MANCHESTER
1824
The University of Manchester

Electrical and Electronic Engineering

UNDERGRADUATE BROCHURE

www.manchester.ac.uk/eee

The facts

Over a century of education and research

Making a difference with our Research

All courses accredited by the Institution of Engineering and Technology

Passionate about student satisfaction

> Aside from a catalogue of technical skills, the course also develops an all rounded skillset, encouraging innovation and entrepreneurship
>
> **Alexander Owens**
> **MEng Electrical and Electronic Engineering**

Contents

The University of Manchester
Making things happen

Influential, forward-thinking and down-to-earth, we'll give you an amazing university experience rooted in a rich academic heritage. We turn enthusiasm into achievement and ground-breaking theory into innovative practice.

We accomplish feats of global significance, from splitting the atom, to giving the world graphene—the two-dimensional wonder material that is one atom thick, but 200 times stronger than steel.

With more Nobel laureates on our staff than any other UK university, and strong links to industry and public services, we vitalise our undergraduate courses with pioneering research.

Learn more about us:
www.manchester.ac.uk

Manchester

Our city
Always moving forward

Manchester thrives on innovation and creativity, always a step ahead in science, industry, media, sport and the arts. The Mancunian character—exemplified by the city's central role in the Industrial Revolution—stands for excellence and originality in all walks of life.

All corners of the world meet in Manchester. It is a cosmopolitan magnet for students and professionals who are eager to experience our can-do attitude, independent spirit and cultural wealth.

Never content to live on past glories, Manchester has a passion for progress. Join us at the heart of Britain's most popular student city.

Discover what makes Manchester unique:
www.manchester.ac.uk/city

Your experience
More than just a degree

Whether you prefer to work in the ultra-modern surroundings of the Alan Gilbert Learning Commons, or if you get your inspiration from the neo-gothic grandeur of the John Rylands Library, we've got it covered with our impressive range of flexible study environments and support services for a truly personal learning experience.

And that's not all. Outstanding sport facilities, over 450 student societies, supported community volunteering, study abroad pathways, career development programmes and mentoring are all ways in which we support you to grow and develop outside the lecture hall.

Make the most of what we have to offer and you'll enjoy a well-rounded university experience that prepares you for life after graduation.

Hear from some of our students:
www.manchester.ac.uk/study/experience

Your future
On a course to success

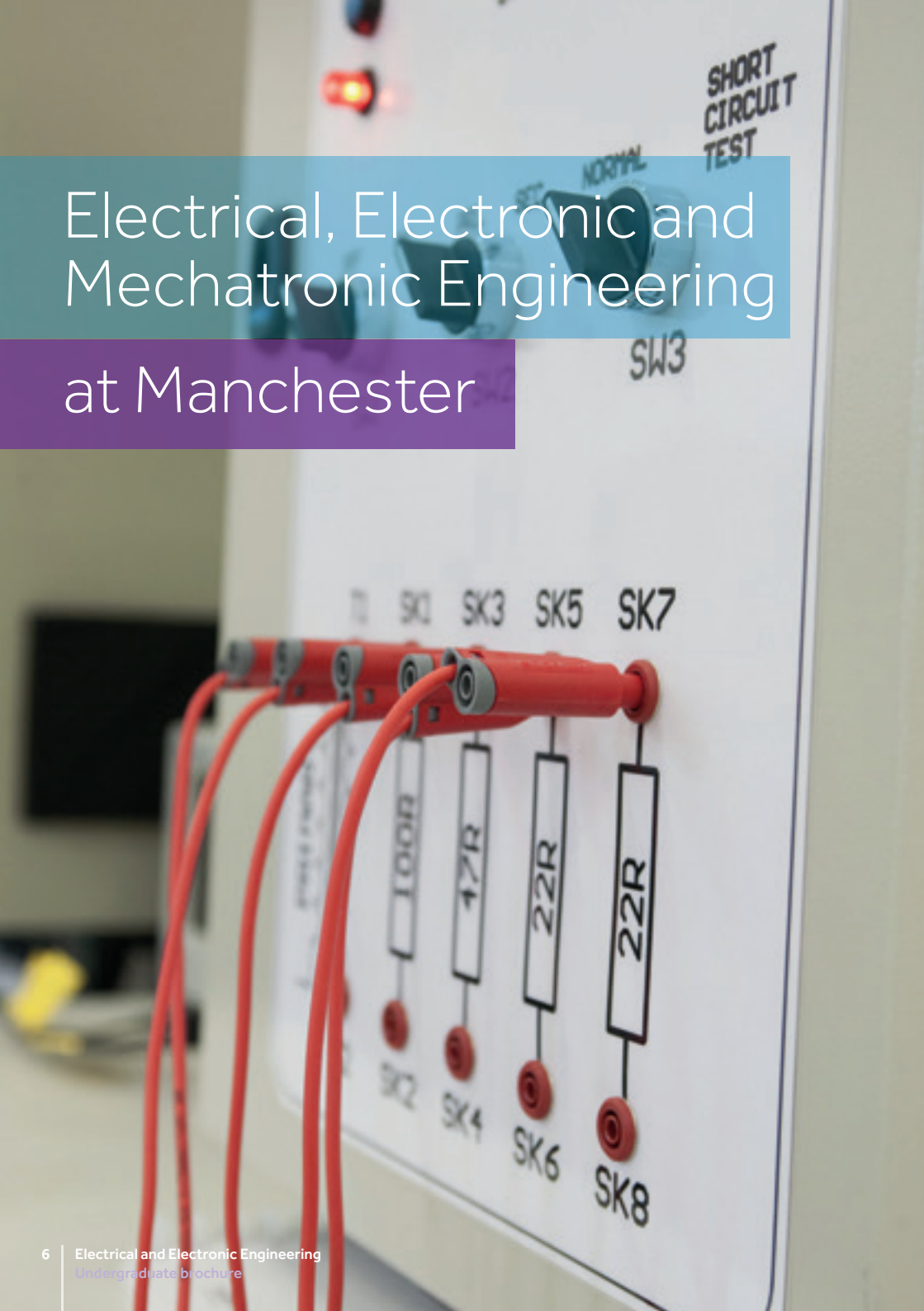
We are one of the UK's most targeted universities by employers, thanks to courses and careers services designed with your employability in mind.

Our problem-based approach to learning inspires you to think critically, creatively and independently. Taking part in activities to enhance your academic record, such as volunteering, personal development and interdisciplinary learning can give you a broad perspective and a competitive edge, shaping you into a socially responsible leader of tomorrow.

Our award-winning careers service provides a wealth of tools, advice and development opportunities, and connects you with employers to put you a step ahead on the path to success.

Take control of your career:
www.manchester.ac.uk/careers

Electrical, Electronic and Mechatronic Engineering at Manchester



Our School of Electrical and Electronic Engineering is one of the largest in the UK, with over 70 academic staff, a similar number of support staff and a student population of over 1000. More than 650 undergraduate students benefit from our wealth of expertise—and a warm welcome.

We have been involved in education and research for over a century. The first stored-program computer was designed and built by Frederic C Williams and Tom Kilburn in our School at The University of Manchester; its first program ran on June 21, 1948.

Since then, computing has advanced enormously—and we are proud to remain at the forefront of these developments. Computing equipment at the University alone now requires a 2MW electrical supply system; thankfully, we contribute towards providing this as well.

Our research activities equip us with the expertise to educate the next generation of electrical, electronic and mechatronic engineers, who will continue to be responsible for major changes to the world that we live in. After all, can you now imagine a world without computers, smart phones, interactive video games, flat-screen 3D smart televisions, or Twitter? Join our School and you could become one of these engineers.

Why Manchester?

- Free 'lab in a bag'—every first-year student receives a National Instruments myDAQ—see www.manchester.ac.uk/eee/mydaq
- Free membership of the Institution of Engineering and Technology (IET)
- Free Microcontroller Development System (but you will have to build it!)

Electrical and Electronic Engineering

Ten reasons why we should be your number one choice:

01 Employability

Our courses are practical-based to ensure you leave us with not just the theory behind electrical, electronic and mechatronic engineering, but also the skills to put that theory into practice. Find out what employers say on page 28.

02 Teamwork

Meet new friends, work in groups, learn from each other and share your experiences. Teamwork plays a big part in student life; find out more on pages 13, 20, 24 and 26.

03 Clubs and groups

With our Electrical and Electronic Engineering Society (EEESoc), Electronics Club (E4C) and Formula Student on offer, we give you the chance to put your studies to work in a social and fun environment – see pages 26 and 27.

04 Industrial experience opportunities and summer jobs

Get paid for a year of your study while gaining hands-on experience as a real engineer – see page 16. Or why not consider a summer job within our School? See page 28.

05 Peer-Assisted Study Scheme (PASS)

PASS has proven to be a huge benefit to our students. It helps resolve any concerns as it ensures you know that help is always at hand. See page 26.

06 IET accreditation

Even if you don't yet know about the IET, you will in the future! This is the professional body that accredits our degrees so that you can apply to become a chartered engineer when you graduate. Read some of the commendations made by the IET when they last visited the School on page 16.

