



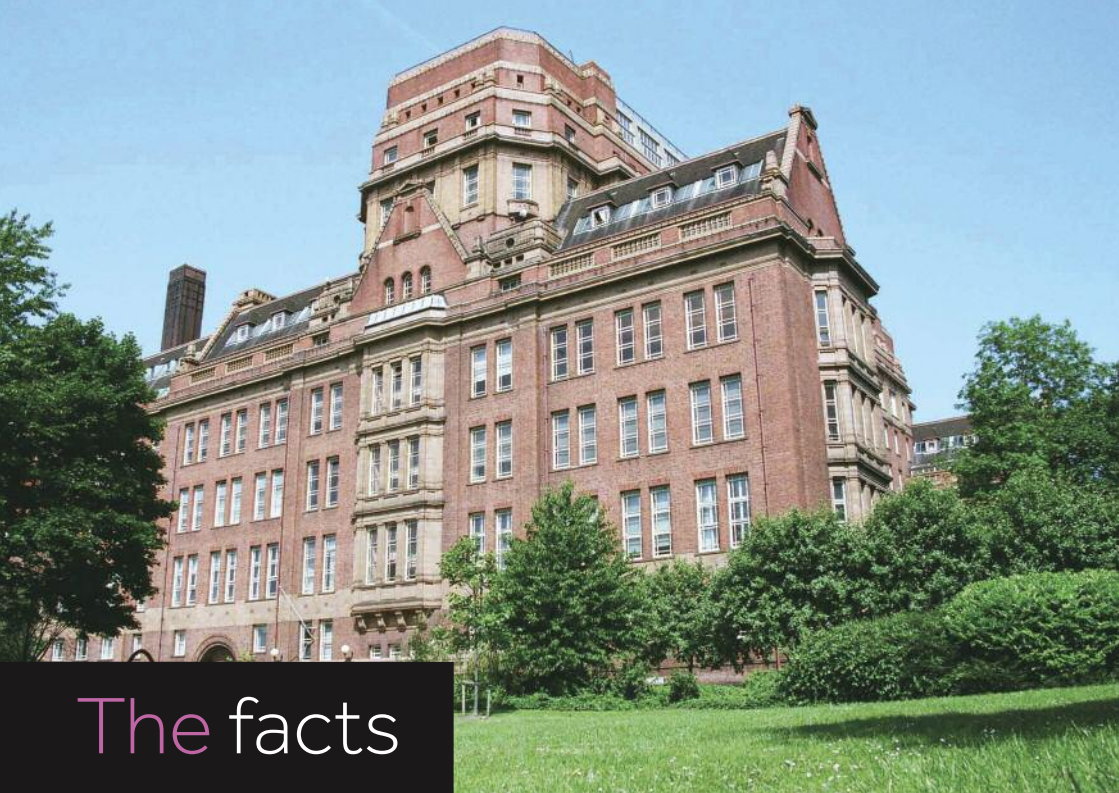
MANCHESTER  
1824

The University of Manchester

# Electrical and Electronic Engineering

UNDERGRADUATE BROCHURE 2014

[www.manchester.ac.uk/eee](http://www.manchester.ac.uk/eee)



