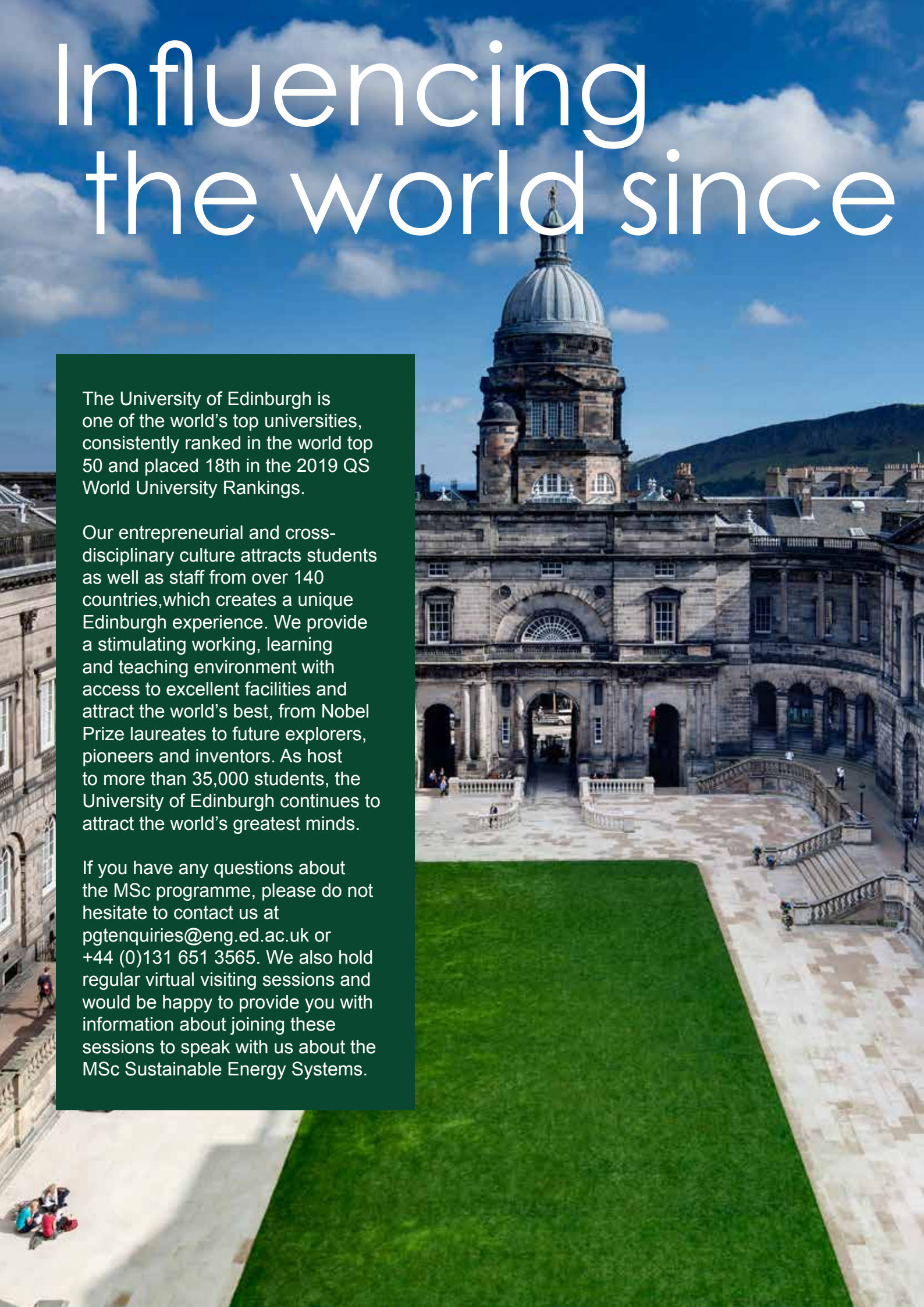
THE UNIVERSITY *of* EDINBURGH
School of Engineering

2019-2020

MSc Sustainable Energy Systems

An internationally renowned masters degree based in a world-leading renewable energy group. We conduct world-class inter-disciplinary research into the systems that control the conversion, transmission and utilisation of many forms of energy.

Influencing the world since



The University of Edinburgh is one of the world's top universities, consistently ranked in the world top 50 and placed 18th in the 2019 QS World University Rankings.

Our entrepreneurial and cross-disciplinary culture attracts students as well as staff from over 140 countries,which creates a unique Edinburgh experience. We provide a stimulating working, learning and teaching environment with access to excellent facilities and attract the world's best, from Nobel Prize laureates to future explorers, pioneers and inventors. As host to more than 35,000 students, the University of Edinburgh continues to attract the world's greatest minds.

If you have any questions about the MSc programme, please do not hesitate to contact us at pgtenquiries@eng.ed.ac.uk or +44 (0)131 651 3565. We also hold regular virtual visiting sessions and would be happy to provide you with information about joining these sessions to speak with us about the MSc Sustainable Energy Systems.

Welcome from the MSc Programme Director

For over a decade, the MSc in Sustainable Energy Systems has provided the starting point for hundreds of students with ambitions to work in the field of renewable energy, or gain further qualification to supplement existing professional experience.

As the Programme Director for this MSc, I am privileged to have known many of them over the years, and am proud that many have realised their dreams owing to their natural talent and hard work while here. I am also looking forward to welcoming many future students – perhaps this could be you!