07 Flexible degrees – because your future isn't fixed

We want to ensure that you obtain the most appropriate degree for your future needs so we give you the flexibility to be able to achieve this. See pages 16 and 20.

08 LabVIEW

The LabVIEW Academy enables us to offer our students courses that are accredited by National Instruments. See page 12.

09 Excellent research rankings

93% of our research was ranked as world-leading/internationally excellent in the national audit of research excellence called the Research Excellence Framework 2014 (REF2014). See pages 35 to 38.

10 Satisfied students

Based on the National Student Survey (NSS) we have achieved an average of more than 95% in overall student satisfaction over the last five years. This shows our continued commitment to one of our key assets, our students. Read some comments from current students about their experiences on pages 19, 21, 23, 25, 27, 31, 32, 33 and 34.

Award-winning community

Our students and staff perform to an excellent level as can be evidenced by the awards that they have received.

Each year the Faculty of Engineering and Physical Sciences, which the School is part of, recognises the best student by awarding them the "Distinguished Achievement Award: Engineering and Physical Sciences Student of the Year Award". The award recognises both academic achievement and contribution to the University and wider community. The faculty has nine schools and over 7,000 undergraduate students so the award is highly competitive. Students from our School have received this award in 2010, 2011, 2014 and again in 2015.

One of our former undergraduate students, Antony Beddard, received the "Postgraduate Research Student of the Year (President's Distinguished Achievement Award) 2015". Antony graduated in 2009 with a MEng in Electrical and Electronic Engineering and secured a graduate job with Alstom Grid. He returned to study for a research degree (PhD) in the field of Next generation power systems technology: High-Voltage DC converter transmission.

Sam Ward, our Welfare and Student Experience Officer, received the "Best Support Staff Member 2015" award from the Students Union. This is a highly coveted award, there is only one to cover the whole of the university and is based on student feedback. It has also previously been awarded to Beckie Davies our Taught Programmes Officer.

Danielle George (Professor of Microwave Communication Engineering) delivered the 2014 Royal Institution CHRISTMAS LECTURES

"Sparks will fly: How to hack your home"

Dan commented "We have embedded a culture within the School of 'do engineering anywhere, anytime", a theme embraced by the CHRISTMAS LECTURES.

Manchester is the European City of Science 2016 and Dan is continuing one of the themes from the lectures by creating a 'Robot Orchestra' which will perform a piece of music composed by the Hallé orchestra. A number of our current students are contributing to this activity as part of our summer placement scheme (see page 28).

Dan has been awarded 2016 Royal Academy of Engineering Rooke Award for public promotion of engineering and will be hosting the 'Engineering the future' event to be run by the IET (**www.engfest.org**)

Mo Missous (Professor of Semiconductor Material and Devices) has received the Royal Society Brian Mercer award for his work into quantum mechanical tunnelling. Mo delivers the first year course unit on 'Electronic Materials'.

Barry Lennox (Professor of Applied Control) won the category of 'Best University Technology of the Year' at the UK Energy Innovation Awards in 2016. Barry lectures on the fourth year course unit on 'Process Control and Automation'.

To find out more about the achievements of our students and staff visit:
www.manchester.ac.uk/eee

Course details

ELECTRICAL AND ELECTRONIC ENGINEERING

Electrical and Electronic Engineering MEng 4yrs
UCAS Code H605

Electrical and Electronic Engineering with Industrial Experience MEng 5yrs
UCAS Code H601

Electrical and Electronic Engineering BEng 3yrs
UCAS Code H600

Electrical and Electronic Engineering with Industrial Experience BEng 4yrs
UCAS Code H606

MECHATRONIC ENGINEERING

Mechatronic Engineering MEng 4yrs
UCAS Code HHH6

Mechatronic Engineering with Industrial Experience MEng 5yrs
UCAS Code HHP3

Mechatronic Engineering BEng 3yrs
UCAS Code HH36

Mechatronic Engineering with Industrial Experience BEng 4yrs
UCAS Code HH63

ELECTRONIC ENGINEERING

Electronic Engineering MEng 4yrs
UCAS Code H614

Electronic Engineering with Industrial Experience MEng 5yrs
UCAS Code H615

Electronic Engineering BEng 3yrs
UCAS Code H610

Electronic Engineering with Industrial Experience BEng 4yrs
UCAS Code H613

Entry requirements

GCSE
Grade C in Mathematics and English language.

GCE A-level / Unit grades
AAB-AAA including Mathematics and either Physics, Electronics or Further Mathematics.

IB Diploma
35-37 points overall, including 6 points in Mathematics and Physics at Higher level and a minimum of 5 points in one other Higher level subject.

BTEC Level 3 Extended Diploma
Applicants must achieve grade B in A/S Level Maths. BTEC Extended Diploma in Electrical and Electronic Engineering with a minimum of 70 credits awarded at Distinction, including the Further Mathematics for Technicians module, 100 credits at Merit and the remaining 10 credits at Pass or above. You must also pass an interview.

Welsh Baccalaureate (including A-levels)
Pass WB and obtain AA in A-Level, including Mathematics and either Physics, Electronics, or Further Mathematics.

Scottish Advanced Highers
AAB-AAA, including grade A in Advanced Higher Mathematics and Physics.

Scottish Highers
AAAAB-AAAAA including grade A in Higher Mathematics and Physics.

Irish Leaving Certificate
A1 A1 A1 B1 B1 including A1 Maths and A1 Physics at Higher level.

English Language qualifications
One of the following: GCSE English Language. Grade C (Grade 4 for applicants holding newly reformed GCSEs in England); IELTS 6 (minimum of 5.5 in any component). TOEFL 79 overall with no subtest less than 20.

Direct entry to the second year
If you have completed learning equivalent to our first year, you could be considered for direct entry to our second year. Each case is considered individually. Contact us for details (see the inner back page of this brochure for our contact details).

Requirements are subject to change, for most up to date information on entry requirements to specific courses, visit:
www.manchester.ac.uk/eee/undergraduate/courses

Electrical and Electronic Engineering

Teaching and learning

We achieved 96% in the National Student survey in terms of our student satisfaction; we consistently achieve one of the best profiles of marks across all assessed categories for any course at any University in the UK.
Find out more: **unistats.direct.gov.uk**

What teaching methods help us to achieve this?

Course units

A typical course unit structure comprises:

- Two laboratory exercises (each of three hours)
- 20 lectures
- Four example classes
- Two personal tutorials

Laboratory exercises

Laboratory exercises are specifically designed for each course unit to give you the best possible learning experience as you put theory into practice. In some instances, in-lab marking will be used, giving you immediate feedback on your understanding of the subject. Alternatively, you may need to submit a concise report after the practical session, which should combine the lecture material with the laboratory exercise. It is in the laboratory sessions that you will meet ELVIS!

ELVIS – this Educational Laboratory Virtual Instrumentation Suite is a leading educational platform by National Instruments (NI). We use it in our laboratory sessions for course units such as Electronic Circuit Design. Find out more: **www.ni.com/nielvis**

NI Lab – this undergraduate laboratory has been equipped with state-of-the-art hardware and software from NI. It is now recognised as one of the best practical teaching facilities available in UK higher education, with enough equipment to accommodate more than 100 students in one session. NI and our University have developed a strong partnership over the past few years, which we continue to build on so that our students can gain the most out of their studies.

myDAQ – a lab in a bag. Designed specifically for students, myDAQ provides you with the technology to experience hands-on learning anytime, anywhere. Within a single plug-and-play USB device, it combines portability with a suite of eight of the most commonly used instruments in the lab. Every first-year student on our courses receives their very own myDAQ, along with LabVIEW and Multisim software. You will be able to use your myDAQ for real engineering and, when combined with NI LabVIEW and NI Multisim, for prototyping systems and analysing circuits outside of the lecture theatre and the lab. Find out more: **www.manchester.ac.uk/eee/mydaq**

LabVIEW – this is an integral part of our courses. You will be taught Data Acquisition and Industrial Control applications in the LabVIEW structured environment, and you will have regular hands-on contact with the relevant hardware, particularly ELVIS and myDAQ. You will be able to take a free exam on your knowledge of LabVIEW at Manchester, and if successful, will be accredited by NI with a Certified LabVIEW Associate Developer certificate, an accreditation that is coveted by Industry. Find out more: **www.ni.com/academy**

Lectures

These are fundamental to our teaching process. We provide course notes in both printed and electronic format, the latter via our e-learning system. Your lecturers deliver material using a range of teaching media, such as PowerPoint, black/white board, video and demonstrations. You will need to take notes to supplement those provided by the lecturer and you are encouraged to ask questions during the session.

There is usually time at the end to talk to the lecturer directly, or possibly to arrange a meeting if further discussion is required.

Example classes

These are interspersed with the lectures at appropriate points and help you to understand key topics. As with lectures, your entire class will be present as the lecturer works through specific examples. You usually have the chance to prepare your own solutions before the class. Of course, we encourage you to participate; asking questions in front of a large audience is an important skill for you to learn and gain confidence in.

