understanding of the experimental and theoretical techniques and research methodology appropriate to advanced study in your field.
Advanced Manufacturing Systems and Technology MSc (Eng)

Full-time
Programme length: 1 year

Modern manufacturing is a growing industry worldwide and is continually challenging engineers for more effective use of technology, management systems, production techniques and processes.

The Advanced Manufacturing Systems and Technology MSc has been developed in conjunction with the industry partners to develop industry ready engineers.

The programme is designed to provide advanced level knowledge, breadth and depth for modern manufacturing engineers and managers.

Fully accredited by the Institute of Mechanical Engineers UK, this programme is constantly updated to reflect the latest developments in technology, management tools and methodologies.

Programme Outline

The modules studied will introduce you to techniques and develop your skills in computer aided design, including modelling in 2D, 3D, parametric and advanced solids. Principles and evolution of computer integrated manufacturing, concepts and criteria for materials selection and processing and optimisation of manufacturing processes will also be covered. New developments in micro manufacturing as well as practical experience of designing, building and testing an autonomous mobile robot also make up this cutting-edge programme.

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<td>MATS520</td>
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<td>MECH607</td>
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<td>MNFG401</td>
<td>Manufacturing Systems</td>
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<td>MNFG409</td>
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Optional

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Research Project

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Please note module information is correct at time of publication. However, modules are subject to change. Please check our website for the latest information.
Compulsory

**Technical Writing for Engineers ENGG596**
This module develops technical writing skills to support project planning.

**Research Skills and Project Planning ENGG597**
This module introduces techniques for project planning and the design of scientific experiments. The purpose is to prepare you for work undertaken in your MSc (Eng) projects and includes a literature survey on the subject of the project.

**Materials Processing and Selection MATS520**
This module will introduce you to the concepts of materials processing and selection and the criteria used in this process. The broad scope of manufacturing and processing technologies for metals, ceramics and polymers will be introduced. This will be followed by development of a deeper appreciation of the influence of processing upon the structure and properties of these materials.

**Advanced Manufacturing with Lasers MECH607**
This module aims to provide an understanding of the principles of advanced manufacturing techniques using lasers and how these are being explored through current/recent research and adopted by industry.

**Manufacturing Systems MNFG401**
The aims of this module are:
- To obtain an overall understanding of manufacturing systems. To understand manufacturing systems on the global, company, factory and shop floor scale
- To enable you to understand that manufacturing systems function at many levels within a Global Company and to identify the interactions between the systems at different levels
- To understand the function of a Manufacturing System at each level and be able to articulate the factors that control the system at that level, while also being able to take a holistic view of the system
- To be able to examine a pre-existing system, identifying points of weakness and how that system may be improved, given the external and internal constraints.

**Industrial Robotics and Automated Assembly MNFG409**
This module will provide you with the basic knowledge and skills to design, build and operate industrial robotic systems and to understand the advantages and disadvantages of their deployment.

**Computer Aided Design MNFG604**
The aims of this module are:
- To introduce you to the latest 3D tools and techniques used by designers
- To develop a wider knowledge and understanding of integrated systems design
- To stimulate an appreciation of modern design and development methodologies.

**Additive Manufacturing MNFG610**
The aim of this module is:
- To provide an overview on the role of additive manufacturing in new product development
- To develop a generic understanding on the principles and the complete process chain of additive manufacturing processes
- To provide an awareness on recent developments in additive manufacturing and associated technologies including reverse engineering.

**Enterprise Studies MNGT414**
The aims of this module are:
- To introduce you to various aspects of entrepreneurial activity
- To develop a knowledge and understanding of enterprise related concepts, legislation and current development tools
- To stimulate an appreciation of modern enterprise challenges and the importance of entrepreneurial activity in relation to organisational success.

You should also have developed a comprehensive knowledge and understanding of the experimental and theoretical techniques and research methodology appropriate to advanced study in your field.

**Optional**

**Operations Modelling and Simulation EBUS504**
The aim of this module is to give you an understanding of the role of modelling and simulation in the development and improvement of business processes in a commercial environment. Important elements include analytical techniques of systems, statistical aspects of modelling and system dynamics. Extensive use will be made of a variety of commercially available modelling and simulation tools such as Witness.

**Supply Chain Operations Management EBUS506**
The aim of this module is to provide a study of the key principles, systems and techniques used to assure effective supply chain management. The module covers an extensive range of subjects including logistics, information management, inventory management, partnerships and information technology.

**Energy and The Environment MECH433**
The aims of this module are:
- To give you an understanding of the advantages and disadvantages of alternative and conventional energy generation methods
- To develop detailed knowledge of wind, wave and solar energy capture
- To develop skills in quantitative analysis of energy generation methods
- To develop skills in dealing with complex problems in a systematic manner
- To develop ability in independent learning.

**Finite Element Analysis MECH452**
This module will develop a fundamental understanding of the Finite Element method, enable you to apply the methodology to a range of problems, spanning mechanical and civil engineering, and develop skills in interpreting and understanding the physical meaning of finite element results.

**Laser Materials Processing MECH605**
This module will provide you with an overview of the interaction of (high power) lasers with materials and their application in a selected range of established industrial processes, including: key features and properties of high power lasers, laser beam deployment, safety in high power laser use; laser process principles and practice for cutting, welding, marking, drilling and selected surface treatments.

**Design for Environment, Manufacture and Assembly MNFG413**
The aim of this module is to provide an introduction to the tools and methods of Eco-design, Design for Manufacture and Assembly using real, everyday products as examples.

**Product Design MNFG611**
The aim of this module is:
- To provide a modern approach to new product development process especially on the early phase of design concept
- To stimulate the awareness of sustainability concept within the context of product life cycle
- To develop the analytical skills for multi-criteria product performance assessment.

**Integrated Systems Design MNFG615**
The primary aim of this module is to gain a practical appreciation of Integrated System Design (ISD) through the design, build and operation of free-standing mobile robots which will perform specific tasks. This module will give you an opportunity to work in teams; gain an understanding of what it means to plan and work through a project; work to deadlines; maximise resources; and cope with uncertainty.

**Management of Design MNGT413**
This module will enable you to develop a general understanding of a wide range of aspects of the design function in a manufacturing company and its management, and in particular a comprehensive understanding of the Design Process.

The core of the module is a detailed study of a six-phase model of the Design Process derived from several authors and BS7000: Product Planning and Feasibility; Design Specification; Conceptual Design; Embodiment Design; Detail Design; Post-Design-Release.

**Research Project**

**MSc Project ENGG660**
On successful completion of the project, you should have developed a substantial and systematic knowledge and understanding of key aspects of the engineering or engineering-related topic of your project including the theory, recognised principles and best practice (as appropriate). Much of this knowledge will be at, or informed by, the forefront of defined aspects of the discipline.
Programme Outline
The core modules studied on the programme will develop your understanding and knowledge of the principles of Advanced Mechanical Engineering to an advanced level. They include specialist knowledge in thermo and fluid dynamics, combustion in IC engines, alternative and conventional energy generation methods and nuclear engineering. You will be taught techniques for managing projects and research, giving you highly desirable skills for working in industry.

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Research Skills and Project Planning

**ENGG597**
To introduce you to various aspects of entrepreneurial activity
To develop a knowledge and understanding of enterprise related concepts, legislation and current development tools
To stimulate an appreciation of modern enterprise challenges and the importance of entrepreneurial activity in relation to organisational success.

**IC Engines MECH428**
The aims of this module are:
To provide an introduction to the different types of Internal Combustion (IC) engines
To present the engineering science background behind the operation of IC engines
To present the principles to assess the performance of an IC engine
To present the thermodynamic and fluid-mechanical analysis of different processes involved in IC engines.

**Nuclear Engineering MECH432**
The aim of this module is to introduce you to nuclear power and its application to civil electrical power generating plant, and to understand the mechanical engineering challenges thereof. It will also equip you to carry out detailed calculations for heat transfer, fluid flow and steam power cycles related to nuclear power generation.
Advanced Manufacturing with Lasers MECH607
This module aims to provide an understanding of the principles of advanced manufacturing techniques using lasers and how these are being explored through current/recent research and adopted by industry.