As we shall explain in this brochure, this programme is primarily designed for engineers who wish to specialise in Sustainable Energy Systems, many of whom go on to find employment in the renewable energy sector or into PhD programmes here or elsewhere. However, carefully selected graduates from other disciplines have over the years been among our most successful.

I hope that you will enjoy finding out more about the MSc. If you have any further queries, please visit our website at www.eng.ed.ac.uk/postgraduate/degrees/msc-taught/msc-sustainable-energy-systems or contact pgtenquiries@eng.ed.ac.uk

Dr Quan Li

What are Sustainable Energy Systems, and why are Engineering Specialists Needed?

The world is hungry for energy to provide the services that ensure comfort, health, and the generation of wealth. With the limited extent of fossil energy resources, and also limits on the ability of the environment to absorb waste products from energy utilisation, the challenge for this generation is to maintain resources and the health of the biosphere in a state fit for future generations – hence the need for Sustainable Energy Systems.

Energy systems are rapidly evolving with great variety between different locations and current infrastructure – from large integrated grids to 'island' systems in remote areas. A great variety of primary sources are available including renewable sources like wind, solar, marine, hydroelectricity, and biomass; and a range of vectors for electricity, heat or fuels, that may or may not be convertible from one to another or stored. All of these operate within very different regulatory, social and political contexts.

These energy systems need engineers to plan, design, model, operate, evaluate performance and provide advice to a wide audience. Graduates from other disciplines who are able to understand the engineering principles of primary resources, as well as their design and operation can also greatly contribute to that effort. Irrespective of their background, all those professionals will have to be aware of the acute importance of non-engineering factors including: economic performance; health and safety; an ethical professional conduct; policy and regulatory frameworks; and last but not least, societal aspects that will underpin acceptance of these systems.

This MSc aims to enable you to approach these energy systems from the point of view of a practicing engineer. The skills that you will acquire during the course of this programme will provide a firm foundation on which to build your career.

Introduction to the MSc in Sustainable Energy Systems

The MSc in Sustainable Energy Systems is a programme of studies grounded in Engineering, which provides graduates and working professionals with a broad training in, and understanding of, energy systems in the context of the sustainability of energy supply. The program has a strong emphasis on energy systems where electricity is the final product, however energy is also considered in the wider context of consumption patterns, efficiency, economics, policy and regulation. While there is particular focus on the deployment of renewable energies in grid-connected systems, there are also opportunities to explore off-grid systems e.g. in dissertation projects. To give a practical edge to the gained theoretical knowledge in previous years students have organised a number of field trips to relevant energy installations.

This programme of study is designed for those:

- from related engineering disciplines wishing to specialise in this field;
- working in industry who wish to update their knowledge and skills;
- non-engineers who are seeking a good understanding of the engineering aspects of energy systems so that they can work within this sector, including in partnership with engineers where required (typically, those students represent about 20% of the class and include physicists, as well as chemists and mathematicians, but exceptional graduates from other disciplines outside science and engineering have previously been accepted).

> "Every one of our departments conducts world-leading research

The programme aims at assisting you with acquiring the following:

- An appreciation of the constraints and opportunities provided by renewable energy resources within pre-existing energy systems, societies, markets and regulatory frameworks.
- An ability to quantify energy flows, environmental impacts, principal aspects of different generation technologies and design specifications and dimensions.
- A knowledge of the technical characteristics and resource evaluation of some of the major renewable power sources (wind, solar, tidal and wave), and the theory underpinning their operation and performance. An ability to develop technology assessments and exploitation plans for nascent technologies like tidal and wave, and design and dimensioning for more mature technologies such as wind, solar and hydropower.
- An understanding of the engineering aspects of power conversion for electricity grids, in particular concerned with the connection of renewable power sources, supported by calculations.
- An understanding of the systems and challenges of energy distribution and the constraints on present distribution systems.
- An understanding of some of the major economic theories describing the markets in which renewable energies are deployed.
- An ability to conduct a critical analysis of competing claims in the energy sector, and evaluate options for energy supply, distribution and utilisation (including renewable and non-renewable) and to appraise the environmental sustainability of energy systems.
- An ability to design, plan and execute an original programme of work appropriate to answering research or

design questions regarding sustainable energy systems.

Why Pursue a Sustainable Energy Systems MSc at Edinburgh?

The MSc in Sustainable Energy Systems has a diverse student body from a number of different countries and backgrounds. The diversity within our programme provides our students with opportunities to learn from one another as they grow in their individual study. James, a recent student, had this to say about the MSc Sustainable Energy Systems:

"I will not say that the MSc in Sustainable Energy Systems (SES) opened my eyes to the political, economic, and environmental problems surrounding the production and use of energy, because these reasons are the very ones that enticed me to pursue this course of study. But now I have completed this course, I feel that I, and all my classmates, have a much better understanding of the complexity and scope of the energy problems we face. The MSc SES programme is a well-rounded one. Although concentrating on the engineering aspects of energy production and use, the program never loses site of the fact that the technical difficulties do not operate in a bubble and that political and economic factors can be just as important.

The highlight of the programme for me was the dissertation. I was able to work with a community on the Isle of Jura off the west coast of Scotland. I worked towards installing wind turbines to provide electricity and a source of income. I was able to visit the Isle of Jura as part of my project. In combination with being vital to my dissertation, I will never forget the beauty of the western island and the warmth of the people. Meeting the people that would directly benefit from the production of electricity from the wind really drove home what I was studying towards. Although getting to experience life outside of Edinburgh was amazing, life in Edinburgh as an MSc student was also a delight. The international nature of the school and city offer a wide range of people to meet and things to do. Although it can be very cold and dark in the winter, it just makes the warm glow of the pub and a pint with good friends that much more enjoyable."