'Clickers' may sometimes be used: this is the term for an in-class voting system that enables students to respond to specific questions. Our lecturers use feedback from this system to judge the level of understanding of the class.

Personal tutorials

You will meet your personal tutor on a weekly basis, in a tutor group of about six students. During these sessions, you present your worked solutions to the tutorial questions that have been set that week; these questions will be relevant to what you have recently covered in lectures. Each week, a particular subject is targeted for detailed discussion and you will be assessed on your understanding of it.

Project work

This runs through all years of your course. You will build a microcontroller development system as a project in your first year and then use it in the embedded systems group project in your second year.

A substantial feature of your third year is the individual project, which allows you to show innovation and application of the knowledge and techniques you have learned.

In your fourth year, you will work on a team project with five or six other students.

Team delivery

A lot of our teaching features students working in teams. This is because team-working skills are an essential requirement in the work environment.

We like to practice what we preach and therefore adopt a team delivery approach for our tutorial scheme, embedded systems project and third and fourth-year project delivery. For these activities, we work in teams to ensure consistent high quality delivery of teaching materials while maintaining individual contact with students.

Electrical and Electronic Engineering

Which course is for you?

Our course structure is aligned with the global drivers that define our research themes and our strategic industrial partnerships.

Our **Mechatronics** course is associated with the School's Rolls-Royce University Technology Centre, which focuses on the deployment of autonomous systems into extreme environments. For example: small, uninhabited aerial vehicles are used in applications such as traffic monitoring, or to provide information to the emergency services after natural disasters such as earthquakes.

The School's National Grid Power Systems Research Centre is playing a significant part in developing the changes needed as we move to a low-carbon economy. Students studying our **Electrical and Electronic Engineering** course will be the power engineers of tomorrow tasked with 'keeping the lights on' as the world becomes more reliant on dispersed forms of renewable energy.

Syngenta is an international company dedicated to improving crop productivity; it funds an innovation centre in our School with the purpose of developing electronic systems for agricultural processes. Why? Well, the world population is exploding at the same time that over-farming, over-fishing and environmental degradation is starting to have an impact. Food and water shortages are becoming the norm, but advanced communications and sensor systems have the potential to help solve these problems. We call this area e-Agri and it is a research theme that aligns with our Electronic Engineering course.

Electronic systems are now everywhere: communications, transport, entertainment, at-home and in-business systems. More and more of this equipment is connected to the web and, as an example of growth, the internet doubles in complexity every two years. Our **Electronic Engineering** course prepares you for professional careers in these areas. Detailed information about our courses and the content of the course units is available online:
www.manchester.ac.uk/eee/undergraduate/courses

Let's take a brief look at these courses.

Electrical and Electronic Engineering (EEE)

The use of electricity is an everyday part of our lives. It has to be generated as efficiently and cleanly as possible, and distributed safely to homes and industry. Our homes require electrical power for lighting, cooking, washing machines, refrigerators and freezers. Electrical power is also needed by computers, iPads, PlayStations, smartphones, MP3 players, digital cameras and any other electronic gadget that you can think of.

The domestic mains voltage needs to be converted to a much lower voltage in other household equipment, such as music and video streaming systems, televisions, DVD and hard disk recorders, PCs, and peripherals, all of which contain sophisticated electronic circuitry. Industry needs power at a higher level for use in heavy machinery, which must be controlled and monitored by sophisticated electronic systems. Increasingly in transport, electrical systems are being used in electric vehicles (road and rail), hybrid drives (part electric motor, part internal combustion), engine management electronics, climate control, on-board entertainment and navigation systems.

Graduate from this course and you will be able to contribute fully in the fields of:

- Power systems analysis and protection
- Efficient and clean power generation
- Smart grids
- Renewable energy schemes
- Power electronics
- Sophisticated control systems
- Communications
- Embedded computer systems

Electronic Engineering (EE)

In the 21st century, we look to electronics to provide answers for more and more complicated problems. Take the mobile phone: a very sophisticated computer and communications system that links to a worldwide network of antennas to allow it to connect to any other mobile or landline. Or the digital camera, at the heart of which is a sophisticated electronic device containing millions of individual light-level detectors.

Modern electronics requires an understanding of basic analogue and digital circuits to enable the design of simple elements, which can be connected together to make small systems, which can be connected together to make bigger systems, and so on. When the systems become complicated, we require techniques to allow us to design and use them, such as digital signal processing – for images and audio signals, concurrent processing – to allow the manipulation of the massive amounts of data, data networking and digital communication systems for local distribution and across the internet.

Graduate from this course and you will be able to contribute fully in the fields of:

- Microelectronics
- Mobile and wireless communications
- Smart grids
- Digital signal processing
- Systems engineering
- Software design
- Concurrent systems
- Embedded computer systems
- Networking
- Analogue circuits and systems

Mechatronic Engineering (MTE)

Mechatronics is the marriage of mechanical engineering with smart electronics and is vital to industrial automation and robotics.

To interact with an object, a system must know where the object is, be able to move the object and be able to place it in the required new position. The electronics therefore require information from sensors that can detect position, orientation and visual or audio signals. The electrical inputs from the sensors have to be interpreted and the appropriate signals sent out to the actuators to perform the required operation. This process relies on sophisticated software and hardware capable of translating low-voltage, low-current signals into power signals of sufficient current to drive the actuators.

A good understanding of feedback control is also required in order to make changes in the system from one steady position to another, without oscillations or unpredictable movements.

Graduate from this course and you will be able to contribute fully in the fields of:

- Robotics
- Actuators (electrical machines and drives)
- Sensors and instrumentation
- Power electronics
- Mechatronic analysis and design
- Advanced feedback control systems
- Embedded computer systems
- Production engineering

Electrical and Electronic Engineering

Course types and flexibility

MEng or BEng?

Many students studying for a degree in engineering aim to become Chartered Engineers, and accredited MEng courses give you the required educational base to achieve this.

Accredited BEng degree courses require you to complete further study in order to achieve the same status. This could take the form of full or part-time postgraduate study, distance learning, or work-based learning.

Of course your career path is still developing so our courses are designed to allow you the flexibility to switch between MEng and BEng during years one to three.

Why 'with Industrial Experience'?

All our courses can be combined with an accredited, year-long industrial placement for the award of a 'with Industrial Experience' degree.

Students on these extended courses spend a year in industry between their second and third years, or third and fourth years. Placements can be accredited by the IET towards the training required for attaining Chartered Engineer status. We encourage you to spend time in industry during your course as it develops your business, team-working and transferable skills, all of which are sought after by graduate employers. It will also increase your awareness of the broad range of careers on offer and guide your choice of option subjects.

We have strong links with industry and our students find industrial placements with high profile companies, such as Red Bull Racing, Jaguar Land Rover, National Grid, BP, National Instruments, AstraZeneca and Texas Instruments.

During an industrial placement year you are paid a salary by the company you are working for so affordability should not be an issue.

The Institution of Engineering and Technology

IET

The IET (**www.theiet.org/**) is the professional body that accredits all of our courses at MEng, BEng and MSc levels; this accreditation is required if you want to become a chartered engineer. Here are some comments from their most recent accreditation visit:

- "The structure of the School's BEng and MEng courses enables many opportunities for students to transfer between courses (including to the MSc). This is a helpful feature which when coupled with the annual review of each student's situation ensures that students pursue the educational route that is to their best advantage."
- "The second year Embedded Systems project unit is an excellent example of students developing their team working skills in a multi-disciplinary project, noting that this acts as an early introduction to team working in a technical environment."
- "The highly active and enthusiastic Industrial Advisory Group which comes from a wide range of high profile industries contributes to the School and its courses extensively, including informing course design, providing placements and supporting the student enterprise challenge."
- "The support given to encourage students to pursue and secure placements is excellent, particularly the two day 'managing my future' programme that all students follow at the start of the 2nd year. This includes an 'Enterprise Challenge' event supported by industrialists, peer-to-peer mock job interviews and a number of other elements which support them in developing key skills related to gaining employment."
- "The level and amount of influence of the School's research into the undergraduate and postgraduate programmes is exceptional."
- "The 'open surgery' sessions of two hours per week which most staff have in place is appreciated by the students and is considered a useful model which facilitates early resolution of any issues which students may have, without resorting to a formal appointment system."
- "The facilities made available to students working on the MEng group projects are excellent, with each group having their own office space in which to work, as well as having access to a dedicated MEng Group Project laboratory."

Our MEng and BEng courses are also accredited by the Institution of Measurements and Control (**www.instmc.org/**).

Electrical and Electronic Engineering

What you study

The following sections briefly describe the content of each year of study. For more detailed information, visit:
www.manchester.ac.uk/eee/undergraduate/courses

Year 1

The first year of study is common for all of our courses. Course units are:

Electronics Project

Introduces you to the practical skills associated with the design, electronic assembly, mechanical fabrication and testing of electronic systems. You will assemble and test an interface board for a microcontroller development system, which is used as a teaching vehicle in later course units.