Engineering Fluid Mechanics MECH627
This module aims:
- To introduce you to the role of viscosity in fluid mechanics, including the no-slip condition and the concept of vorticity
- To introduce basic principles of laminar and turbulent flow through pipes including definition and evaluation of the Fanning and Darcy friction factors
- To introduce the concept of a boundary layer, including separation and transition, and basic equations for friction factor in laminar and turbulent flow with zero pressure gradient
- To outline the calculation of bluff-body drag using drag coefficients with qualitative explanations
- To introduce potential-flow theory including the concept of irrotationality and the principle of superposition
- To show how to analyse compressible flow through constant-area ducts accounting for friction or heat transfer and to use the Fanno- and Rayleigh-flow tables
- To show how to analyse external compressible flow including expansion and compression turns (Prandtl-Meyer expansions and oblique shock waves).

Advanced Fluid Mechanics MECH409
This module will cover fluid motion in a range of problems of engineering interest. Both laminar and turbulent flows will be considered and a strong emphasis is placed on modern computational approaches (ie Computational Fluid Dynamics).

The module will be delivered via a series of lectures and assessed through three exercises (30%) and a final examination (70%).

Optional
Musculoskeletal Biomechanics ENGG410
This module will:
- Introduce biomechanics terminology and concepts
- Develop knowledge of biomechanics of tissues and structures of the musculoskeletal system (bone, cartilage, tendons, ligaments, skeletal muscle)
- Develop knowledge of biomechanics of joints (knee, hip, foot and ankle)
- Develop understanding of biomechanics of human movement.

Composite Materials MATS511
The aim of this project is:
- To identify the types of fibres and matrices commonly used in the manufacture of composite materials
- To investigate the manufacturing techniques commonly used to produce composite structures
- To identify the commonly used NDT techniques for composites
- To use micromechanics approaches and Classical Lamine Theory to study the mechanical response of composites.

Energy and the Environment MECH433
The aims of this module are:
- To give you an understanding of the advantages and disadvantages of alternative and conventional energy generation methods
- To develop detailed knowledge of wind, wave and solar energy capture
- To develop skills in quantitative analysis of energy generation methods
- To develop skills in dealing with complex problems in a systematic manner
- To develop ability in independent learning.

Finite Element Analysis MECH452
This module will enable you to:
- Develop an appreciation of the capabilities on modern finite element package in the analysis of a variety engineering problems
- Develop skills in interpreting and understanding the physical meaning of finite element results.

Laser Materials Processing MECH605
This module will provide you with an overview of the interaction of (high power) lasers with materials and their application in a selected range of established industrial processes, including: key features and properties of high power lasers, laser beam deployment, safety in high power laser use; laser process principles and practice for cutting, welding, marking, drilling and selected surface treatments.

Industrial Robotics and Automated Assembly MNFG409
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Design for Environment, Manufacture and Assembly MNFG413
The aim of this module is to provide an introduction to the tools and methods of Eco-design, Design for Manufacture and Assembly using real, everyday products as examples.

Computer Aided Design MNFG604
The aim of this module is to:
- Introduce the student to the latest 3D tools and techniques used by designers
- Develop a wider knowledge and understanding of integrated systems design
- Stimulate an appreciation of modern design and development methodologies.

Additive Manufacturing MNFG610
This module provides an overview on the role of additive manufacturing in new product development, develops your understanding on the principles and the complete process chain of additive manufacturing processes, and provides an awareness on recent developments in additive manufacturing and associated technologies.

Management of Design MNGT413
This module will enable you to develop a general understanding of a wide range of aspects of the design function in a manufacturing company and its management, and in particular a comprehensive understanding of the Design Process.

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Research Project
MSc Project ENGG660
On successful completion of the project, you should have developed a substantial and systematic knowledge and understanding of key aspects of the engineering or engineering-related topic of your project including the theory, recognised principles and best practice (as appropriate). Much of this knowledge will be at, or informed by, the forefront of defined aspects of the discipline.

You should also have developed a comprehensive knowledge and understanding of the experimental and theoretical techniques and research methodology appropriate to advanced study in your field.
Biomedical Engineering MSc (Eng)

Full-time
Programme length: 1 year

The growth of biomedical engineering is being driven by the demand for new treatments for diseases for the ageing worldwide population. It is the fastest growing engineering discipline worldwide, with a projected 72% increase in biomedical engineering jobs in the USA alone over the next 10 years.

The Biomedical Engineering MSc at the University of Liverpool is at the forefront of advancing these areas.

This MSc combines academic expertise from Engineering, Physics and the Faculty of Health and Life Sciences and offers the ideal opportunity to specialise in biomedical engineering and contribute towards the future development of artificial organs, medical devices and novel treatments.

This programme is suitable for graduates from engineering and physical science disciplines seeking to develop advanced specialist knowledge in biomedical engineering combined with essential research skills. It provides a strong background and advanced learning in the main biomedical engineering areas including biomechanics, imaging, tissue engineering and modelling.

This programme is fully accredited by the Institution of Mechanical Engineers.

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Optional

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Please note module information is correct at time of publication. However, modules are subject to change. Please check our website for the latest information.
Compulsory

Musculoskeletal Biomechanics ENGG410
This module will give students an understanding of the biomechanics of the musculoskeletal system and will cover techniques used to measure and analyse body movements as mechanical systems.

Cardiovascular Bioengineering ENGG411
In this module the behaviour of biofluids under flow will be studied with particular emphasis placed on the flow of blood ("haemodynamics"). In particular, blood flow in relation to cardiovascular prostheses and devices, including heart valves, cardiac assist devices, arterial bypass grafts, extracorporeal devices for haemodialysis and blood oxygenation will be explored.

Tissue Engineering ENGG412
This module provides an understanding of the role of surfaces in materials behaviour. The concept of surface engineering and thin films in optimising a biomaterial/implant/medical device is introduced. An overview of essential analytical techniques to characterise these surface modification and engineering techniques is provided. Furthermore, the module will develop an understanding of the need for enhanced control of material induced biological interactions and how we can utilise novel material development and engineering techniques to control biological responses from the “bottom-up” (controlled biological interactions), developing the next generation of smart-implantable medical devices. As well as presenting fundamental concepts that are relevant to real clinical situations the module explores the need for cost effective solutions and viable routes for scale up and translation.

Technical Writing for Engineers ENGG596
This module develops technical writing skills for support project planning.

Research Skills and Project Planning ENGG597
This module introduces techniques for project planning and the design of scientific experiments. The purpose is to prepare you for work undertaken in your MSc (Eng) projects and includes a literature survey on the subject of the project.

Structural Biomaterials MATS410
The aims of this module are to develop an advanced understanding of the structure and properties of materials used in medical devices.
In particular:
- How this relates to their application in medical devices
- How the interactions with the biological environment influences their structure and properties (eg degradation)
- How the surface properties of the materials influence the biointeractions and biocompatibility
- How the surface properties of the materials can be modified to enhance the biological interactions.

Computer Aided Design MNFG604
The aims of this module are:
- To introduce you to the latest 3D tools and techniques used by designers
- To develop a wider knowledge and understanding of integrated systems design
- To stimulate an appreciation of modern design and development methodologies.

Statistics PHYS809
This module provides a theoretical and practical understanding of key statistical principles. Students will develop knowledge of experimental errors and probability distributions and the ability to use statistical methods in data analysis.

Anatomy, Physiology and Biochemistry PHYS875
This module provides knowledge of the necessary physics and biological principles which underpin medical physics and clinical engineering.

Optional

Advanced Topics in Cell Signalling LIFE713
This module aims to:
- Illustrate the importance of cellular responses to external signals and how signalling information is transferred within cells
- Define, in detail, the range of different strategies used by cells for dealing with signalling information and the processing of signalling information
- Develop knowledge and deep understanding in biochemistry and biomedicine, and ability to apply, critically evaluate and interpret this knowledge to solve complex problems in cell signalling.