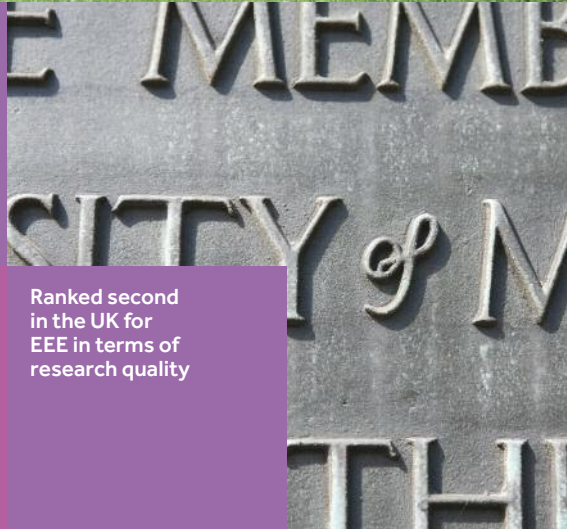
# The facts



Manchester  
boasts over a  
century of  
education and  
research in EEE

All courses  
accredited by the  
Institution of  
Engineering and  
Technology

EEE awarded 96%  
student satisfaction  
in the last National  
Student Survey



Ranked second  
in the UK for  
EEE in terms of  
research quality







“ I have a number of attractive job opportunities available to me, thanks to studying at Manchester.

Michael Madera  
MEng Electrical  
and Electronic Engineering ”



# Contents

- 4 Introducing Manchester
- 6 Electrical and Electronic Engineering at Manchester
- 10 Course details
- 30 Graduate profiles
- 34 Research at Manchester
- 38 Student funding
- 42 Find out more online

## Our University

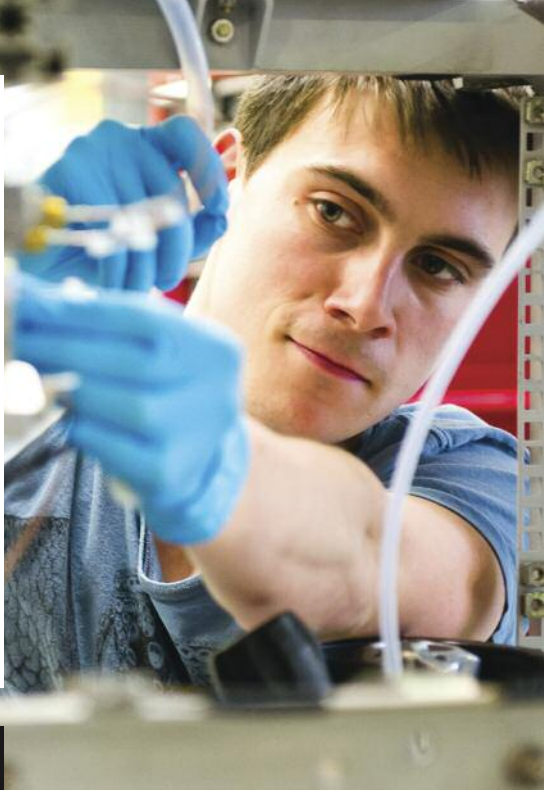
### Making things happen

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 groundbreaking theory into 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.

Join us at the heart of Britain's most popular student city.

Learn more about us:  
**[www.manchester.ac.uk](http://www.manchester.ac.uk)**



## Introducing Manchester

### Our city

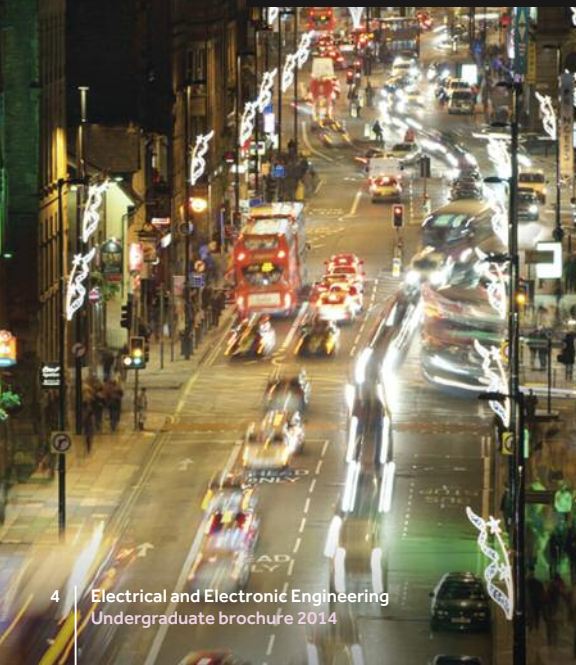
#### Always moving forward

Manchester lives on the edge of tomorrow, ever 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, strives for excellence in all walks of life.