Electronic Materials

Introduces you to states of matter and classifications, such as metals, insulators and semiconductors; to electronic devices in nanoelectronics and nanophotonics; to sensors for applications in robotics, renewable energies, medicine and healthcare.

Measurements and Analytical Software

Systematically introduces you to the process of electrical measurement and the treatment and analysis of measurements and errors, as well as various types of instruments. The course unit also introduces you to LabVIEW, a widely used programming and computing platform for numerical analysis, modelling and electrical system simulation.

Circuit Analysis

Introduces you to the techniques used to analyse electric circuits, starting with DC circuits, progressing through Thévenin and Norton equivalent, moving on to RL, RC and RLC circuits, and finishing with AC circuits.

Digital System Design I

Introduces you to the principles of logic design, starting with Boolean algebra, progressing through combinatorial specification and minimisation, and culminating with sequential design using finite state machines.

Electronic Circuit Design I

Explains the fundamentals of amplification using electronic components. Introduces you to the characteristics of electronic components and the concept of functional flexibility with respect to operational amplifiers, diodes and transistors. Practical implementation of electronic circuit design is a key part of the learning outcomes.

Energy Transport and Conversion

You discuss the various sources and forms of energy. The principles governing mechanics, AC electrical circuits, energy conversion and electrical transmission are described.

Electromagnetic Fields

Introduces you to the fundamental concepts and basic laws of electromagnetic fields and demonstrates their application to the solution of field problems, such as the fields produced by metal security detectors and RFID tag readers. We also link field concepts to the passive circuit components and the methods by which they are calculated.

Microcontroller Engineering I

Introduces the fundamental concepts of microcontroller architecture, digital interfacing and programming. The workings of a simple microprocessor is exemplified by a Microchip Technology microcontroller. You will learn how to control the interface board assembled in the Electronics Project, in both Assembly and C using an 8-bit PIC18F and a 32-bit ARM microcontroller.

C Programming

Gives you a foundation in practical programming skills with an emphasis on problem solving, data structures and algorithms.

Engineering Mathematics I and II

Engineers need the appropriate mathematical skills: functions and geometry, differentiation, integration, vectors, complex numbers, hyperbolic functions, matrices, ordinary differential equations, partial differentiation and series. These form a skill set that is applied in the other course units that we teach and are taught in this context.

Electrical and Electronic Engineering seemed like an obvious choice to me. I'd always been really interested in electronics, so the thought of designing and developing innovative solutions to tomorrow's technical challenges naturally appealed. It didn't take much digging to find that the University of Manchester is consistently considered one of the best institutions in the country for the course. Combining this with an electrifying student city at the forefront of technological innovation is like strawberries and cream.

Manchester is a far cry from the quaint village I was used to, but it was without a doubt the best decision I've ever made. The city never stops, there's always somewhere to go, something to do, no matter what scene. And with so many opportunities within the University, be it societies, sports, or volunteering, I've barely scratched the surface of what's on offer.

This year, I've been working on my Third Year Project, which has without a doubt been the highlight of the degree so far. Given the challenge of developing a solution to a real world problem, this is the opportunity to design a product or conduct research that you're passionate about. I decided to develop an educational device to be used in primary science lessons, and am currently applying for funding to develop the device beyond the project.

I believe Manchester provides a comprehensive further education, so much more than just teaching your chosen course. Skills, experience, and memories picked up from all areas of the university develop an individual, and I know Manchester has left a euphoric lasting impression on me.

Alexander Owens, third year student

MEng Electrical and Electronic Engineering

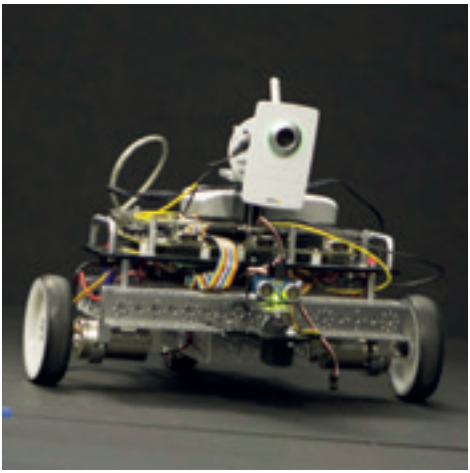
Electrical and Electronic Engineering

Year 2

The first semester of the second year is common for all three courses; the second semester introduces the topics that lead to the specialisations of each course. You have the opportunity at this point to change course if you want to.

The theme of practical application and project work continues with the Embedded Systems Team Project. In this team project, you work in a small group to solve a realistic engineering design problem, using the microcontroller development system built in your first year.

The project centres on the design, construction and testing of a robotic buggy and culminates in a race day, when your buggy will be competing to be the fastest, most energy-efficient, cheapest, or simply the most innovative design. To win, your team needs to be able to bring together the very best skills in sensing, circuit design and building, chassis construction, programming, and navigation.



Year 2 course units	Credits	EEE	EE	MTE
Embedded Systems Project (full year)	20	C	C	C
Microcontroller Engineering II	10	C	C	C
Sustainable Development for EEE	10	C	C	C
Signals and Systems	10	C	C	C
Engineering Mathematics	10	C	C	C
Digital System Design II	10	C	C	C
Control Systems I	10	C	C	C
Electronic Circuit Design II	10	C	C	C
Analogue and Digital Communications	10	C	C	
Machines, Drives and Power Electronics	10	C		C
Applied Mechanics and Industrial Robotics	20			C
Microelectronic Components	10		C	
Generation and Transport of Electrical Energy	10	C		
VLSI Design	10		C	
C = Compulsory course unit course unit **120 credits per year**				

I first came in contact with Robotics and automation whilst working as an Electrician in Spain. I was soon fascinated by the complexity of the subject and the endless opportunities in this fast growing field, so I decided to embark on my academic Engineering journey! I considered a number of options when looking at Mechatronics courses at different universities; Manchester appealed me the most due to its high content on Laboratory sessions, which I thought would suit me better, being a more hands on individual.

I was looking for a University with both an excellent reputation and facilities for the students. Manchester ticked all the boxes! However it was at the School open day where I became completely convinced; I felt extremely comfortable by the friendliness and enthusiasm of the staff and students. I am totally at home here in this lively multicultural city filled with friendly and welcoming people.

I am thoroughly enjoying the embedded systems project during second year; teams consisting of five students get to design, build and program an autonomous line following robot. I most enjoying this part of the course as I get to experience what it is like to work on a project in the real world. Knowledge itself is not the only relevance; I am building up my employability by using soft skills such as teamwork organisation and working under pressure. The possibilities of this project are endless since the theoretical knowledge acquired is put in to use with our creativity. It really is fascinating to witness how different teams come up with an array of designs, all searching for that edge on performance to make it through to the final where the entire School assist to show their support.

The stand out skills I have gained from studying at the University of Manchester are: independence, being a more competent and confident researcher and adaptability. We are constantly challenged to develop new and alternative ways to approach problems in a methodological manner, breaking complex tasks into smaller ones.

I am learning every day here in Manchester. My course is providing me with the knowledge, that I can put into action in extra curricula activities such as the Robotics society. To me it is important to have this balance at university; growing academically and socially. When it is time to leave university I know I will be leaving as a much more complete individual, well prepared for the working world that awaits me. I have already made connections with industries through university.

My advice for other students would be to apply right away! This course really allows you the opportunity to build up a solid background in engineering, whilst providing opportunities to get experience within this field; with the optional work in industry year or summer internships. It is a dynamic course, which offers a wide variety of teaching methods to suit different learners. In particular I have benefited from working in groups; despite its challenges, I like bouncing off other people's ideas and pushing each other to our limits to achieve the maximum. That truly is a fulfilling feeling.

Raul Funes Tena, second year student
BEng Mechatronic Engineering

Electrical and Electronic Engineering

Year 3

By the third year, our courses are quite distinct and you will be studying towards your chosen area of specialism. The table below illustrates the structure of the third year, including the elective course units available to each course.

Your third year also contains an individual project that consolidates your knowledge, skills and understanding. Some of our projects are organised around 'themes', such as Photovoltaics, e-Agri (electronics in agriculture), Green Communications, Smart Grids and Autonomous Systems.

We run over 160 different individual projects in the third year. Example projects include:

- Active control of vehicle vibration
- Design and build a symmetrical hexapod robot with autonomous navigation
- Integration of wind turbines into the electric distribution network
- Water droplet movement in a High Voltage (HV) environment
- Transparent flexible electronic devices
- Financial time series modelling using neural networks
- Colour readers for the blind/visually impaired
- A smart data legacy for education

Year 3 course units	Credits	EEE	EE	MTE
Individual Project (full year)	30	C	C	C
Leadership in Action	10	E	E	E
Engineering Analysis	10	E	E	E
Data Networking	10	E	E	E
Computer Systems Architecture	10	E	C	
Power Electronics	10	E		C
Power System Analysis	10	E		
Concurrent Systems	10	E	E	E
Mechatronic Analysis and Design	10			C
Digital Mobile Communications	10	E	E	E
High Speed Digital and Mixed Signal Design	10	E	C	E
Tools and Techniques for Enterprise	10	C	C	C
Digital Signal Processing	10	E	C	E
Control Systems II	10	E	E	C
Sensors and Instrumentation	10	E	E	C
Current Trends in Optoelectronic Devices	10		C	
Power System Plant	10		E	
Electrical Drive Systems	10		E	E
Mobile Robotics and Autonomous Systems	10			C
Transmission Lines and Optical Fibres	10	E	E	E

C = Compulsory course unit
E = Elective course unit
120 credits per year

I always knew I wanted to study science because I've have this fascination for figuring out how things work ever since I was a kid. For me, Electronic Engineering sounded like the best way to indulge my interests and I'm very happy to say, it lived up to (and sometimes even went beyond) what I expected it to be.