Smart Materials MATS515
This module introduces the concept of smart behaviour through integration of sensors and actuators at various length scales.

Finite Element Analysis MECH452
The aims of this module are:
- To develop an appreciation of the capabilities on modern finite element package in the analysis of a variety engineering problems
- To develop skills in interpreting and understanding the physical meaning of finite element results.

Advanced Manufacturing with Lasers MECH607
This module aims to provide an understanding of the principles of advanced manufacturing techniques using lasers and how these are being explored through current/recent research and adopted by industry.

Additive Manufacturing MNFG610
The aims of this module are:
- To provide an overview on the role of additive manufacturing in new product development
- To develop a generic understanding on the principles and the complete process chain of additive manufacturing processes
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Enterprise Studies MNGT414
The aims of this module are:
- To introduce you to various aspects of entrepreneurial activity
- To develop a knowledge and understanding of enterprise related concepts, legislation and current development tools
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Research Project MSc Project ENGG660
On successful completion of the project, you should have developed a substantial and systematic knowledge and understanding of key aspects of the engineering or engineering-related topic of your project including the theory, recognised principles and best practice (as appropriate). Much of this knowledge will be at, or informed by, the forefront of defined aspects of the discipline.

You should also have developed a comprehensive knowledge and understanding of the experimental and theoretical techniques and research methodology appropriate to advanced study in your field.
Product Design and Management MSc (Eng)

Full-time
Programme length: 1 year

The aim of this MSc programme is to provide advanced training in all major aspects of product design from conceptual design and product modelling to prototyping to a high level of competence. This programme will train you to develop reliable, high quality products with true market appeal, within the budgets and tight timescales demanded by competitive businesses.

You'll gain detailed expertise in product design's key concepts, tools and methodologies, including:
- Innovative product development and design techniques
- Advanced CAD/CAM and modelling
- Materials selection
- Industrial design
- Rapid prototyping
- Total quality management
- Marketing.

There's a strong practical element to the course and you'll develop your skills through individual and group projects, using facilities that include:
- CAD (ProE)
- CAM (Vericut, Machining Strategist)
- Rapid prototyping (3D Printing, FDM, SLM and vacuum casting)
- Reverse engineering (laser scanner and x-ray scanner).

As well as receiving excellent tuition from our world-renowned academics you'll be able to listen to visiting product designers and professors from the Royal Academy of Engineering talk about advanced concepts and case studies.

This programme is fully accredited by the Institution of Mechanical Engineers.

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Please note module information is correct at time of publication. However, modules are subject to change. Please check our website for the latest information.
Compulsory
Materials Processing and Selection MAT5520
This module will introduce you to the concepts of materials processing and selection and the criteria used in this process.
The broad scope of manufacturing and processing technologies for metals, ceramics and polymers will be introduced.
This will be followed by development of a deeper appreciation of the influence of processing upon the structure and properties of these materials.
Design for Environment, Manufacture and Assembly MNFG413
The aim of this module is to provide an introduction to the tools and methods of Ecodesign, Design for Manufacture and Assembly using real, everyday products as examples.

Computer Aided Design MNFG604
The aims of this module are:
- To introduce you to the latest 3D tools and techniques used by designers
- To develop a wider knowledge and understanding of integrated systems design
- To stimulate an appreciation of modern design and development methodologies.

Product Modelling and Virtual Reality MNFG608
This module provides a continuance to the subjects and topics covered in Product Design 1 and an opportunity to apply them to a detailed project. This module also includes an overview and introduction to the area of modelling and virtual reality in design on a practical level.

Product Design MNFG611
The aims of this module are:
- To provide a modern approach to new product development process especially on the early phase of design concept
- To stimulate the awareness of sustainability concept within the context of product life cycle
- To develop the analytical skills for multi-criteria product performance assessment.

Industrial Design MNFG614
The aims of the module are:
- To teach the basics of Industrial Design including drawing, graphical, presentation and design communication skills
- To detail the role the Industrial Designer plays in the development of a new or existing products
- To give an appreciation of the importance of human perception and anthropometrics with respect to the end use of a product.

Integrated Systems Design MNFG615
The primary aim of this module is to gain a practical appreciation of Integrated System Design (ISD) through the design, build and operation of free-standing mobile robots which will perform specific tasks. This module will give you the opportunity to work in teams; gain an understanding of what it means to plan and work through a project; work to deadlines; maximise resources; and cope with uncertainty.

Management of Design MNGT413
The aim of this module is to enable you to develop a general understanding of a wide range of aspects of the design function in a manufacturing company and its management, and in particular a comprehensive understanding of the Design Process.
The core of the module is a detailed study of a six-phase model of the Design Process derived from several authors and BS7000: Product Planning and Feasibility; Design Specification; Conceptual Design; Embodiment Design; Detail Design; Post-Design-Release.

Enterprise Studies MNGT414
The aims of this module are:
- To introduce you to various aspects of entrepreneurial activity
- To develop a knowledge and understanding of enterprise related concepts, legislation and current development tools
- To stimulate an appreciation of modern enterprise challenges and the importance of entrepreneurial activity in relation to organisational success.

Optional
Technical Writing for Engineers ENGG596
This module develops technical writing skills to support project planning.

Research Skills and Project Planning ENGG597
This module introduces techniques for project planning and the design of scientific experiments. The purpose is to prepare you for work undertaken in your MSc (Eng) projects and includes a literature survey on the subject of the project.

Advanced Manufacturing with Lasers MECH607
This module aims to provide an understanding of the principles of advanced manufacturing techniques using lasers and how these are being explored through current/recent research and adopted by industry.

Additive Manufacturing MNFG610
The aims of this module are:
- To provide an overview on the role of additive manufacturing in new product development
- To develop a generic understanding on the principles and the complete process chain of additive manufacturing processes
- To provide an awareness on recent developments in additive manufacturing and associated technologies including reverse engineering.

Project Management MNGT502
The aim of this module is to introduce you to some of the tools and constraints associated with managing both small and large projects, and with some simple costing approaches. A virtual project is undertaken by every student.
You are encouraged to adopt a project approach to current and future tasks, to learn the language adopted by project-oriented employers and to analyse the positive and negative aspects of project management.

Research Project
MSc Project ENGG660
On successful completion of the project, you should have developed a substantial and systematic knowledge and understanding of key aspects of the engineering or engineering-related topic of your project including the theory, recognised principles and best practice (as appropriate). Much of this knowledge will be acquired informally, by the forefront of defined aspects of the discipline.
You should also have developed a comprehensive knowledge and understanding of the experimental and theoretical techniques and research methodology appropriate to advanced study in your field.
Risk and Uncertainty MSc (Eng)

Full-time
Programme length: 1 year

This MSc aims to provide you with the theoretical and practical tools, along with professional and research skills, necessary to understand, model and tackle the major problems that arise from the complexity of systems which demand decision-making under Risk and Uncertainty.

The association of this programme to the Liverpool Institute for Risk and Uncertainty gives you the opportunity to learn from and interact with a truly multidisciplinary team of academics. Additionally, due to the strong links with industrial partners, you will be exposed to the knowledge of professionals who deal with risk and uncertainty from an industrial perspective. You will not only be taught through the traditional interaction with lecturers, but also:
- Master classes from academics and industry experts
- A Master class with industrial experts
- An Easter school with academic and industrial experts
- Group work tasks
- Individual project activities.

The programme provides a unique opportunity in the UK for training professionals and graduates who are able to communicate across the boundaries of the traditional disciplines; eg architecture, computer science, engineering, environmental sciences, finance, law, management, mathematics, psychology and social sciences. Those trained in this way will be able not only to enumerate the risks associated with a particular activity or process, but also to express clearly the meaning of the risk to the general public and decision-makers. As such, they will be able to cross the traditional divide between mathematical intricacy and explanation in common language.