What Does the Degree Involve?

The MSc covers the following programme:

In Semester 1, the following three 10 credit core courses lay the foundations for a deeper understanding of Sustainable Energy Systems, and introduce the specialist courses of Semester 2:

Technologies for Sustainable Energy introduces the resource and engineering characteristics of the major types of renewable energy, particularly wind, solar and marine (tidal and wave), including basic quantitative techniques as well as constraints and fundamentals of economic analysis and grid integration.

Sustainable Energy Contexts focuses on the sustainability of energy systems in the context of geopolitical, economic and environmental constraints. Quantitative techniques are applied to the evaluation of energy flows, and the description of patterns, trends and strategies of energy production, use, and conservation.

Energy and Environmental Economics examines the theoretical framework of conventional as well as ecological economics, as applied to industry, company and consumer behaviour; resource extraction; pollution control; energy markets; taxation that affects energy production and use.

In Semester 1, you must also attend one of 2 elective core courses, Mechanical Engineering Fundamentals of Renewable Energy and Electrical Engineering Fundamentals of Renewable Energy. You must take one of these courses (whichever is the one that you will be least familiar with); each is worth 10 credit points. Both may be attended, but you will only take the exam in one.

We are consistently ranked in the top 50 universities in the world

In Semester 2 a compulsory 10 credit Group Design Project allows you to apply your knowledge in a preliminary design project (it has been on hrdroelectricity in recent years) though in the future it may well cover another topic too).

In Semester 2, students without a Power or Electrical Engineering background must take a 10 credit course on Elements of Power System Operation, which is based on hands-on experiments in the lab followed by simulation work using a commerical package. In addition, they must also take at least two of the three 10-credit, specialist core courses: Principles of Wind Energy; Solar Energy and Photovoltaics; and Marine Energy. Students with a Power or Electrical background must take all three of these specialist core courses.

During the summer months, you carry out a project (Sustainable Energy Systems Dissertation) worth 60 credit points.

Finally, you must take 20 credit worth of optional courses in Semester 1, and 10 or 20 in Semester 2. These options may be from non-engineering subjects and related to e.g. social and policy aspects. Please note that the availability of any one option in a particular year is not guaranteed.

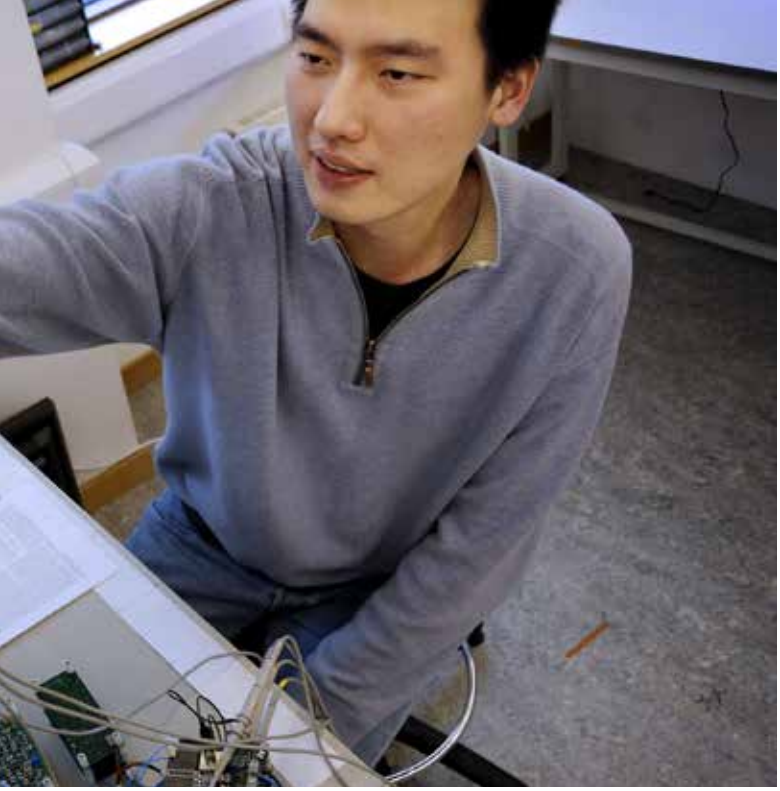
Teaching and Assessment Methods

Teaching is delivered as follows:

- Lectures are the main teaching format on both core and optional courses. Each course consists of a total of 20-22 hours of formal teaching.
- In most courses, concepts from lectures are developed in tutorial and workshop sessions, with students encouraged to question the validity of the information provided and to interpret and apply the information according to your academic background.
- Formal class contact is supported with regular surgery hours for courses and email contact.
- Independent learning is heavily emphasised throughout the programme, and is most relevant to the project and dissertation, which also encourages critical thinking and appraisal.
- Group work is used to enhance the learning process in the core courses Energy and Environmental Economics, Sustainable Energy contexts, Sustainable Energy Group Design Project, and Solar Energy and Photovoltaic Systems.
- The MSc Project (designated as Sustainable Energy Systems Dissertation) develops skills in project planning and management; independent problem scoping and problem solving; survey and critical appraisal of literature; methodology design; critical evaluation of results; health and safety mindfulness and risk assessments. You are assigned a supervisor, with regular meetings that include feedback on progress, and further feedback will be provided to you during a seminar you will give on your project. You will also be given an individual interview by the thesis examiner, independently from the supervisor.