Being an international student, I based my choice of University on the world-class reputation of the course and snippets of what I found online.

I really enjoy the more practical aspects of the course which include the laboratories and projects, because they help me get a better understanding of how things work rather than just the theory. I particularly enjoyed my third year project based on Machine Learning since it allowed me to learn things that I would not have otherwise.

I realised that this degree provided me with the ability to think critically and find answers for myself during my placement year. For my placement, I was doing a primarily software based role specialising in things that I had not learnt over the course of my studies. Though initially daunting, I quickly realised that my course had equipped me with the skill of picking up things for myself, with the result that I performed very well at my placement.

Manchester provides you with a lot of opportunities to go beyond the academics and experiment new activities. I was a peer mentor in second year, facilitating weekly group sessions among first year students, a role that helped me develop my leadership and communication skills. I am now a co-ordinator in the peer mentoring scheme in the School, managing the scheme and organising large workshops for first year students, and that has ensured that I keep my time management and organisational skills up to scratch!

The School provided me the opportunity to do a summer placement after my first year working on laboratory exercises for first year students. Thanks to this opportunity I managed to get a year-long industrial placement and an international scholarship the next year.

Ananya Gupta, third year student
BEng Electronic Engineering with Industrial Experience

Electrical and Electronic Engineering

Year 4 (MEng)

The MEng fourth year comprises a team project, an Enterprise course unit and a range of advanced study course units taught at masters level.

Industrial problems are not solved by individuals working alone, so being able to work effectively as a team member is a sought-after skill. Our fourth-year team project provides you with this challenge and accounts for 50% of the assessment for your fourth year. Many of the projects are directly funded by industry, or inspired by actual industrial needs.

Recent projects have included:

- Improving Humanitarian Demining Operations; creating a low-cost ground penetrating radar (GPR) system including augmented reality to improve operator feedback
- Flying a remote inspection vehicle and its sensing scheme for use inside high voltage direct current voltage source converter stations
- Smart campus energy system
- Integrated electric vehicle energy management system
- Photometric stereo hyperspectral vision system for precision agriculture
- Autonomous cable detection and tracking using quantum well Hall-effect sensors
- Real time distribution network models; monitoring and control

Year 4 course units	Credits	EEE	EE	MTE
Team Project (full year)	60	C	C	C
Advanced Technology Enterprise	15	C	C	C
Process Control and Automation	15	E	E	E
Antennas and RF Systems	15	E	E	
Analysis of Electrical Power and Energy Conversion Systems	15	E		
Nanoelectronic Devices and Nanomaterials	15	E	E	E
Design of Electrical Machines	15	E		E
Power System Operation and Economics	15	E		
Solar Energy Technologies	15	E	E	E
Digital Control and System Identification	15			E
Microwave Circuit Principles and Design	15	E	E	
Digital Image Processing	15	E	E	E
Power System Protection	15	E		
Intelligent Control and Robotics	15	E		E
Wireless Communication and Mobile Networks	15	E	E	
Tomography Engineering and Applications	15	E	E	E
Advanced Power Electronics	15	E		E

C = Compulsory course unit
E = Elective course unit
120 credits per year

Once in high school, my teacher taught me the physics behind a simple electric motor. I was so amazed that something simple can also be so sophisticated. That lesson was what motivated me to learn electrical engineering at university.

After researching different universities around the UK, it was clear to me that the University of Manchester is the right choice. Its incredible reputation, history, and location had made me want to become part of it. After all, what is not to like about Manchester?

Having missed the orientation week, I was nervous that I wouldn't know what to do on my first day. But I remember the staff were very friendly and I quickly caught on to what I was supposed to do to settle in.

What I like most about my course is that it is never repetitive. Each year, there is always something new to look forward to; new project, new software, even new friends. There is a wide range of different software application that I got to try throughout my university career, and it's very exciting.

I have gained many technical and leadership skill throughout my time at the university. Other than the theories that I learn in lectures, I also get to learn how to plan a project, be a part of a team, and work under pressure. This course requires me to actively interact with other students, which has helped boost my confidence and get me out of my shell.

Studying at Manchester, with students from various backgrounds, has not only made me become a better critical and creative thinker, but also helped me learn how to appreciate and work with other people despite any cultural and character differences.

Engineering may sound intimidating, but it can also be very exciting. Make sure that both the course and place is the right fit for you. Imagine the day when you finally receive your degree, what would you feel?

Amy Maharati, fourth year student

MEng Electrical and Electronic Engineering

Student-run activities

EEE Society

Our Electrical and Electronic Engineering Society (EEESoc) is the School's social society. It is run by students, but our events are attended by everyone from undergraduates to lecturers. Some past events have included paintballing, a pool tournament, go-karting, a football mini-league and a pub quiz sponsored by NI.

The society also organises industrial visits. In the past, we have visited: Drax Power Station in Selby, North Yorkshire; Electric Mountain in Llanberis, North-West Wales; and the Jaguar Land Rover site in Gaydon, Warwick.

The biggest event of the year is the annual ball and prize-giving in spring. This is a formal event where everyone has the chance to celebrate all their hard work over the year and students and staff are honoured for their contributions to life in the School. Many of our events are sponsored and attended by high-profile engineering companies, giving you a great chance to network with people in the industry in a more social environment.

To see more of what EEESoc get up to, add us on Facebook: **www.facebook.com/eeesoc**

PASS

PASS runs across many different Schools within our University. Being student-led, it is naturally tailored to the particular needs of the students within our School. The scheme has run within our School of EEE for almost four years now, enhancing the first-year student experience at Manchester.

PASS sessions are informal weekly study sessions where first-year students get together in groups and discuss any challenging academic material, revision questions, or even their experience in adjusting to university life. The sessions are facilitated by students who are mostly in their second year, who are there to share their experiences and to act as a first point of contact for the attendees, guiding them in the right direction in case of any particular issues.

You will find these sessions very beneficial. It is a chance for you to discuss questions, go over the basic concepts taught during that week and explore different approaches to difficult tutorial questions with fellow classmates. It is an ideal way for you to meet new people on the course and make long-lasting friendships.

Besides the regular sessions, PASS is involved in further events, including activities in Welcome Week, revision quizzes, a circuit-building exercise and extra lab sessions where you get a chance to play around with the equipment away from any regular class time. In short, PASS can enhance your life as a student in our School both academically and socially.

EEE Electronics Club (E4C)

E4C provides technical support and workshop facilities that enable you to create, develop and promote your own ideas for electrical, electronic, or mechatronic robotic systems. In addition to practical work, the club organises presentations by industrial speakers, and a formal project evening. The club has a Facebook page and a website describing past and present projects. Find out more at the E4C webpage: **www.manchester.ac.uk/eee/e4c**

Athena Swan

The School holds the Prestigious Athena SWAN charter bronze award. The Athena SWAN Charter recognises commitment to advancing women's careers in science, technology, engineering, maths and medicine (STEMM) employment in higher education and research. Further details can be found here: **www.athenaswan.org.uk/**

Robotics Society

"Robotics can be a fascinating area of study; the combination of electrical, electronic and mechanical systems can make for some weird and terrifying creations. Our newly formed Robotics Society (RoboSoc) hopes to build on this, supporting everyone from first year engineers to budding Roboticists. Officially formed in September 2013 by students from the School of Electrical and Electronic Engineering and the School of Mechanical, Aerospace and Civil Engineering and has delivered weekly training and practical sessions to teach students robotic fundamentals and Arduino laboratories.

Right now, we're working on a project to get all our first-year members to build their own quadruped (four-legged) robot. The RoboSoc Quad, as it's called, is a simple robot that uses four legs for locomotion, and should help our first-year members to gain experience with practical robotics, electronics and mechanical design. Our future plans involve building a variety of different robots and running a robot-dance competition! We hope to see you in one of our sessions soon."

Josh Elijah

Third-year student MEng Electrical and Electronic Engineering with Industrial Experience

WiSET

Members of our School are actively involved in WiSET: Women in Science, Engineering and Technology.
This is a network for all female students, research and academic staff in our Faculty of Engineering and Physical Sciences. The network organises a series of social networking events, industrial site visits, skills workshops and debates.

The WISE award recognises the efforts of early-career female engineers in encouraging women and girls to participate in science and engineering.