This is a city of many accents, having become a cosmopolitan magnet for students and professionals eager to experience its can-do attitude, independent spirit and cultural wealth.

Never content to live on past glories, Manchester has a passion for progress.

Discover what makes Manchester unique:  
**[www.manchester.ac.uk/cityofmanchester](http://www.manchester.ac.uk/cityofmanchester)**







## Your experience

### More than just a degree

From the flexible, 24/7 learning environment of the Alan Gilbert Learning Commons to the personal development opportunities and specialist support services we offer, we will empower you to be your best.

We're well underway with the biggest investment programme ever seen in UK higher education, having invested £750 million in our facilities since 2004, with another £1 billion to follow. Away from your studies you'll have access to the UK's largest student union, almost 300 student societies, and excellent sports and fitness facilities.

The only thing you won't experience is boredom.

Hear from some of our students, graduates and staff:

**[www.manchester.ac.uk/ug/profiles](http://www.manchester.ac.uk/ug/profiles)**



## Your career

### On a course to success

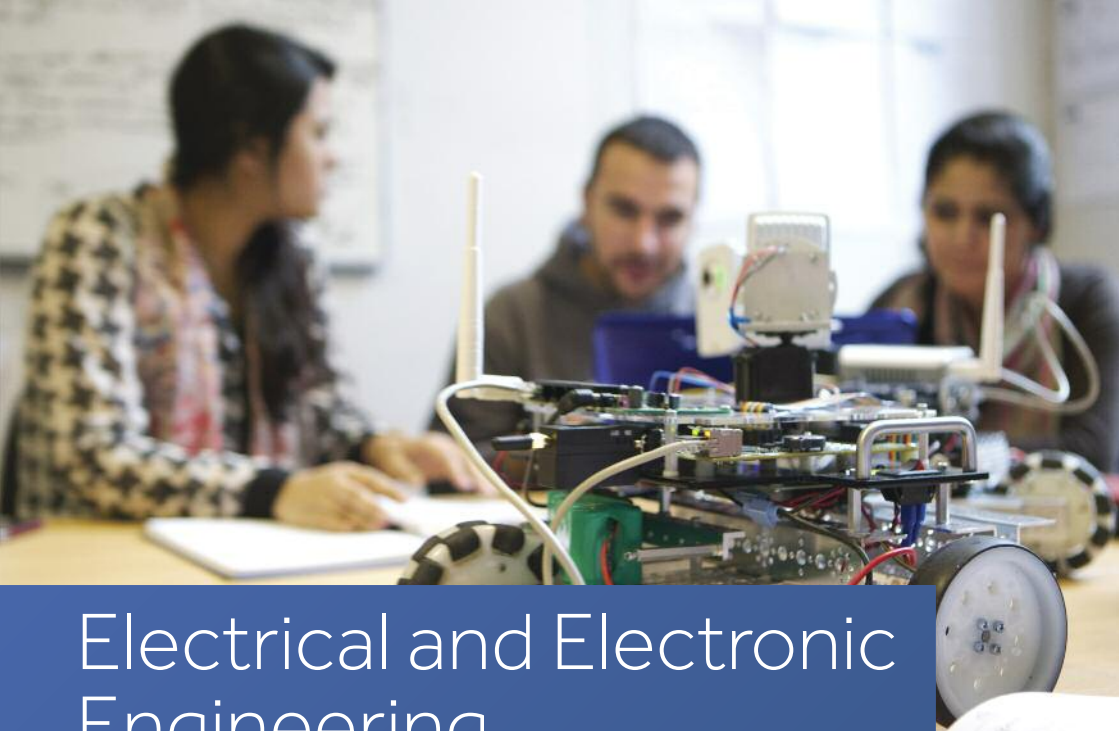
We are one of the UK's most targeted universities by employers – 92% of our graduates go straight into employment or further study.