Graduates from this MSc will gain high-level competencies for employment with organisations, such as industrial companies, environmental science bodies, consultancies and financial institutions, which are currently developing, or already have in existence, in-house units focusing on Risk and Uncertainty.

The required modules are divided according to the following three aspects of educational content:
- A comprehensive appraisal of risk and uncertainty from the point of view of different disciplines
- The underlying theoretical and computational tools
- Research skills necessary to complete the final project.

The optional modules are provided by all participating Schools involved in the Institute for Risk and Uncertainty, and include multidisciplinary learning material. Academic guidance will be provided to students along with monitoring of their choices to ensure they gain the most from the programme given their background.

This 12-month course runs from September and consists of a taught component and a dissertation, totalling 180 credits.

The taught component represents 120 credits and is organised into two 12-week semesters, with assessment or examinations at the end of each semester in January and May. The remaining 60 credits are allocated to the applied research project dissertation.

Assessment is by a combination of: examinations, coursework, teamwork, assessed field work, presentations and an individual dissertation.

You may also be interested in our Big Data and High Performance Computing MSc, Geographic Data Science MSc and Big Data Management MSc. For more information visit www.liverpool.ac.uk/study/postgraduate

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Research Project
ENGG660 MSc Project | 60 | Summer | 0.100 |

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Compulsory
Quantitative and Qualitative Perspectives of Risk RISK623
This module provides you with an introduction to the range of quantitative and qualitative methods/approaches used in the decision-making of Risk and Uncertainty. It is given from a diversity of discipline perspectives, Architecture, Computer Science, Engineering, Environmental Sciences, Finance, Law, Management, Mathematics, Psychology and Social Sciences, delivered mainly through a series of weekly ‘master class’ teaching sessions. The content focuses on theoretical principles, along with aspects of real-world application. This draws from connections made by University of Liverpool academic presenters to their collaborations with a variety of external/industrial partners, those associated with the Liverpool Institute of Risk and Uncertainty (LIRU) and the Centre for Doctoral Training (CDT) in Risk and Uncertainty.

Risk and Uncertainty: Probability Theory ENGG404
This essential module aims to provide students with a rigorous understanding of basic probability theory. It will equip students with the theoretical tools necessary for the modelling and numerical implementation of solutions to problems that involve decision under uncertainty. The module involves the quantification of uncertainties in the input and modelling, their implementation and the evaluation of the associated results in view of decision making. An introduction to numerical concepts is provided and methods provide understanding of probabilistic modelling and uncertainty quantification.

Risk and Uncertainty: Numerical Applications ENGG403
The module presents the state-of-the-art in numerical methods and simulation for uncertainty quantification and risk management. Particular focus is on the assessment of components, structures and systems. The methods shown in the module have a general applicability, which is demonstrated by examples and practical applications. It also provides the evaluation of the associated results in view of engineering decision making.

Research Skills and Project Planning ENGG599
This module introduces techniques for project planning and research skills. The purpose is to prepare you for work undertaken in your MSc(Eng) projects and includes a literature survey on the subject of the project.

Technical Writing for Engineers ENGG596
This module develops technical writing skills to support project planning.

Advanced Modern Management MNGT352
The aims of this module are:
- To introduce you to various aspects of advanced modern management
- To develop a knowledge and understanding of modern management tools
- To stimulate an appreciation of management and its importance in organisational success.

Enterprise Studies MNGT414
The aims of this module are:
- To introduce you to various aspects of entrepreneurial activity
- To develop a knowledge and understanding of enterprise related to concepts, legislation and current development tools
- To stimulate an appreciation of modern enterprise challenges and the importance of entrepreneurial activity in relation to organisational success.

You should have also developed a comprehensive knowledge and understanding of the experimental and theoretical techniques and research methodology appropriate to advanced study in your field.

Optional
Design of Safety Critical Systems and Computational Inference ENGG406
As a complement to Risk and Uncertainty: Probability Theory (ENGG404) and Risk Uncertainty: Numerical Applications (ENGG403), this module introduces more advanced Monte Carlo methods. Importance sampling, Markov Chain Monte Carlo and subset Simulation are studied in depth. In particular, students are introduced to techniques used for the analysis and design issues of safety-critical systems. Industrial standard qualitative and quantitative approaches will be analysed in order to manage risk, eliminating or reducing the frequency of failure to an acceptable level.

Introduction to Project Management ARCH408
This module aims to:
- Cover basic theory, methods and techniques of the conventional project-life-cycle approach to Project Management
- Relate the above to real-life situations encountered in projects
- Introduce students to the ideas embodied in various alternative perspectives on the nature of Project Management.

Project Risk Management ARCH409
This module aims to:
- Extend your knowledge of project risk management beyond that introduced in the module Introduction to Project Management
- Consider more sophisticated models of risk management and their application
- Explore the use of software in the analysis of risk and uncertainty
- Consider the implications of novel perspectives on project management for the management of risk and uncertainty.

Privacy and Security COMP522
The aims of this module are:
- To introduce you to the major problems and solution approaches in the area of computer and Internet privacy, confidentiality and security
- To provide a theoretical framework for subsequent research in these challenging areas.

Safety and Dependability COMP524
This module will:
- Provide a critical and in-depth understanding of all aspects of software safety and dependability; including issues relating to security, reliability and trustworthiness
- Provide a broad understanding of the state-of-the-art software engineering techniques currently used to address safety and dependability issues
- Provide an overview of the contemporary research issues relating to software safety and dependability.

Data Mining and Visualisation COMP527
This module provides an in-depth, systematic and critical understanding of some of the current research issues at the forefront of the academic research domain of data mining.

Big Data Analysis COMP529
The aim of this module is to:
- Introduce the student to middleware often used in Big Data analytics
- Introduce the student to implementing algorithms using such middleware.

Financial Risk Management ECON809
This module aims to train you in evaluating, measuring and managing a range of financial risks to which companies are exposed. Particular emphasis is placed on the measurement and management of market risks, cash flow risks, interest rate risks and credit risks. The module also includes a brief discussion of recent issues on risk management (subprime crisis, the role of risk management failures etc).

Portfolio Management ECON923
This module will allow you to understand and appreciate the basic notions underlying the management and selection of efficient portfolios. Special emphasis should be given to notions of efficiency and the discussion of selection criteria.

Research Project MSc Project ENGG660
On successful completion of the project, you should have developed a substantial and systematic knowledge and understanding of key aspects of the engineering or engineering-related topic of your project including the theory, recognised principles and best practice (as appropriate). Much of this knowledge will be at, or informed by, the forefront of defined aspects of the discipline.

You should also have developed a comprehensive knowledge and understanding of the experimental and theoretical techniques and research methodology appropriate to advanced study in your field.
Business and the Environment ENVS470
This module aims to:
- Explore the relationships between business and the new environmental agenda
- Develop an understanding of the benefits of a positive approach to environmental management for business
- Develop an understanding of the processes involved in developing environmental management systems for businesses.

Human Impacts on the Environment ENVS485
The aim of this module is to provide you with:
- The opportunity to conduct in-depth research on a chosen topic within the broad theme of human impacts on the environment
- Training in research methods and critical analysis techniques
- The ability to present the results in the form of a high impact, high quality poster.

Techniques in Environmental Planning and Management ENVS529
This module provides for a comprehensive overview of the theory and practice of strategic environmental assessment of policies, plans and programmes and of environmental impact assessment of projects.

Geographical Information Systems ENVS563
The module will enable you to:
- Develop a theoretical knowledge of GIS
- Develop a practical ability to apply GIS in the handling and analysis of spatial data
- Build an understanding of how and why GIS may be useful in geography, planning, and other disciplines.

Research Methods and Statistics PSYC640
The aim of this module is to:
- Highlight the importance of research and professional ethics in psychology
- Broaden your understanding of the range of quantitative and qualitative psychological research methods available to you
- Familiarise you to the concepts, underlying principles and general purposes of basic and advanced data analysis techniques in psychology.