Career opportunities

While you study

Summer placements in our School

As well as studying in our School for a degree, many of our students take on summer placements (jobs/internships) with us as well. Why? Simply put, they are a fantastic way to enhance your understanding of the subject and, in many cases, experience research work first-hand. You may receive a bursary, so it could help with your finances.

It will also give you work-based experience, which is a very important factor that will be taken into account when you apply for graduate jobs. That experience doesn't have to be directly related to the job that you have applied for; it is to show that you are aware of the challenges of the work environment. Having this experience will complement your course and improve your employability—it will set you apart from others.

We also benefit from summer placements. A placement may involve the development of teaching materials. Who better to help with this than our students, they know which parts of the subject they find difficult and can help develop material that will enhance the student experience? If the project is research-based, then the benefits to the School are obvious—it enhances our research reputation. It can also help us to identify students with the ability to continue after their first degree to study for a PhD.

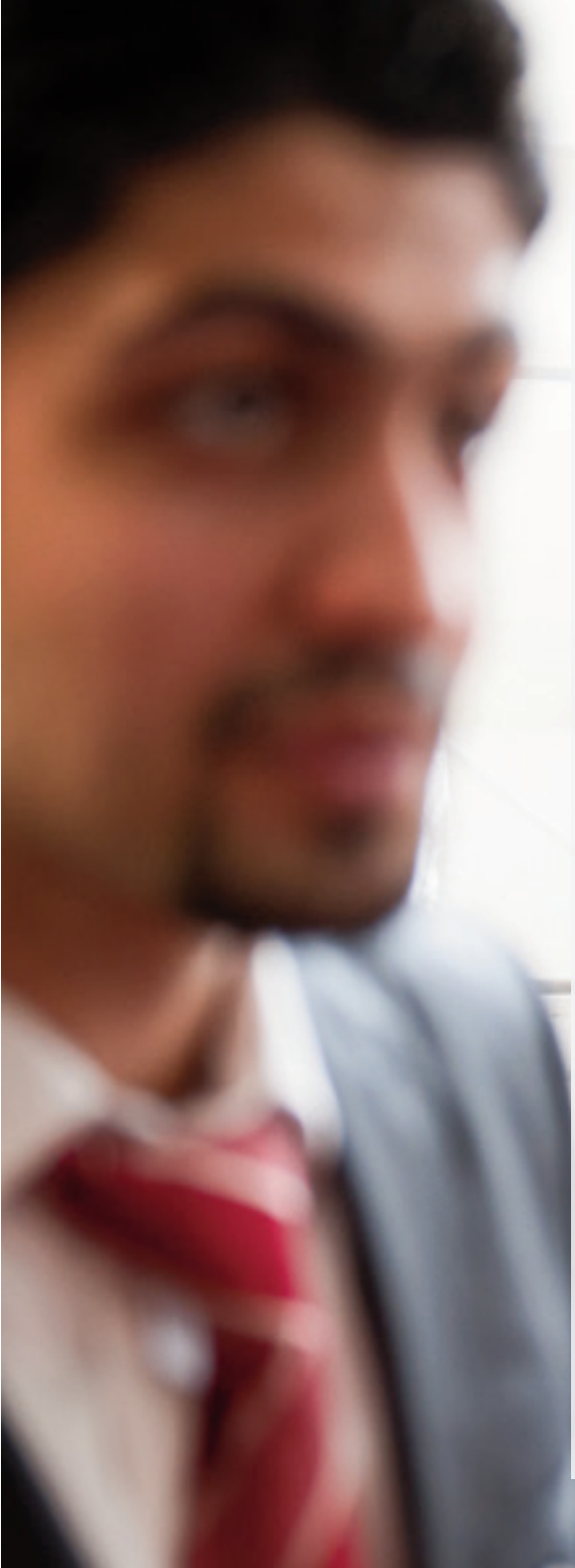
> "The Welcome Week planning internship was an amazing experience for me. I worked with another student intern and we spent several weeks planning the welcome week events for over 500 students. It was an advantage for us to organise the activities more from a students' point of view and it felt great to see so many happy faces of new students during welcome week. As an international student, the benefit of this internship was not only gaining many transferable skills but also having chances to be more integrated into the University"
>
> **Mingyu Han, third year student BEng Electrical and Electronic Engineering**

After graduation

On successful completion of your chosen course, you will be well equipped for a graduate career in engineering and other sectors. Read on to find out what employers have to say about our graduates.

> "Our relationship with The University of Manchester, as well as our involvement with the Power Academy, provides us with the quality of engineers that we require to meet our future business needs. We want to recruit professional engineers who enjoy analysing technical requirements, specifying innovative solutions and being involved in the installation and commissioning of vital infrastructure projects for the UK both onshore and offshore.
>
> Students who come to work for us ypically undertake a graduate training programme to ensure they obtain a full appreciation of the different engineering disciplines involved in the delivery of our exciting energy transmission projects."
>
> **Kevin Hewling, Engineering Manager Siemens plc**

> "It is important that we have well-qualified engineers coming into the company, and we target specific centres to ensure that we have a flow of well-qualified graduates. It is important to us that we play to the interests and ambitions of students through the industrial placements, which can be up to 12 months.
>
> Students who come to work with us have a couple of years' grounding within their chosen field. They come to the company and we would typically have a major programme for them to work on, where they will make a genuine contribution to the company."
>
> **Brian Simmers, Engineering Manager Rolls-Royce**



Careers

Opportunities are available to our graduates across a massive range of industry areas and companies, including:

- Research and development – Siemens, ABB, National Grid
- Design – ARUP, Rolls-Royce
- Process engineering – BP, AMEC
- Control – Bentley, ABB, BP, P&G
- Manufacturing – FKI plc, DIODES Inc
- Information technology – Intel, IBM
- Consultancy – Accenture, Detica
- Investment banking – Goldman Sachs, Deutsche Bank, Citi, Deloitte
- Communications – BT, Agilent Technologies, Vodafone, Nortel Networks
- Automotive and aviation – Bentley, Jaguar Land Rover, Red Bull Racing, Rolls-Royce
- Energy – ABB, AREVA, BP, EDF Energy, E-On, National Grid, Shell, United Utilities

Of course, not all engineering students decide to pursue a career that is directly related to the course they have studied. Our courses will provide you with many key skills, such as logical thinking, team working, report writing, analytical and presentation skills, programming and a high level of numeracy. These skills will be useful in any career and will put you in a good position to apply for the 40% or so of graduate jobs that are not degree-specific.

Around 15% of our graduates decide to continue their studies by following a postgraduate degree course. This could be in the form of a specialist taught course, or a research programme, either of which can give you a further boost in the jobs market, or lead you into a research career.

For more information on postgraduate opportunities, see our website:
www.manchester.ac.uk/eee/study

Graduate profiles

I graduated with a first class BEng in Mechatronic Engineering from the University of Manchester. I also gained professional year-long industrial experience by working as software development engineer within the Research and Development department at PBSI Group Limited. I am currently working as a Graduate Engineer at Babcock International, employed under the three-year rotational graduate scheme within the Network Engineering – Rail department.

Apart from doing well in my exams, I made sure that I had fun during university and got myself involved in various volunteering activities, networking events, part time jobs, cultural and academic societies to develop relevant experience and soft skills that most employers look for within a graduate. I realised that work experience is a must before graduating in today's highly competitive environment. With help and support from the School's career advice team, I made sure that I did a year-long industrial placement relevant to my degree. This was immensely helpful during graduate job applications and interviews.

My degree not only attracted employers, but played a major role in equipping me with practical engineering experiences; strong academia and challenging projects which helped me stand out amongst the crowd. The second year group project that involved developing an autonomous line following robot, helped me develop expertise in sensors and gave me a broader understanding on motors profiles, gearbox, PIC microcontroller programming, mechanical chassis design, control systems, PCB design software along with cost analysis, safety constrains, innovation and other soft skills.

Third year individual projects are always challenging but the level of complexity and immediate application into industries makes sure that you have a product that has never been developed before. My "Capacitance Based Car Mist Clearing Sensor" project was selected as one of the highly commended projects and gave me the opportunity to attend the three day conference at the global Undergraduate Awards 2014 Summit held in Dublin. The project was selected amongst 5000 applicants over 26 countries. That is the level of expertise and knowledge one can develop at the University of Manchester.

The excitement of what each day can bring is something I enjoy the most. The multi-disciplinary work experience and the opportunities to work with experts from various engineering and non-engineering backgrounds are truly intriguing. One day I can be in the office, working on design. Another day, I will be on site walking alongside live railway lines, doing surveys. Once a month I meeting up with other graduates for a professional development training course that takes place in Manchester.

Mechatronic Engineering is a relatively new subject and awards you with the opportunity to excel in integrating mechanical systems with smart electronics. With the global revolution of automation and technology, a degree in Mechatronic Engineering is exceptionally valuable in global industrial development. University of Manchester's outstanding student life, friendly environment, helpful stuff along with solid teaching and learning facilities makes it one of the best universities to graduate from. You can be successful by just enjoying the course, gaining some experience and relishing every single day at the University.