We design our courses with your employability in mind. Our problem-based approach to learning inspires you to think critically, creatively, and independently. You'll also be able to learn new skills through volunteering, personal development programmes and study abroad pathways.

We have the UK's best careers service, providing advice and mentoring services, and connecting you with employers who'll put you on a path to career success.

Take control of your career:

**[www.manchester.ac.uk/careers](http://www.manchester.ac.uk/careers)**



# Electrical and Electronic Engineering at Manchester

**96%**

student satisfaction (NSS, Unistats)

**Our School of Electrical and Electronic Engineering is one of the largest in the UK, with over 65 academic staff, a similar number of support staff and a student population of over 950. More than 550 undergraduate students benefit from our wealth of expertise – and a warm welcome.**

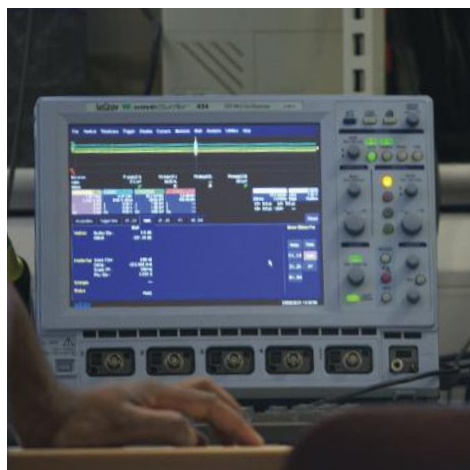
We have been involved in education and research for over a century. The first stored-program computer was designed and built by Frederic C Williams and Tom Kilburn in our School at The University of Manchester; its first program ran on June 21, 1948.

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](http://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 EEE life; find out more on pages 13, 20, 24 and 26.

### 03 Clubs and groups

With our EEE 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! Each student on our course receives free membership to the IET. Read some of the comments from the IET's last visit to our School on page 16.

### 07 Be associated with the big players – Strategic Industrial Partners

The University of Manchester has many collaborative alliances with leading businesses, meaning our courses and research is on the cutting edge of engineering advances. See pages 12 and 38 to 40.

### 08 LabVIEW

The LabVIEW Academy will place EEE in a unique position to offer its students courses that are accredited by National Instruments. See page 12.

### 09 Excellent research rankings

The Research Assessment Exercise (RAE) ranks universities' quality of research against international standards of excellence. Our School is ranked second in the UK for its world-class research reputation. See page 34 to 37.

### 10 Satisfied students

What better endorsement than to achieve 96% student satisfaction in the 2012 National Student Survey, ranking us the top institution in the country for engineering?

Read some comments from current students about their experiences on pages 19, 21, 23, 25, 27, 31, 32, 33 and 37.



## Award-winning community

The past few years have been fantastic, especially in terms of teaching, research and awards.

In 2012, Professor Patrick Gaydecki received a University Teaching Excellence Award for his 'inspiring commitment and contribution to Teaching and Learning'. Patrick joins a growing list of academics from our School who have received recognition for their teaching.

In 2011, the University Teaching Excellence Award was presented to Mr Geoff Rubner and in the previous year one of our senior lecturers, Mr Peter R Green, received the same award. The University also recognised the excellent teaching of Dr Danielle George when she was awarded a Distinguished Achievement Award as Teacher of the Year; Danielle was also a finalist in the Woman of the Future Awards.

Our students have also been recognised. Martin Schuster, who spent a year working with Volkswagen in San Francisco on his industrial experience year, received a University Distinguished Achievement Award – Undergraduate Student of the Year. Another of our students, Hassan Hakim Khalili, received the Distinguished Achievement Award: Engineering and Physical Sciences Student of the Year for 2011. Two of our undergraduate teams were winners in the PricewaterhouseCoopers Student Team Working Awards. Six of our students from first and second year all won BP essay prizes in an annual competition.