Assessment is carried out in a variety of way depending on the course:

- A mixture of continuous assessment and formal examinations is used in the taught courses. Examinations take place in December and in April and May each year. The weighting between coursework and exam depends on the course being examined.
- The individual project begins in May, and a thesis of around 18,000 words is required by the middle of August. There is also an assessed presentation of the project at a poster day held at the end of the course. The individual project counts for one-third of the marks for the MSc degree programme.
- Intellectual skills are assessed through written examinations, the project, and coursework reports
- Design skills are assessed through poster presentation; exam questions that may cover the skills and knowledge gained during design tutorial exercises; and methodology design during the project.
- Transferable skills are assessed through coursework reports and the project reports as well as poster presentations (in the Solar Energy and Photovoltaic Systems course, and project).



At the heart of ideas and inspiration

Links to Industry

This MSc programme has an Industry Liaison Board which advises the teaching staff on the MSc in Sustainable Energy Systems regarding the following:

- Contents of the course programme with respect to employability of its graduates, and the needs of organizations (mostly private) that are active in the energy sector and related fields, of the types that are known to employ our graduates.
- Outlook on the job markets, and opportunities for graduates that may accrue from ongoing or expected developments in corporate activities, technologies, policies and regulations.
- Current and forecast needs of the energy sector in general or specific areas within the energy sector, in terms of skills and contents of the MSc programme.

The Board meets twice yearly. Class representatives are invited to attend.

What can I do After my Degree?

A select number of top performing students who excel in their research project and demonstrate the critical thinking necessary to proceed to further study may be invited to apply for a PhD with us. For further information on PhD projects, please visit: www.eng.ed.ac.uk/postgraduate/degrees/phd.

For those graduates not interested in further studies, opportunities in industry can be explored through our Careers Service (www.ed.ac.uk/careers/postgrad/taught-pg). The Careers Service at the University of Edinburgh offers our graduates support throughout their degree and for two years afterwards. The Careers Service can help with your job search and marketing yourself effectively, as well as making career decisions to ensure that you are moving towards your goals.

Ranked 6th in the UK and 32nd in the world for employability*, the University of Edinburgh is an excellent choice for a postgraduate education with prospects.

*latest emerging Global Emplyability University Rankings

Within six months of finishing their MSc Sustainable Energy Systems degree, graduates of our programme were working with the European Commission, SSE, Alstom Grid, Selex Galileo, Deutsche WindGuard, Impact Energy Asia and Grandio Intelligent Systems.

What is the Admissions Team Looking for?

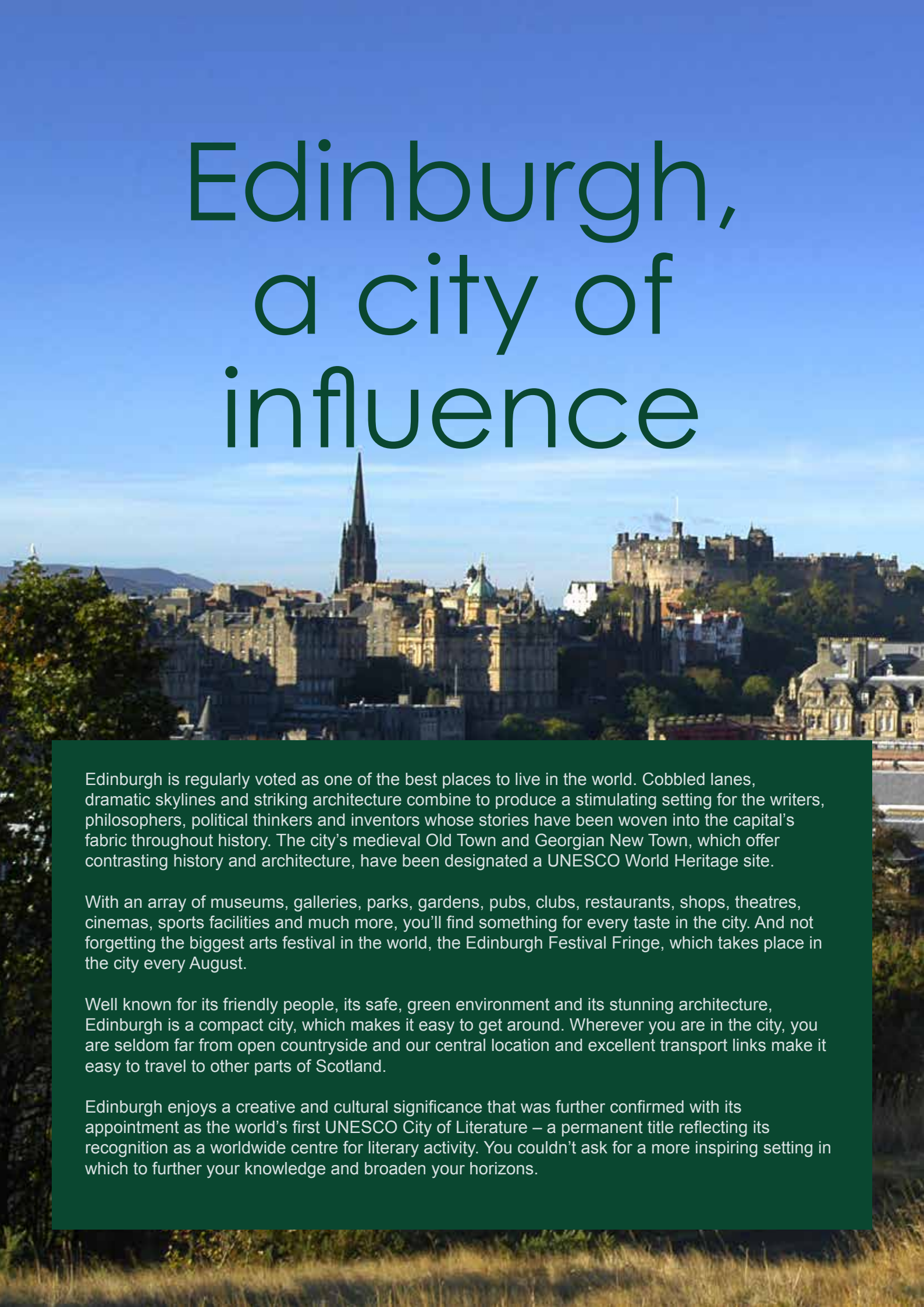
A UK 2:1 honours degree, or its international equivalent, in Engineering or Physics. If you apply with a background in another field, you may be accepted if you hold a UK first class honours degree, or its international equivalent, and have studied mathematics to first year undergraduate level, including vectorial calculus (gradients, curls, etc), complex algebra and Fourier transforms. You must also be able to demonstrate a strong interest in the energy sector.