Harish Gautham Kathiresan
BEng Mechatronic Engineering with Industrial Experience
Graduate Mechatronic Rail engineering at Babcock International group

I decided to read Electrical and Electronic Engineering at Manchester for its leading research, global reputation and strong links with industry. The depth and variety of the course units gave me the skills and confidence when later on industrial placements.

After completing my MEng I chose to further my academic career and management skills. An engineering doctorate at Manchester provided the perfect vehicle through which to achieve this and I undertook research into solid-oxide fuel cells with Rolls-Royce. I enjoyed the challenging work of R&D and shortly after joined Manchester's power conversion group as a researcher. It was here that I was exposed to projects in other technical fields and had the opportunity to work and lead international teams.

I'm presently a manager in R&D at Alstom Grid. Alstom Grid is a world leader in HVDC with over 50 years of experience. Recently Alstom Grid won the DolWin3 900MW offshore HVDC project, using the HVDC MaxSine Voltage Source Converter technology. Alstom is also currently providing an 800kV Line Commutated Converter HVDC energy highway long distance project in India; with many other projects across the globe. The opportunities to work in a culturally rich environment with travel appealed to me greatly.

Alstom Grid's worldwide HVDC Centre of Excellence in Stafford provides complete turn-key solutions for the rapidly-growing global HVDC market. Project Management, Engineering, Manufacturing, Test Laboratories and R&D are all located in Stafford. This unique setup gives HVDC engineers at Stafford exposure across the manufacturing cycle; allowing innovation and design to quickly influence new and existing products.

My role in System Concepts includes leading research projects for future voltage source converters for HVDC applications. This includes making offshore converters for the wind energy market. The post is challenging and demands the technical expertise and management skills that I have developed throughout my career.

Studying at Manchester provided me with fantastic opportunism; allowing me to build my academic career while expanding my experience and industrial network. Manchester offers such a culturally diverse and exciting place from which to study that every moment has been memorable.

Dr Kevin J Dyke
System Concepts Manager, HVDC R&D, Alstom Grid
MEng, PgDip, EngD, CEng, MIET, MIEEE, MInstLM

I have been on the Rolls-Royce professional excellence programme for just over six months after graduating from The University of Manchester. At Rolls-Royce, we develop high performance gas turbines predominantly for use in civil and defence aerospace, though our marine and nuclear businesses are also experiencing rapid growth.

I am currently working as an Electrical Systems Engineer in the Strategic Research Centre, which has the responsibility of investigating and developing emerging technologies that could offer a step change in the performance of Rolls-Royce products. We take what are initially 'blue-sky' concepts and rapidly turn them into feasible solutions, before they are passed on to other parts of the business.

I have been tasked with the development of high performance heat exchangers for the next generation of power electronic converters. It is my responsibility to determine which technologies we should invest in, secure any surrounding intellectual property and design and build functional prototypes.

My next attachment will be in Singapore, at the new Rolls-Royce Seletar facility. There I will be Project Manager on a work package to introduce 3D surface measurement techniques onto Wide Chord Fan blade production lines.

Work at Rolls-Royce is challenging, but each day is different. It's never difficult to get up for work in the morning when you know you are working for one of the true giants of the engineering world.

My MEng degree gave me a solid foundation in every aspect of electrical engineering, especially in power electronics and electrical measurement, which are both of growing importance in the aerospace industry. Course units throughout the EEE course at Manchester, in particular the fourth-year team project, give you all the skills that you need to work effectively in industry. This is invaluable, along with the other experiences you gain while at the university.

I would recommend the course, the University and the city as a whole to anyone who is looking to get ahead in life and have an enriching experience along the way.

James Gyves
MEng Mechatronic Engineering with Industrial Experience
Now a Professional Excellence Engineering Graduate at Rolls-Royce

It is a common belief that some of the best years of your life are those spent at university. I could not agree more! That said, I am having a fantastic time in my graduate job as an engineering consultant at Parsons Brinckerhoff. It is the skills that I developed and the experiences that I gained during my time at The University of Manchester that are helping me to be successful in this role.

During my four years at the University I developed a wide range of skills, both technical and transferable. The course involved the study of many interesting topics, with lectures taught by experts in the sector. There were also practical sessions, which helped to reinforce the knowledge, and team projects, which helped to improve leadership and team working skills. The course involved several opportunities to practice presentation skills, and report-writing skills were developed through the submission of coursework. The University's involvement in the IET Power Academy scheme meant that I also gained invaluable on-the-job experience working for Alstom Grid over three summer placements.

Since joining Parsons Brinckerhoff one and a half years ago, I have enjoyed a varied range of work. For the past eight months I have been working for a distribution network operator on a range of asset replacement projects. These projects involve the replacement or refurbishment of substation equipment, such as transformers and circuit breakers. Initially, I was involved in helping out with producing tender specifications, but more recently I have taken on the role of project manager. So far this has involved site meetings, discussions with contractors, ordering equipment, producing specifications, and developing a plan for the duration of the project.

I am currently working towards chartered status, which I hope to gain in the next four to five years. There are so many exciting developments in the power industry and I look forward to a varied and interesting career in this field.

Angela Rotheram
MEng Electrical and Electronic Engineering
Now a Graduate Engineer at Parsons Brinckerhoff

Read on for information on what some of our students have gone on to do since graduating.

www.manchester.ac.uk/eee/people/student-spotlights

Research at Manchester

As part of a research-led university, research is naturally very important to our School and students.

Research is important to you because you will be studying a subject that is very dynamic. The fundamental concepts of the subject are fixed (almost!) but the technology and applications are continually changing and expanding. You need an education that can take this into account and, with academic staff who are research-active, this is what you get at Manchester.

This means when you graduate you will have the education and knowledge needed by industry now and in the future, which is what makes our graduates so popular with industry.

We may be research-led, but our teaching activity is fundamental to our research capability. A lot of our research is funded by industry: the industry that employs our graduates. We also recruit our graduates to conduct our research (See Charles Vey's graduate profile on page 38). Many of our third and fourth-year projects and summer placements are research-based, so well-educated undergraduate students are essential to us.

Research quality

93% of our research was ranked as world-leading/internationally excellent in the national audit of research excellence called the Research Excellence Framework 2014 (REF2014). For the first time an assessment of research impact has been included as part this audit and this ranked us in the top three of all institutions in our discipline – a clear indication of the importance and relevance of our research and to achieve this success we depend on the contributions from our students.

Examples of key research themes

Efficient energy delivery has been a major research theme of ours for more than 50 years – but never has it been as important as it is today. For example, major cities in western countries suffer from blackouts due to decaying power supply infrastructure at a time when targets to reduce global warming create additional pressures on the implementation of renewables, clean technology and energy storage systems.

A new and exciting research theme for us is e-Agri, which describes the application of electronic sensors and Information Communications Technology (ICT) to agricultural and food processes. Apart from climate change and overpopulation, the westernisation of world diets is producing even greater pressure on agriculture: approximately 7kg of grain is required to produce 1kg of meat. Many of the benefits of fertilisation, irrigation and seed selection have already been realised and a new impetus is required to deliver the necessary yield improvements. We believe that this will come from sensor and ICT-based control processes applied to agricultural processes.

Our Autonomous Systems Theme develops autonomous systems for real-world industrial applications in the three domains of Unmanned Aerial Vehicles, Unmanned Underwater Vehicles and Unmanned Ground Vehicles. These systems typically manifest themselves as mobile robotic platforms and are used for a variety of purposes, including performing remote tasks in hazardous environments and remote sensing. We explore new sensing technologies, novel vehicle platforms, new control strategies, new cognitive algorithms, power management and optimisation, and methods and tools for perception, abstraction, path-planning and decision making.

Research at Manchester

Research areas

Our research can be broadly split into the following six areas. These greatly enhance our degree courses and ensure that we are educating engineers with leading edge courses informed by the latest developments in research.

The IET commented when they last visited to accredit our courses that:

"The level and amount of influence of the School's research into the undergraduate courses is exceptional."

1. Control Systems

We are internationally recognised for our achievements in advancing theory and application of frequency-domain design methodologies for multivariable control systems, self-tuning regulators, and theoretical foundations of fault detection and diagnosis.

2. Electrical Energy and Power Systems

We are one of the world leaders in this area and we make major contributions across a broad range of electrical power systems and high voltage engineering activities. Our comprehensive high-voltage research laboratory - the largest in the UK - is used for investigations of over headlines, insulation and lightning protection systems.

3. Microwave and Communication Systems

This group considers a wide range of advanced topics applicable to communications and radar: from highly mobile wireless networks, propagation, microwave and milli-metric components, through to digital signal processing, coding and signal analysis. The group operates at radio frequencies from HF to 200GHz and allows a wide range of cross-disciplinary issues to be studied, while retaining a strong focus on communications and microwave component research.

4. Microelectronics and Nanostructures

Semiconductor devices are at the heart of all electronic engineering and at the core of information technology, electronics and communications (ITEC), the world's largest industry. Our research is aimed at inventing and developing new electronic materials, devices and systems.