Advanced Statistics and Methods PSYC643
The module aims to introduce you to the concepts, underlying principles, and general purpose of a range of advanced data analysis techniques, both quantitative and qualitative. You will learn how to conduct a selection of these analyses using different software packages during supervised Statistical Practical sessions.

Assessment, Mitigation and Communication of Risk RISK622
This module will:
- Provide you with a range of theoretical paradigms relevant to industry, retail, management, security, law enforcement and defence processes (including decision-making, leadership and communication)
- Introduce you to both traditional and naturalistic paradigms and the recent research that synthesises the two (dependent on time pressure, stress and context)
- Introduce you to differences in ‘sender’ messages and ‘receiver’ perceptions, to the psychology of framing risks and understanding probabilities
- Introduce you to the mechanisms by which high-reliability organisations can more effectively and accurately transmit messages about risk (especially low risk, high consequence messages).

Probabilities Essential for Financial Calculus MATH480
This module will:
- Equip you with the essential probabilistic concepts, to be used further in advanced stochastic and financial calculus
- Equip you with the understanding of measure theory, probability measures and integration with respect to probability measures
- Acquaint you with random variables, sums of random variables, central limit theorem and law of large numbers
- Give you the ability to analyse the different type of convergences of random variables
- Introduce you to the concepts of conditional expectation, martingale and stopping times, building blocks of applied probability.

Stochastic Modelling in Finance MATH482
This module aims at demonstrating the advanced mathematical techniques underlying financial markets and the practical use of financial derivative products to analyse various problems arising in financial markets. Emphases are on various option pricing formulae, hedging methods, and stochastic analysis.
I chose to do a postgraduate degree at Liverpool because I was already an undergraduate student here. The academic staff are really good and helpful with the students; that’s the most important thing for me. When I want help I can go straight to the lecturer and they’ll help me.

My advice to anybody considering postgraduate study is don’t hesitate to get involved. At the end of your course you will be a more confident person and your personal investment of time and finance will certainly pay off.

Petros Tsamatropoulos
Sustainable Civil and Structural Engineering MSc (Eng)
Sustainable Civil and Structural Engineering MSc (Eng)

**Full-time**
Programme length: 1 year

**Part-time**
Programme length: 2 years

With the ever increasing environmental challenges, there is strong demand for civil and structural engineers who are practically-skilled in efficient design, green construction and sustainable development and who can play a central role in achieving sustainable adaptation to and mitigation of these challenges.

The Sustainable Civil and Structural Engineering MSc programme provides a specialist, technical master’s-level education in civil and structural engineering.

The programme is designed to embed the knowledge, skills and understanding required to critically assess the function, use and impacts of concrete, steel and alternative construction materials in structural designs and to participate in the design, implementation and evaluation of engineering projects which are truly sustainable, bringing social, economic and environmental benefits to current and future generations.

The Sustainable Civil and Structural Engineering MSc provides an opportunity for you to develop advanced specialist knowledge in structural engineering, understand how to address the increasing challenges for the industry and develop your skills for the working environment.

The programme is pending accreditation by the Institution of Civil Engineers, the Institution of Structural Engineers, the Chartered Institution of Highways and Transportation and the Institute of Highway Engineers.

This programme can also be studied part-time over two years. The same modules are followed and the same total credits are achieved, but these are spread over four semesters at 30 credits per semester. The independent research project (module ENGG660) is chosen in the first year, but the completion deadline is not until the end of the second year, allowing flexibility in timing and distribution of effort over the full duration of the course.

Programme Outline
The modules focus on sustainability and durability of construction, whilst exploring in depth the influences and impact that climate change has on building and water related environments.

Compulsory
Materials for Durable and Sustainable Construction CIVE401
The aim of the module is to enhance your knowledge and understanding of the advances made in conventional construction materials and alternative construction materials that have and are currently being developed for use in construction to achieve more innovative, and sustainable structures.

Structural Systems CIVE405
The module is designed with particular emphasis on learning design, safety considerations and environmental impact of structural decisions.

Bridge Engineering CIVE441
The aims of this module are to:
- Introduce you to the concepts and procedures involved in the design of modern bridge structures
- Ensure that you are aware of the limitations in terms of structural form, geometric alignment, material choice, structural analysis and the design for long-term durability
- Introduce you to the relevant Eurocode codes of practice and their use in the geometric and structural design of bridges.

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**Structural Steelwork, Timber and Masonry CIVE444**  
The aims of this module are:  
- To introduce you to the basic behaviour of various forms of steel structures, timber structures and masonry structures  
- To ensure that you are aware of the limitations of each material  
- To introduce you to the relevant Eurocode codes of practice and their use in structural design.

**Tackling Environmental Issues ENVS471**  
This module will promote independent thinking, critical insights, leadership, teamwork and a sound understanding of environmental issues that affect local, national and international governance. It will enable you to develop the skills to research a key environmental issue, showing a good grasp of what is required in terms of synthesising the relevant information in an objective and robust manner and communicating this at the right level for both a consultancy report and a policy brief.

**Technical Writing for Engineers ENGG596**  
This module develops technical writing skills to support project planning.

**Research Skills and Project Planning ENGG597**  
This module introduces techniques for project planning and the design of scientific experiments. The purpose is to prepare you for work undertaken in your MSc (Eng) projects and includes a literature survey on the subject of the project.

**Optional**  
**Construction Management CIVE345**  
The overall aim of this module is to introduce you to various aspects of construction management with a particular focus on practice in the UK. You will develop a knowledge and understanding of modern management tools as applied in construction, and gain an appreciation of management and its importance in the success of construction projects.

**Foundation Engineering CIVE422**  
This module will ensure that the specialist structural engineer has adequate knowledge relating to foundation design. The module includes advanced topics in Soil Mechanics and deals with reinforced concrete design of foundations and soil/structure interaction including simplified methods of assessing the effects of earthquake forces.

**Advanced Construction Management CIVE445**  
This module aims to:  
- Develop your awareness of professional practices in construction management  
- Develop your knowledge and understanding of strategic and life-cycle approaches to management  
- Stimulate an appreciation of construction management's role in creating new business and opportunities.

**Environmental Site Assessment CIVE449**  
The aim of this module is:  
- To introduce you to the structure and purposes of environmental assessments for contaminated land, including the drivers of the regulatory and legislative frameworks which enforce them  
- To gain technical and conceptual understanding of the range of environmental sources, pathways and receptors, and the major remediation technologies available to engineers in the appropriate management of environmental hazards and impacts  
- To develop the ability to critically compare environmental assessment practices demanded by different regulatory regimes, eg different national jurisdictions or sites with known special issues (acid tars; nuclear, etc).

**Research Project**  
**MSc Project ENGG660**  
On successful completion of the project, you should have developed a substantial and systematic knowledge and understanding of key aspects of the engineering or engineering-related topic of your project including the theory, recognised principles and best practice (as appropriate). Much of this knowledge will be at, or informed by, the forefront of defined aspects of the discipline.  
You should also have developed a comprehensive knowledge and understanding of the experimental and theoretical techniques and research methodology appropriate to advanced study in your field.