You will find our most up to date entry requirements at: www.ed.ac.uk/pg/22. You will also need to submit a personal statement outlining why you want to attend the MSc Sustainable Energy Systems and an academic reference.

To read further information about the application process and advice on submitting an application please either visit the “Apply Now” page on the University of Edinburgh Postgraduate Online here: https://www.ed.ac.uk/studying/postgraduate/applying or email the Postgraduate Taught Office at the School of Engineering at pgtenquiries@eng.ed.ac.uk.

If you receive an offer to study at the School of Engineering you will be invited to attend a virtual visit session. The sessions run regularly throughout the year and you will have an opportunity to hear more about the University of Edinburgh and the School of Engineering. Applicants and prospective students can meet with staff in an online setting, listen to presentations and chat with the them using audio or text to find our more about the School and the programmes we offer.

Edinburgh, a city of influence



Edinburgh is regularly voted as one of the best places to live in the world. Cobbled lanes, dramatic skylines and striking architecture combine to produce a stimulating setting for the writers, philosophers, political thinkers and inventors whose stories have been woven into the capital's fabric throughout history. The city's medieval Old Town and Georgian New Town, which offer contrasting history and architecture, have been designated a UNESCO World Heritage site.

With an array of museums, galleries, parks, gardens, pubs, clubs, restaurants, shops, theatres, cinemas, sports facilities and much more, you'll find something for every taste in the city. And not forgetting the biggest arts festival in the world, the Edinburgh Festival Fringe, which takes place in the city every August.

Well known for its friendly people, its safe, green environment and its stunning architecture, Edinburgh is a compact city, which makes it easy to get around. Wherever you are in the city, you are seldom far from open countryside and our central location and excellent transport links make it easy to travel to other parts of Scotland.

Edinburgh enjoys a creative and cultural significance that was further confirmed with its appointment as the world's first UNESCO City of Literature – a permanent title reflecting its recognition as a worldwide centre for literary activity. You couldn't ask for a more inspiring setting in which to further your knowledge and broaden your horizons.


DUGALD STEW

Semester 1: September – December

Welcome Week

Semester 1: Taught courses

The compulsory courses taken this semester are Technologies for Sustainable Energy, Energy and Environmental Economics and Sustainable Energy Contexts (MSc). There are a number of optional courses available in addition to the compulsory courses.

Exam Revision

Semester 1 Exam Diet

University closes for Christmas

Semester 2: January – April

University reopens after Christmas break

January Welcome Week

Semester 2: Taught courses

Students will choose 80 credits worth of optional courses depending on their background in Electrical or Power Engineering, including available courses from the Schools of Engineering, Geosciences, Mathematics and Social and Political Science.