5. Power Conversion

We have an international reputation in the closely linked activities of electrical machines, drives and power electronics. We focus on electromechanical and mechatronic systems with associated control functions, and actively collaborate with a wide variety of industrial partners.

6. Sensing, Imaging and Signal Processing

Comprises three world-leading teams:

- Industrial Process Tomography: electrical, microwave and optical modalities, commercial instruments from Industrial Tomography Systems Ltd and Process Tomography Ltd
- Vision and Information Processing: scientific imaging devices and systems, image and video processing, neural networks and pattern recognition, cognitive science studies
- Digital Signal Processing: instrumentation and software for non-destructive testing of materials using inductive scan imaging and ultrasonic systems, analysis of cardiovascular and autonomic function, real-time DSP hardware for audio bandwidth applications

Ever since my early childhood, I can remember being inexplicably intrigued by technology. Having matured in this information age I have become actively involved in the evolution of its golden era. Manchester, as a research-led university, was the perfect fit for me.

Coming from a larger city, London, I felt at home in Manchester but quickly came to appreciate the scale; allowing me to walk to university every day. The School is situated right in the heart of the city, in the iconic Sackville Street Building. It took some time to get used to the maze of corridors and hidden lecture theatres but these all add to the character of the building.

My particular interest is in the application of contemporary concepts into the developing market, as it allows the application of new-technology to a social requisite. My research allows me to work at the cutting-edge of technology whilst fulfilling my social aims of helping society.

From the start of my post-graduate career, I developed an interest in communicating the work that we do here. Thanks to my supervisor, I have spoken at a number of conferences, presented for government policy, been interviewed on the radio and have even begun some outreach to local schools. In terms of co-curricular activities, I have begun some consulting work for a local social enterprise, which allows me to develop my professional portfolio whilst within the training envelope of the university.

My work is focused around agricultural technology and aims to promote sustainability in its application. Almost by chance, Manchester has become a beacon for sustainability in the UK as it establishes its title as 'the second city' and was awarded this year as the European city of science. Thanks to the university's close relationship with industry, I find that my research is kept in context and I am given the opportunity for invaluable feedback.

I spent my Masters Year working as part of a team, on low cost sensor systems, for promoting water sustainability in developing rice farming. As part of this work, I developed an image processing algorithm that monitored the growth stage of the plant. Thanks to my progress in this, I was asked to take on a PhD using similar techniques but looking at the samples in much more details.

I would recommend both the undergraduate and postgraduate courses within the School of Electrical & Electronic Engineering. As a teaching assistant I have seen the ever-updating projects that keep the course relevant and prepare students for industry. With regards to postgraduate applications, I would note that the department is moving to a new-state-of-the-art building which will allow unrivalled access to facilities and resources.

Charles Veys
MEng in Mechatronic Engineering
Currently studying for a PHD in Developing Low-Cost Diagnostic Imaging for Emerging Agriculture

Power Academy

We are involved in the Power Academy scheme, which has the following mission statement:

"The Power Academy aims to deliver world-class graduate engineers to design, develop, implement and maintain the power industry of tomorrow. The emphasis of the Academy will be on developing exciting, rewarding and challenging careers for those involved and for meeting the changing demands of a dynamic and progressive industry."

The Power Academy (**conferences.theiet.org/power-academy/**) has established an Engineering Scholarship Fund for European Union students who would like to study electrical engineering. The University of Manchester is one of just seven universities involved with this initiative, along with The IET and the following companies:

- Atkins
- BAE Systems
- Culham Centre for Fusion Energy (CCFE)
- Costain
- London Underground
- Mitsubishi Electric
- National Grid
- Network Rail
- Northern Ireland Electricity
- Northern Powergrid
- RWE Generation
- Rolls-Royce
- Scottish Power
- Scottish and Southern Energy
- Western Power Distribution

BP awards

BP offers a range of awards for students within our School. The aim is to recognise academic excellence and support the potential for future achievement. Students who receive a BP award not only benefit from financial contribution, but also get the opportunity to gain an insight into the exciting careers available in BP. They will be able to forge strong relationships with industry experts and gain practical knowledge.

NI Engineering Scholarship Programme

We are actively involved with NI and use their teaching platform, ELVIS, in our laboratories. NI also contributes to our project work by providing instrumentation systems and training for students.

This scholarship programme allows students who have shown outstanding academic achievement to develop their professional engineering career. In order to be eligible for the NI Engineering Scholarship Programme, you must be in your first year at university.

Student funding

UK Electronics Skills Foundation (UKESF)

We are a university partner in the UKESF, which offers scholarships to home/EU students studying MEng and BEng degrees in Electrical, Electronic and Mechatronic Engineering. Successful candidates are matched with sponsoring companies for scholarships that include: an annual bursary of around £1,500, paid summer work placements, industrial mentoring, professional development training at summer workshops and opportunities to build relationships with potential employers.

Partner companies offering scholarships:

- Aptina Imaging
- ARM Ltd
- Broadcom
- C-MAC MicroTechnology
- Cambridge Silicon Radio Ltd
- Dialog Semiconductor
- Fujitsu Semiconductor Europe GmbH (FSEU)
- Imagination Technologies
- Infineon Technologies UK Ltd
- Renesas Electronics Europe Ltd
- Swindon Silicon Systems
- Wolfson Microelectronics PLC

For further information please see:
www.ukesf.org/scholarship-scheme

For more information on these and other scholarships, contact us, or check online:
www.manchester.ac.uk/eee/undergraduate/funding

University funding

For the latest information on funding awards available from the University, visit our student finance webpages:
www.manchester.ac.uk/studentfinance

Industrial collaboration

As a student in our School of Electrical and Electronic Engineering, you will benefit from our strong links with industry.

Our Industrial Advisory Group is the forum where industry tells us of its vision for the future and offers guidance on the knowledge and skills that industry will expect of the best graduates in three or four years' time. Through the guidance of this group and our annual course review, we are able to offer courses that produce the graduates prized by industry.

Industry-linked facilities and funding

Our strong, ever-growing links with industry not only help to inform our courses, but also boost our excellent teaching and research facilities. State-of-the- art facilities in our School include:

- National Instruments Undergraduate Teaching Lab (including LabVIEW, LabView Academy and Multisim)
- National Grid High Voltage facility, including the National Grid Power Systems Research Centre
- Rolls-Royce University Technology Centre (Electrical Systems for Extreme Environments)
- Oxford Instruments VG Semicon Molecular Beam Epitaxy facility
- Agilent Technologies Millimetre-Wave Laboratory

Industry also provides direct support for our teaching, for example

- Freescale, the semiconductor division of Motorola, provides equipment for use in our Digital Signal Processing (DSP) teaching laboratories
- Siemens, NI, Control Techniques and Sensor Technology have sponsored the refurbishment and equipping of one of our teaching laboratories
- Rolls-Royce, The Power Academy, NI, Procter and Gamble, BP, Hima-Sella, the IET and Centrica provide us with prizes and scholarships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Find out more online

Accommodation
Discover your new home:
www.manchester.ac.uk/accommodation

Admissions and applications
Everything you need to apply:
www.manchester.ac.uk/ug/howtoapply

Alan Gilbert Learning Commons
Take a look around our 24/7, independent learning space:
www.manchester.ac.uk/library/learningcommons

Careers
Take control of your career:
www.manchester.ac.uk/careers

IT Services
Online learning, computer access, IT support and more:
www.manchester.ac.uk/itservices

Library
We have one of the UK's largest and best-resourced university libraries:
www.manchester.ac.uk/library

Maps
Find your way around our campus, city and accommodation:
www.manchester.ac.uk/aboutus/travel/maps

Prospectus
Download or order a copy of our prospectus:
www.manchester.ac.uk/study/undergraduate/prospectus

Disability Advisory and Support Service
Talk to us about any support you need:
www.manchester.ac.uk/dass

Funding and finance
Get to grips with fees, loans, scholarships and more:
www.manchester.ac.uk/studentfinance

Careers
Take control of your career:
www.manchester.ac.uk/careers

International students
Let us help you prepare for your time here:
www.manchester.ac.uk/internationa

Sport
Get active with our clubs, leagues, classes and facilities:
www.manchester.ac.uk/sport

Support
Let us help with any academic, personal, financial and administrative issues:
my.manchester.ac.uk/guest

Students' Union
Immerse yourself in societies, events, campaigns and more:
manchesterstudentsunion.com

Videos
Learn more about us on our YouTube channel:
www.youtube.com/user/universitymanchester

Contact details

For further information about the courses, or about qualifications, please contact:

Admissions tutor

Dr Ognjen Marjanovic

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For the most up-to-date course information, please visit our website: **www.manchester.ac.uk/eee**

Disclaimer

This brochure is prepared well in advance of the academic year to which it relates. Consequently, details of courses may vary with staff changes. The University therefore reserves the right to make such alterations to courses as are found to be necessary. If the University makes an offer of a place, it is essential that you are aware of the current terms on which the offer is based. If you are in any doubt, please feel free to ask for confirmation of the precise position for the year in question, before you accept the offer.

“Pioneering innovation since 1824”

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