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### Part-Time**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Title</th>
<th>Credit Value</th>
<th>Semester</th>
<th>Exam: CW (Course Work)</th>
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</thead>
<tbody>
<tr>
<td><strong>Compulsory</strong></td>
<td><strong>Year 1</strong></td>
<td></td>
<td></td>
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<tr>
<td>CIVE401</td>
<td>Materials for Durable and Sustainable Construction</td>
<td>15</td>
<td>2</td>
<td>70:30</td>
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<tr>
<td>CIVE405</td>
<td>Structural Systems</td>
<td>15</td>
<td>1+2</td>
<td>90:10</td>
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<tr>
<td>CIVE422</td>
<td>Foundation Engineering</td>
<td>15</td>
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<tr>
<td>ENGG596</td>
<td>Technical Writing for Engineers</td>
<td>7.5</td>
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<tr>
<td>ENGG597</td>
<td>Research Skills and Project Planning</td>
<td>7.5</td>
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<tr>
<td><strong>Compulsory</strong></td>
<td><strong>Year 2</strong></td>
<td></td>
<td></td>
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<tr>
<td>CIVE441</td>
<td>Bridge Engineering</td>
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<tr>
<td>CIVE444</td>
<td>Structural Steelwork, Timber and Masonry</td>
<td>15</td>
<td>2</td>
<td>85:15</td>
</tr>
<tr>
<td>ENVS471</td>
<td>Tackling Environmental Issues</td>
<td>15</td>
<td>2</td>
<td>0:100</td>
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<tr>
<td><strong>Optional</strong></td>
<td></td>
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<tr>
<td>CIVE345</td>
<td>Construction Management</td>
<td>7.5</td>
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<td>CIVE445</td>
<td>Advanced Construction Management</td>
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<td>CIVE449</td>
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<tr>
<td><strong>Research Project</strong></td>
<td></td>
<td>60</td>
<td>Summer</td>
<td>0:100</td>
</tr>
</tbody>
</table>

**Part-time students select their project and supervisor during ENGG597 in Year 1, then have flexibility to spread the 600 hours' effort on ENGG660 over the rest of the two-year programme.**

Please note module information is correct at time of publication. However, modules are subject to change. Please check our website for the latest information.
Postgraduate Taught Programmes – London Campus

Advanced Transdisciplinary Design MSc

Full-time
Programme length: 1 year

Part-time
Programme length: 2 years

This programme equips you with the digitally driven design skills that organisations across the globe are now seeking from their designers, engineers, architects and managers.

Visiting lecturers from leading design practices and industry will contribute to the programme as guest lecturers, with current research, and demonstrating real-life case studies.

Programme Outline

This unique programme pioneers a collaborative transdisciplinary approach between Architecture and Industrial Design disciplines sharing a design ethos and methodology whilst exploring the similarities and differences in a collaborative studio environment.

Leading UK industry is relying on Virtual Engineering to drive competitiveness in an increasingly tough global market. The dramatic change in practices within organisations to be digitally driven in the future requires a wider approach to design and fresh business models. To capitalise on this, it is critical for future and existing Designers and Managers to have the skills this programme provides.

The programme is a collaboration between the schools of Architecture and Engineering that brings together the best of design teaching from different professions; from Industrial and Product Design to Architecture, alongside facilities at the technological forefront of digital design including Virtual Engineering, Virtual Reality and Rapid Prototyping.

Programme Outline

This unique programme pioneers a collaborative transdisciplinary approach between Architecture and Industrial Design disciplines sharing a design ethos and methodology whilst exploring the similarities and differences in a collaborative studio environment.

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The programme is a collaboration between the schools of Architecture and Engineering that brings together the best of design teaching from different professions; from Industrial and Product Design to Architecture, alongside facilities at the technological forefront of digital design including Virtual Engineering, Virtual Reality and Rapid Prototyping.

The programme also links the knowledge and experience held by industry partners with the University’s research strengths. With a history of new product development initiatives dating back to the 1990s, and drawing on its substantial developments in Virtual Engineering, the University is well placed to harness knowledge, expertise and networks that have been developed over recent years.

This programme draws on the knowledge, expertise and networks that have been developed within the University as part of the Virtual Engineering Centre (VEC). More information on the VEC can be found on page 26 or at www.virtualengineeringcentre.com

This programme offers a semester at our campus in China, Xi’an Jiaotong-Liverpool University.

<table>
<thead>
<tr>
<th>Module Title</th>
<th>Credit Level</th>
<th>Semester</th>
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<tbody>
<tr>
<td>Presenting Design Research</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Design Project 1</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>Managing New Product Development</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Digital Design and Simulation Technologies</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>User-Centred Research and Design</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Design Appreciation 1</td>
<td>15</td>
<td>1</td>
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<tr>
<td>Research Methodology</td>
<td>15</td>
<td>2</td>
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<tr>
<td>Design Project 2</td>
<td>15</td>
<td>2</td>
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<tr>
<td>Innovation and Entrepreneurship</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Group New Product Development Project</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Design Appreciation 2</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Thesis (Dissertation, Research by Design or Design)</td>
<td>60</td>
<td>Summer</td>
</tr>
</tbody>
</table>

Please note module information is correct at time of publication. However, modules are subject to change. Please check our website for the latest information.
Presenting Design Research
The aims of this module relate to the skills and techniques needed to undertake the three elements required to make a seminar paper presentation and a conference poster presentation. You will develop techniques used in writing a paper abstract that convey ideas clearly and concisely; discuss how to present research information and ideas clearly to an audience using the spoken word and relevant technology and develop techniques to present research information and ideas clearly in the form of a conference poster.

Design Project 1
The module aims to engage you critically with a current design topic and through research and tutorials undertaken both in groups and individually, develop a design for a given topic or brief. You will submit drawings, written reports and models that are presented to a review panel made up of staff and other students for open forum discussion.

Managing New Product Development
Through this module, you will be exposed to management principles, methods and techniques that are effective in new product design and development projects. The importance of proper management to strategic, organisational and project success is emphasised. You will be able to apply what you have learned to the management of your group and individual project modules.

Digital Design and Simulation Technologies
This module seeks to raise your awareness and skills in the realm of digital design, visualisation and simulation. You will examine and participate in digital design workflows, from ideation to final presentation, with particular emphasis on hardware and software that can support low-fidelity and/or high-fidelity modeling, whether on-screen or in immersive environments.

User-Centred Research and Design
Through this module, the main philosophies and advantages of user centred design thinking and decision making will be introduced. You will be guided through the pivotal process of researching and eliciting user needs, formulating user requirements, and creatively translating requirements into design proposals. Practical exercises will be set, which may include but not be limited to: ethnographic research, user testing and observation, and participatory design.

Design Appreciation 1
This module aims to engage you critically, particularly if you are not from an architectural background, with current architectural theory and/or practice. The individually chosen project may be an opportunity to form links with other related disciplines.

Research Methodology
This module examines key skills needed to prepare a written dissertation in architecture. It consists of a series of lectures, seminars and exercises, and presentations about your own research and dissertation preparation and methods, with the overall aim of assisting you to select, define and launch your dissertation project.

Design Project 2
This module aims to engage you critically with a current architectural topic and through research and tutorials undertaken both in groups and individually, to develop a design for a given topic or brief. The module builds on the semester 1 module ‘Design Project 1’ and is concerned with designing in an urban environment. It may also use collaborative design elements with either the Liverpool MA Architecture students and/or another non-UK university.

Innovation and Entrepreneurship
Through this module, links between design as ideation and design as a commercial and market necessity will be explored. You will develop understanding of critical differences between routine design and innovation, alongside the role of trends, forecasting and scenario building. A practical entrepreneurial activity will be set, based around design intervention for an identified need or opportunity.

Group New Product Development Project
This module gives you the opportunity to work together on a challenging industry initiated design brief that combines problem-finding activities at the ‘fuzzy front end’ of design, with ideation and problem-solving activities that are necessary ‘further downstream’. It is anticipated that digital simulation as well as rapid prototyping will be used to communicate interim and finalised design proposals.

Design Appreciation 2
Building on ‘Design Appreciation 1’, you will critically research the design methods and designs of an individually chosen architect or designer. By using available library resources and, where possible, visiting realised designs, you will gain a deeper critical understanding of your chosen subject.