Flexible Learning Week

Semester 2 resumes

Spring Vacation

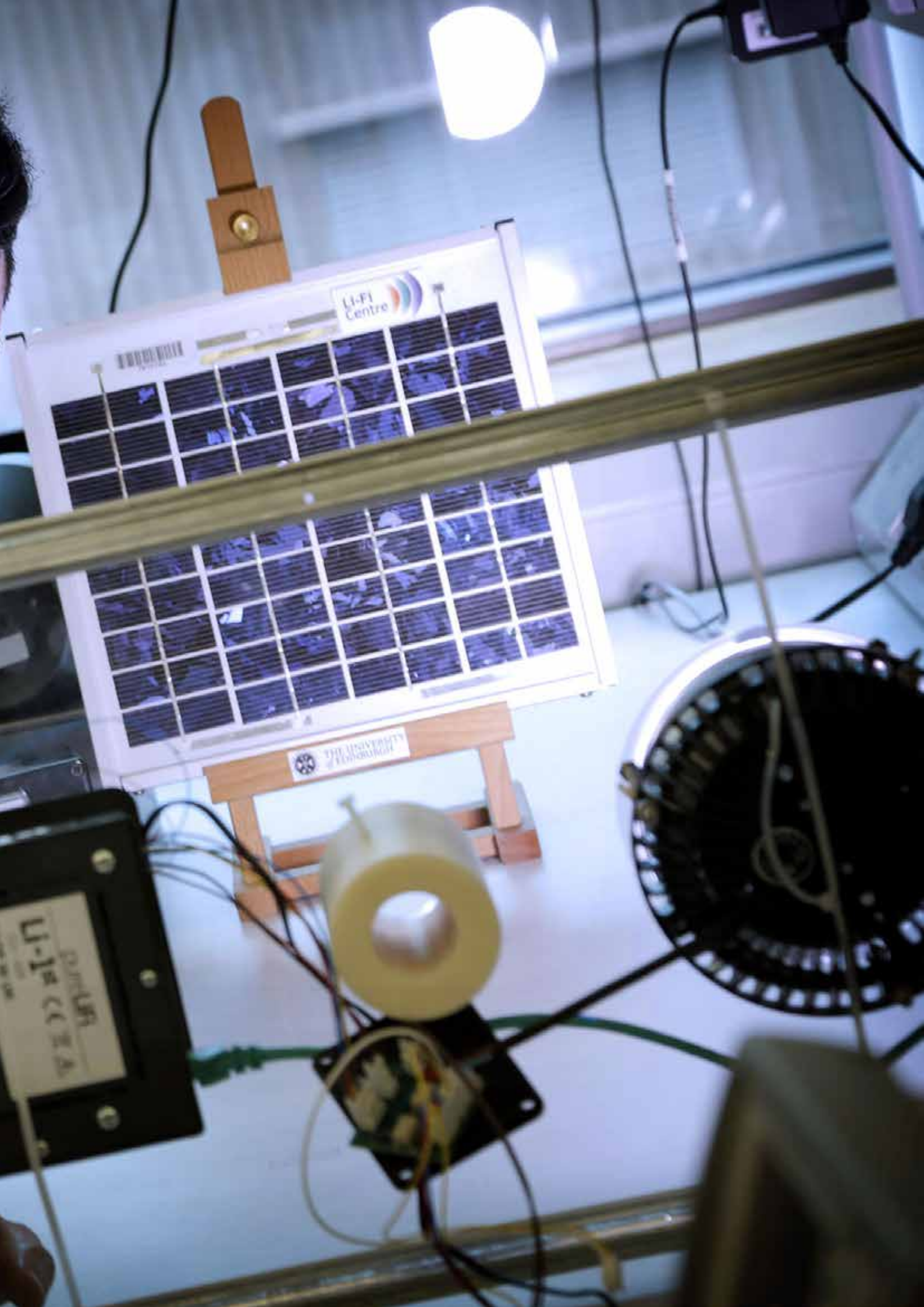
Exam Revision

Semester 2 Exam Diet

Dissertation: May - August

Dissertation

Dissertation Submission


Li-Fi
Centre

Course Information

In Semester 1, the following three 10 credit core courses lay the foundations for a deeper understanding of Sustainable Energy Systems, and introduce the specialist courses of Semester 2:

Technologies for Sustainable Energy introduces the resource and engineering characteristics of the major types of renewable energy, particularly wind, solar and marine (tidal and wave), including basic quantitative techniques as well as constraints and fundamentals of economic analysis and grid integration.

Sustainable Energy Contexts focuses on the sustainability of energy systems in the context of geopolitical, economic and environmental constraints. Quantitative techniques are applied to the evaluation of energy flows, and the description of patterns, trends and strategies of energy production, use, and conservation.

Energy and Environmental Economics examines the theoretical framework of conventional as well as ecological economics, as applied to industry, company and consumer behaviour; resource extraction; pollution control; energy markets; taxation that affects energy production and use.

In Semester 1, you must also attend one of 2 elective core courses, Mechanical Engineering Fundamentals of Renewable Energy and Electrical Engineering Fundamentals of Renewable Energy. You must take one of these courses (whichever is the one that you will be least familiar with); each is worth 10 credit points. Both may be attended, but you will only take the exam in one.

In Semester 2 a compulsory 10 credit Group Design Project allows you to apply your knowledge in a preliminary design project (it has been on hrdroelectricity in recent years) though in the future it may well cover another topic too).

In Semester 2, students without a Power or Electrical Engineering background must take a 10 credit course on Elements of Power System Operation, which is based on hands-on experiments in the lab followed by simulation work using a commerical package. In addition, they must also take at least two of the three 10-credit, specialist core courses: Principles of Wind Energy; Solar Energy and Photovoltaics; and Marine Energy. Students with a Power or Electrical background must take all three of these specialist core courses.

During the summer months, you carry out a project (Sustainable Energy Systems Dissertation) worth 60 credits.

Compulsory Courses

Technologies for Sustainable Energy (10 credits)

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 1

This course offers a reasonably in depth introduction to renewable energy technologies. It sets renewable energy in the wider context and develop a basic qualitative and quantitative toolkit for appraising technologies. It examines each of the major technologies covering aspects such as: Resource, Conversion technologies, Practicalities, Economics and Environmental impacts. Finally it briefly examines how renewables can be integrated effectively within the energy system.

This course provides sufficient depth and coverage to allow comprehension of renewable energy whilst acting as an introduction to more specialist courses on individual technology areas (e.g. wind energy). This course material requires numeracy and knowledge of basic physics concepts.