Thesis (Dissertation, Research by Design or Design)
A primary aim of this module is to offer the opportunity to submit a conventional written dissertation or to submit a design thesis with supporting documentation on an approved topic or brief of your choice. The second of these alternatives responds to current research agendas in the field of design, and in particular the idea of Design as Research. It is expected that the majority of students will work individually but, with the prior agreement of the Programme Director, students undertaking a Design or Research by Design Thesis may be permitted in pairs where the project is of sufficient complexity. Thesis projects may be in one of three forms, a Design Thesis, a written dissertation or Research by Design.
Postgraduate Research Opportunities – Liverpool Campus

Engineering PhD

Full-time
Programme length: 2-4 years

Part-time
Programme length: 4-7 years

Engineering MPhil

Full-time
Programme length: 1-4 years

Part-time
Programme length: 2-6 years

E: pgeng@liverpool.ac.uk

www.liverpool.ac.uk/engineering

The Centre for Doctoral Training (CDT)

If you are considering a PhD, our Doctoral Training Schemes offer you extraordinary training opportunities, as well as excellent links and career prospects with leading industry partners. Each scheme has been competitively won from The Engineering and Physical Sciences Research Council (EPSRC), The Economic and Social Research Council (ESRC), and The Natural Environment Research Council (NERC). You would enjoy a rigorous, but supportive and vibrant academic environment, working with academics at the forefront of their field. You will also receive strong industrial support, with access to state-of-the-art facilities as well as innovative skills and training to prepare you for the world of work. While funding is only available to UK and EU students, we welcome international students and have a variety of support options for international applicants. Our CDT schemes include:

- Global Risk and Uncertainty in Complex Systems and Environments
- Next Generation Nuclear
- Additive Manufacturing and 3D Printing
- New and Sustainable Photovoltaics
- Fusion Energy
- Understanding the Earth, Atmosphere and Ocean
- North West Doctoral Training Centre
- Adapting to the Challenges of a Changing Environment (ACCE)
- Global Eco-Innovation

E: pgeng@liverpool.ac.uk

www.liverpool.ac.uk/engineering

Personal Development Record (PDR)

All research students are required to complete an online Personal Development Record that documents their formal meetings with their supervisors, their skills development and their record of training and generic activities. The Personal Development Record is an online tool that allows you to capture and monitor your own progress throughout your PhD. The PDR follows Quality Assurance Agency and Research Council guidelines that students should complete a programme of personal development planning. The PDR is a required part of the skills programme for all PhD and MPhil students. It is possible to gain exemption from some of the required and optional training components if you already have the appropriate skills.

E: pgeng@liverpool.ac.uk

www.liverpool.ac.uk/engineering

For further details of staff research interests, please contact the relevant staff member via E: pgeng@liverpool.ac.uk

Visit www.liverpool.ac.uk/science-and-engineering/postgraduate-research/doctoral-training/ for more information.
Research Centres

The School of Engineering has four main research centres. These centres have brought together a shared research interest that, with a wealth of expertise in all engineering disciplines, has developed research in some of the most challenging technical areas facing the human race. Initiatives are developing and becoming world leaders in areas such as additive and subtractive manufacturing, environmental engineering, risk and uncertainty and bioengineering, reflecting the new dynamism which is evident in the School.

Centre for Materials and Structures

One of the major challenges facing us is to provide the engineering materials and infrastructure to support the needs of a changing society in an economic, environmentally responsible and sustainable way. The infrastructure for transport, energy production and the built environment require advanced materials and engineering to meet these grand challenges. The Centre for Materials and Structures (CMS) is focused on delivering outstanding research and development to meet these needs.

The establishment of CMS brings together academics researching nanostructured functional materials; structural materials and mechanics for optimum structural design, explosion resistance and impact loading; materials degradation at high temperatures; manufacturing and lasers; construction and infrastructure.

CMS is well equipped with state-of-the-art facilities in materials characterisation, synthesis and processing with investment in capital equipment totaling over £8 million. Some of the significant strengths in the centre’s facilities include:

- A suite of electron microscopes in Liverpool and the SuperSTEM project led by CMS at Daresbury Laboratory, equipped with two sophisticated scanning transmission electron microscopes. These resources enable academic researchers and industry to understand materials and manufacturing processes at the atomic scale.
- The Laser Group at Liverpool is one of the UK’s largest University based research groups in laser materials processing. The facilities at Liverpool provide state-of-the-art high power laser equipment for the research and industrial development of welding, cutting, marking, surface treatments, micro machining and novel laser based processes.
- The Royal Society – Wolfson Foundation Nanotechnology clean room houses modern manufacturing facilities for the development of nanostructured materials. Examples of technological applications of these materials include energy saving architectural glazing, solar cells and information technology amongst others.
- The Impact Research Centre was founded in 1985 in order to integrate several disciplines, which contribute to our understanding of those problems involving the large dynamic loading response and failure of materials and structures that occur throughout the field of engineering. Recently, research has focused on lightweight structures, including the use of composites and cellular materials (including the use of additive layer manufacture).
- A new Ocular Biomechanics laboratory supporting the development of understanding and devices related to the eye, in collaboration with a large clinical activity in the Faculty of Health and Life Sciences.
- A Civil Engineering testing laboratory for assessing construction materials that is one of the best equipped in the UK.
- A new Experimental Mechanics Laboratory with instrumentation for measuring deformation and strain in laboratory specimens and engineering components of various scales in static, cyclic and dynamic loading conditions. Measurement techniques that can be deployed include digital image correlation, thermoelastic stress analysis, electronic speckle pattern interferometry and more.
- A new suite of multidisciplinary tissue engineering and biomaterials laboratories that enables the physical, chemical, mechanical and biological design, production and characterisation of novel materials for implantable devices, designed to repair and replace naturally occurring tissue. This activity has strong links with a vast array of groups in health and life sciences, physics, chemistry and industry at local, national and international levels.
- Nanomechanics Lab – a new nanomechanics lab has also been established in the Centre for Materials and Structures. The lab houses a state-of-the-art nanoindentor and atomic force microscope providing the ability to characterise a range of materials at the micro and nano level.

CMS supports synergistic research to exploit engineering materials across a diverse range of infrastructure. CMS’s outward facing multidisciplinary research is exploitable by the other Centres within the School of Engineering, the wider Faculty of Science and Engineering and beyond. The grand challenges facing materials for the future, as outlined above, are clearly recognised as prioritised areas for future funding by EU Framework (FP7), EPSRC and TSB. It is recognised that much of the work required is by its nature interdisciplinary.

Visit www.liverpool.ac.uk/engineering/research/materials-and-structures/ for more information.
Centre for Engineering Dynamics

The Centre is concerned with the mathematical modelling, experimentation, testing and control of dynamic systems (specifically associated with vehicles, fluids and structures). Increasingly sophisticated techniques are needed for energy-efficient and lightweight engineering solutions, which depend upon deep scientific understanding of nonlinear phenomena, the treatment of modelling and experimental uncertainty, and improvements in precision and performance available through feedback control. Research of two types is required: fundamental advances in the understanding of physical processes and the exploitation of these advances towards applications, typically through multidisciplinary studies. The development of strength in both of these areas, and their connection, is critical to the success of the centre.

The Centre has excellent computational resources for (CFD) Computational Fluid Dynamics, a first-class dynamics and control laboratory, large-scale rope and channel flow facilities, research quality flight simulators and a high specification water channel.

Virtual Engineering Centre

The Virtual Engineering Centre is establishing case studies in the application of virtual engineering and is developing many links with industry. The topic of aeroelasticity is a particular strength in the Centre, with collaborations with companies such as Airbus, BAE SYSTEMS and Stirling Dynamics, and many academic institutions around the world. Theoretical research on nonlinearity ranges from the phase-plane to large-scale engineering systems, and arises from diverse problems in aerodynamics and combustion, structural dynamics, flight dynamics and aeroelasticity. Nonlinear systems are inherently more uncertain than linear systems, may contain discontinuities and bifurcations and may enter limit cycles or become chaotic. The methodology for the treatment of uncertainty, based on probabilistic, perturbation and interval techniques, is applicable across the range of activities of the Centre, and is an active area for research.

Active feedback control is increasingly an essential requirement for dynamic system performance. Robustness to uncertainty is mostly based on deterministic methods, but much greater understanding of the effects of uncertainty is achievable by the application of stochastic analysis methods, for example in flight control, active vibration control (including moving-load problems) and control of complex fluid flows over compliant surfaces, flow separation and vortices.

Virtual engineering involves the exploitation of computer simulations to develop new engineering concepts and reduce project risk. The centre includes research expertise in developing new approaches to computer simulations, and is developing research expertise in treating uncertainty. There is significant potential for developing methodology for simulations into a wider range of systems relevant to design and manufacturing.