This course deals mainly with renewable electricity generation and its role but includes some material on renewable heat; nuclear and conventional power is excluded. The lectures are:

- Sustainable energy: the context
- Hydropower
- Bioenergy
- Onshore and offshore wind
- Wave power
- Tidal power
- Solar energy
- Economics
- Integration of renewables

The course is lecture based which provides efficient summary of key material and techniques. These are supplemented by an extensive tutorial question set, examples classes and a text book. The course is challenging and requires hard work.

Sustainable Energy Contexts (10 credits)

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 1

This course aims to establish a basic understanding of global patterns of energy use and systems of energy supply, in the context of their sustainability: social, environmental and economic. It is structured so as to familiarise students with the wide range of literature on sustainability, and will develop independent study and analysis skills.
More specifically;

- To provide an overview the world's energy resources, and the current patterns of the production and use of energy.
- To examine the current world energy picture in the context of sustainability.
- To present strategies for more sustainable supply, and to consider the constraints on expansion of supply.
- To discuss future sustainable energy scenarios.
- To develop an appreciation of the global nature of the issues, and an accompanying appreciation of the need for local variations to be understood and accounted for.
- To develop a realisation of the intricacy and complexity of sustainable energy issues; to gain ability to critically appraise information in the sector, and to detect and reject over-simplified assertions and/or solutions.

Energy and Environmental Economics (10 credits)

2 Lecture hours per week; Tutorials run in weeks 3, 6 and 9; Taught Semester 1

The aim of this course is to provide a theoretical grounding in economics from first principles, exploring the fundamental principles of efficiency in the distribution of resources in society. These principles are then applied in the fields of energy and the environment. No prior knowledge of economics is assumed.

On completion of this course, you will be able to:

- Understand and apply the main economic theories and concepts underlying environmental and energy economics, including the theories of consumer and producer behaviour, welfare theory, and theories of industry structure.
- Understand and reflect on different methods to value environmental goods, and on the use of these valuations in environmental cost-benefit analysis.
- Critically discuss previous, existing, and potential future pollution control measures.
- Understand and critically evaluate the functioning of different types of energy markets, future challenges to these markets, and their relevance to engineering problems.
- Describe and discuss important ethical issues in energy markets and environmental valuation, and their implications for good practice and policy.

Sustainable Energy Group Design Project (10 credits)

2 Lecture hours per week; Taught Semester 2

This course takes the form of a multi-disciplinary design project. The project is scheduled to run on one supervised afternoon per week, and you will need to devote substantial self-study time also.

The project within this course is an inter-disciplinary group project (with elements of at least two disciplines, e.g. electrical and mechanical engineering) that requires team effort. This course is intended to develop your design experience on the Sustainable Energy Systems programme. In particular, it should enhance and assess your ability to generate an innovative design for products, systems, components or processes to fulfil new needs. It will also enhance and assess the awareness of the need and ability to make general evaluations of risk issues in the context of the particular specialisation, including health & safety, environmental and commercial risk. In addition, the course aims at encouraging questioning and creative thinking; developing skills in problem identification and study planning; providing a realistic team working environment; further developing communication skills. By the end of the project you should have: improved team working skills; improved communication skills; a better appreciation of project planning issues; an appetite for creative engineering and planning.

Sustainable Energy Systems Dissertation (60 Credits)

This course is the dissertation project element of the MSc programme in Sustainable Energy Systems. You will contribute an original piece of research on a topic relevant to sustainable energy systems. You will report on the work, its results and a critical appraisal of these in your thesis.

Dissertation work begins at the start of the second semester, when the general topic and area of research are selected and agreed with the allocated Supervisor. You should meet with your Supervisor in the second semester to discuss the dissertation topic. You are expected to take the time to start researching the literature and think about appropriate methods to carry out the research, following which you must submit a Dissertation Mission Statement by the end of the second semester after approval by the Supervisor. The main phase of the dissertation work starts immediately after the May examinations. By mid-June, a Dissertation Seminar will take place, during which you will present your plans for Dissertation work and expected outcomes. By the first week of July, you will have arranged and taken a one-to-one interview with your Dissertation Thesis Examiner. Around mid-August, the Dissertation Thesis must be submitted by the specified deadline. Finally, you are required to prepare a Dissertation Poster and present it at a dedicated session for the whole class a week after thesis submission, which is the final part of the Dissertation Project.

Optional Courses

Students must take 20 credit worth of optional courses in Semester 1, and 10 or 20 in Semester 2. These options may be from non-engineering subjects and related to e.g. social and policy aspects. Please note that the availability of any one option in a particular year is not guaranteed. A selection of available courses is listed below, for the full list please visit: http://www.drps.ed.ac.uk/18-19/dpt/ptmscsuses1f.htm

Electrical Engineering Fundamentals of Renewable Energy (10 credits)*

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 1

This course will introduce basic principles and fundamental concepts of electrical engineering, providing a foundation facilitating understanding of electrical aspects of renewable energy engineering and further quantitative analysis of the techniques and equipment used in the generation, transmission, distribution and utilisation of electrical power. General circuit theory, principles of electromagnetics and theory of electrical machines will be used for the analysis of power supply systems with renewable resources and for discussing some of the problems facing electricity utilities.