Visit www.liverpool.ac.uk/engineering/research/vec for more information.

Centre for Engineering Sustainability

It is generally acknowledged that global society faces unprecedented environmental challenges over coming decades. Climate change is the focus of most current debate and there is now unilateral agreement that greenhouse gas inputs into the atmosphere from anthropogenic activity must be reduced drastically if increased occurrence of natural hazards, such as drought, flood and typhoon, are to be avoided. There remains, however, a severe lack of appreciation of the unsustainability of ‘business as usual’ in a world with pressures for ever greater consumption of goods and services by an increasing and rapidly urbanising global population, which is expected to rise by almost 50% to more than 9 billion by 2050.

Living within environmental limits needs to become the new paradigm. Finite raw material resources and fossil fuel reserves are becoming depleted, some at alarming rates. Water resources to satisfy global thirst, irrigation for food/fodder and for product manufacture are rapidly becoming over-exploited, and environmental and ecological issues arise as a result. More fundamentally, the underlying dependence of modern ways of living, in our ‘consumer society/material world’, upon levels of energy availability far exceeding the technological capability of renewable sources represents a potential catastrophe within a human lifetime as fossil reserves decline.

Whilst this is a problem extending to many disciplines, the engineering challenge is: to use less material resource (reduce, reuse and recycle waste); to maximise efficiency in supply of goods and services (ie manufacturing, construction and utilities like transport and water/gas/electricity distribution), so as to minimise energy consumption; and to displace fossil fuels with renewable sources in electricity, transport and heating provision. By this means to mitigate climate change through greenhouse gas reductions, but also to help society adapt to the effects of temperature change already in train.
Within the School of Engineering, themes of activity contributing to this challenge are underway:

- **Low energy materials for the transport infrastructure** – use of waste, recycled and secondary products in road construction; sustainable asphalt materials; structural use of sustainable timber

- **Manufacturing** – products and production systems using minimal raw materials, waste products and energy (electricity, heat and fossil fuel) consumption

- **Renewable Energy** – tidal energy resource evaluation (barrages/lagoons and free-stream arrays), with the National Oceanography Centre (NOC); impacts of marine energy extraction; tidal-stream device assessment under realistic environmental loading; wave climates and their energy potential

- **Maritime, Environmental and Water Systems** – adapting to climate change and sea level rise: catchment hydrology and water resources; the geo-environment and water quality, coastal zone management including wave/tide motions, beaches and sea defences and marine pollution.

Other contributions to engineering sustainability, and levels of overlap with CES, can be expected from the Centre for Materials and Structures – new materials with lower embedded energy/carbon footprint; Centre for Engineering Dynamics; mechanical performance of wind, tide or wave energy conversion devices and improved efficiency in conventional engine technology. Attention is now being paid to identifying and exploiting opportunities that lie in collaboration with the School of Environmental Sciences, and interest from prospective students in joint projects is particularly welcome.

Visit [www.liverpool.ac.uk/engineering/research/engineering-sustainability](http://www.liverpool.ac.uk/engineering/research/engineering-sustainability) for more information.

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**The Institute for Risk and Uncertainty**

The University’s Institute for Risk and Uncertainty is dedicated to helping people and organisations create a safer world.

The Institute encompasses world-leading expertise from many disciplines including architecture, engineering, environmental sciences, financial and actuarial mathematics, computer science, electrical engineering and electronics, economics and finance, social sciences and psychology as well as working closely with global industries, Governments and other research centres and universities.

The Institute is the only centre in Europe that combines cutting-edge research, the latest technologies and experts to create a multi-disciplinary approach to explore the issues of risk and resilience associated with building design, climate analysis, reliability engineering, software reliability, materials science as well as incorporating financial modelling, methods to reduce any socio-political harm and critical incident management.

Visit [www.liverpool.ac.uk/risk-and-uncertainty](http://www.liverpool.ac.uk/risk-and-uncertainty) for more information.
Admissions Information

The easiest way to make an application, for both taught and research programmes, is to apply online. Go to [www.liverpool.ac.uk/study/postgraduate/applying/online](http://www.liverpool.ac.uk/study/postgraduate/applying/online)

If you are unable to apply online, you can apply by downloading a copy of the Postgraduate Application Form from the University’s website at [www.liverpool.ac.uk/study/postgraduate/applying/online](http://www.liverpool.ac.uk/study/postgraduate/applying/online) and returning it to us by post or email.

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

- School or college transcripts/certificates
- University transcripts
- Degree certificates
- Evidence of English Language proficiency (EU and international applicants only)
- Personal statement
- Two references
- Proof of funding
- Research proposal (for MPhil/PhD applicants only).

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

**International Postgraduate Taught Applicants**
The University operates a fee deposit scheme. Under this scheme postgraduate international students who accept an unconditional offer are required to pay a fee deposit of £1,000. The introduction of the fee deposit initiative brings us into line with many other UK universities who already operate this requirement.

After you inform us that you have accepted your offer to study at the University of Liverpool you will receive an email from the University’s approved payment provider, Flywire.

Once we have received payment of your fee deposit your Confirmation of Acceptance for Studies (CAS) will be issued as a priority. A CAS is an essential document if you are applying for a student visa through the UKVI Tier 4 Points Based System. For all programmes your full deposit amount will be deducted from your tuition fee when you register with us.

For more information visit [www.liverpool.ac.uk/study/international/money-and-scholarships/fee-deposits/](http://www.liverpool.ac.uk/study/international/money-and-scholarships/fee-deposits/)

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

- Check the Research Centres on page 25 and the website to see if we can offer expert supervision in your chosen area of specialisation
- Prepare a brief research proposal to outline the research project you would like to undertake
- Submit a full application with all supporting documents, including a clear statement on how you intend to fund your research degree.

**Applications from Students with Disabilities**
We welcome applications from students with disabilities and consider them on the same academic grounds as those of other students. If you have a disability, medical condition and/ or support needs it is important that you inform the University so that you receive appropriate support. To discuss your situation or to obtain a copy of the University’s booklet, “A Guide for Disabled Students”, please contact a member of the Disability Advice and Guidance Team on T: +44 (0)151 794 5863 or at E: disteam@liverpool.ac.uk

**Admissions Policy**
Full details of the admissions procedures for taught programmes operated by individual departments may be found in the departmental Postgraduate Admissions Policies, which are available on the University’s website [www.liverpool.ac.uk/study/postgraduate](http://www.liverpool.ac.uk/study/postgraduate)

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

**International Students**
Please note, it is a mandatory requirement for some postgraduate applicants who need Entry Clearance to study in the UK, to have an Academic Technology Approval Scheme (ATAS) certificate. It is your responsibility to check if this scheme applies to you. See [www.liverpool.ac.uk/study/postgraduate/applying/atas](http://www.liverpool.ac.uk/study/postgraduate/applying/atas) for more information.

**Representatives Overseas**
In some countries the University works with local representatives who can provide more information and help you with the application process. For further details, please visit [www.liverpool.ac.uk/international](http://www.liverpool.ac.uk/international)

**EU Referendum Outcome**
As you will be aware, the UK voted to leave the European Union on 23 June 2016. At the time of going to print we are unsure how this decision will affect our EU students.

We value our international student community. Every single student at the University contributes to our welcoming and diverse community and we will continue to take great pride in offering a truly international experience for all of our students.

As the country begins to move away from EU membership, we will endeavour to keep you as up-to-date as possible on any changes that may affect you.

For the latest information visit [www.liverpool.ac.uk/europe/prospective-students](http://www.liverpool.ac.uk/europe/prospective-students)

**Admissions Team**
The University of Liverpool
Foundation Building
Brownlow Hill
L69 7ZX UK

**UK and EU Applications**
E: pguk@liverpool.ac.uk

**International Applications**
E: pgint@liverpool.ac.uk

For more information visit [www.liverpool.ac.uk/study/postgraduate](http://www.liverpool.ac.uk/study/postgraduate)