Topics covered will include:

- Introduction to Power Systems and Overview of Renewable Energy Sources
- Phasors, Operators and Analysis of RLC Circuits
- Active, Reactive and Apparent Powers, Power Factor, Reactive Power Compensation
- Three Phase Systems with Balanced and Unbalanced Loads
- Low Voltage Systems, Star and Delta Connection
- Introduction to Electromagnetics, Transformers
- Induction Machines
- Synchronous Machines

*depending on the student's background

Mechanical Engineering Fundamentals of Renewable Energy (10 credits)*

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 1

This course will introduce fundamental concepts from mechanical engineering that will facilitate understanding and quantitative analysis of renewable energy systems. This will include concepts from the fields of dynamics, thermodynamics, fluid statics/dynamics as well as structural mechanics. The course provides a grounding in key physical concepts and analytical methods to enable understanding of and quantitative analysis of renewable energy systems. Lecture material will cover:

- Thermodynamics and energy concepts
- Newtonian Dynamics
- Fluid statics and dynamics
- Structural mechanics

These are presented within the context of and applied to renewable energy systems.

*depending on the student's background

Thermodynamics for Energy Systems (10 credits)*

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 2

This course will consider advanced applications of thermodynamics in a range of engineering contexts. Topics covered will include advanced power cycles, psychrometry and an introduction to combustion:
- Introduction to exergy
- Thermodynamic cycles for power plants and other engineering applications
- Ideal gas mixtures and psychrometry (simple gas/vapour mixture models)
- Combustion and gasification

*typical optional course choice for student's with a Mechcanical/Chemical Engineering background

---

Principles of Wind Energy (10 credits)*

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 2

Wind energy is a fast growing renewable source for electricity generation. The objective of this course is to present a broad overview of the technology covering aspects such as the history of wind turbine development, the characteristics of the wind and its

impact on site selection, and the design, manufacture, and operation of modern wind turbines. The course has a practical flavour, drawing on examples from the wind turbine engineering and development sectors. The political and economic implications of wind energy are explored in the final lecture.

*depending on the student's background

Solar Energy & Photovoltaic Systems (10 credits)*

2 Lecture hours per week; Taught Semester 2

This course presents and assesses the fundamentals of solar energy conversion. It starts with a discussion of the resource and the mechanisms of its propagation through the atmosphere up to the point of conversion. It then discusses the various conversion processes (solar heating/cooling, concentrated thermal power generation and the photovoltaic phenomenon). The state-of-the-art of each of these technologies is then discussed, including their market and economic aspects.

The course includes a project, for which you will work in groups, undertake the design and dimensioning of a solar energy conversion system. Their results are submitted as a group report and presented at a poster session during the last lecture of the term.

*depending on the student's background

Marine Energy (10 credits)*

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 2

The seas and oceans appear to offer opportunities for the long term, cost effective, generation of energy. Waves and tidal currents represent high density energy resources which, in the case of the tides, are highly predictable in form. The wave resource, whilst not predictable in a true sense, is more easily forecast than is the wind. The engineering difficulties associated with effective exploitation of the marine resources are considerable, however. This course will guide you through the process of understanding the resources and how to best develop and apply techniques for exploitation.

*depending on the student's background

Energy Policy and Politics (10 credit and 20 credit versions of this course are available)

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 2

This course introduces students to the design of power electronic circuits for low power applications. It concentrates primarily on power supplies for electronic circuits, and covers the operation and design of the most common power supply circuit topologies. Also included in this course are the design of the magnetic components required in such applications, and the design of the feedback control circuit. Students are introduced to the main characteristics of power semiconductor devices and their drive requirements. A continuous theme throughout this course is designing circuits for 'worst case' conditions, and taking into account commercial requirements as well as practical realities such as device and circuit imperfections.

Engineering Project Management (10 credits)

2 Lecture hours per week; Taught Semester 1

Project Management is the application of management principles to deliver a project to a specified timescale, budget and quality. This course will consider the principles of the management of engineering projects with respect to the life-cycle of the project, the parties, planning, estimating, contractor selection and contract management. On completion of this course, the student will be able to:

- Recognise the constituent parts of a project life cycle and the relevant parties involved
- Demonstrate understanding of the importance project demand and client responsibility in project success
- Be able to analyse basic project cost and time information and produce simple estimates and plans
- Distinguish between different contractual and procurement methods for engineering projects
- Appraise project information and critique a project's likely success

---

Power Electronics (10 credits)*

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 1

This course will introduce you to the design of power electronic circuits for low power applications. It concentrates primarily on power supplies for electronic circuits, and covers the operation and design of the most common power supply circuit topologies. Also included in this course are the design of the magnetic components required in such applications, and the design of the feedback control circuit. You will be introduced to the main characteristics of power semiconductor devices and their drive requirements. A continuous theme throughout this course is designing circuits for 'worst case' conditions, and taking into account commercial requirements as well as practical realities such as device and circuit imperfections.

*typical optional course choice for students with a Power Engineering background

---

Energy Finance (10 credits)

2 Lecture hours; 1 Tutorial hour per week; Taught Semester 1

The energy finance course aims to integrate conventional finance with energy finance. The course will provide a basis for understanding the links between conventional corporate finance and energy and carbon finance. The course will provide students essential skills for project cash flow assessment.

The Course Organiser will draw on both theoretical and applied concepts and will be taught by experienced practitioners, with knowledge of structured and energy finance. In addition to introducing the students to the wider literature on energy finance, recent publications and case studies will be used to ensure that students will come away from the course with specific skills in the evaluation of risks and opportunities associated with energy finance.

The University of Edinburgh is ranked 18th in the world by the QS World University Rankings 2019.

Contact Us

Email: pgtenquiries@eng.ed.ac.uk
Tel: +44 (0)131 651 3565

School of Engineering
The University of Edinburgh
The King's Building
Edinburgh
EH9 3FB