The success of our students has continued with Simon Watson, who won the Leslie H Paddle Scholarship of £10,000 from the IET for his research into mobile platforms for underwater sensor networks.

A major breakthrough in the battle against breast cancer has come from our very own Professor Zhipeng Wu. Professor Wu has invented a portable breast scanner that, using radio frequency technology, can in a second show the presence of tumours, malignant and benign.

All in all, this is an exciting time for our School, packed with achievements that only push us to build upon our successes further and, perhaps with your help, achieve even more in the future.

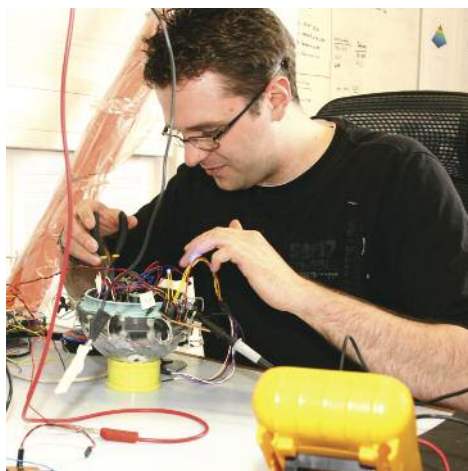
## Visiting us

The University of Manchester holds open days for prospective students. Currently, open days are planned for 21 and 22 June 2013, and 5 October 2013. Find out more online:

**[www.manchester.ac.uk/opendays](http://www.manchester.ac.uk/opendays)**

We invite students who apply for our courses to attend a UCAS visit day in order to learn more about the School, our courses and career prospects in Electrical, Electronic and Mechatronic Engineering.

For more information contact us at:  
[ug-eee@manchester.ac.uk](mailto:ug-eee@manchester.ac.uk)





## 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

#### GCE A-level / Unit grades

AAB-AAA including Mathematics and either Physics, Electronics, or Further Mathematics

#### GCE AS-level acceptability

Two GCE AS-levels accepted in place of the third A-level

#### 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

#### 14-19 Diploma

Minimum grade B in the Engineering Progression Diploma plus grade A in A-level Mathematics

#### BTEC Level 3 Extended Diploma

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

#### 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; IELTS 6 (minimum of 5.5 in any component); TOEFL; internet-based 79 (minimum of 20/30 in each component)

#### 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).

For further information on entry requirements to specific courses, visit:

[www.manchester.ac.uk/eee/undergraduate/courses](http://www.manchester.ac.uk/eee/undergraduate/courses)





# Electrical and Electronic Engineering

## Teaching and learning

Take a look at our 2012 National Student Survey (NSS) results: once again, we have achieved a student satisfaction of 96% and one of the best profiles of marks across all assessed categories for any course at any university in the UK.

<http://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](http://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](http://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](http://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 no more than 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 clever 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](http://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

### 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.

Our School has 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. 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.

Placements can be accredited by the IET towards the training required for attaining Chartered Engineer status.

### MEng or BEng?

All of our courses can be studied at MEng (Master of Engineering) or BEng (Bachelor of Engineering) level. The most obvious difference between these is duration: four years for MEng and three years for BEng. But what else should influence your choice?

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.

## IET

The IET accredits all of our courses at both MEng and BEng level. Here are some comments from the most recent IET visit:

"The panel was impressed with the recent developments in the design of the students' learning experience in the first and second years of the undergraduate curriculum. Of special note was the embedded systems group project work in both years and the reorganisation of tutorial support into 'Year Teams'."

"There are excellent links between the research groups and the MSc courses, as well as with the content of the final year of the undergraduate courses."

"Feedback from the students indicates that the newly introduced switch to having specialist teaching teams for each year of the undergraduate courses has significantly improved the first-year learning experience."

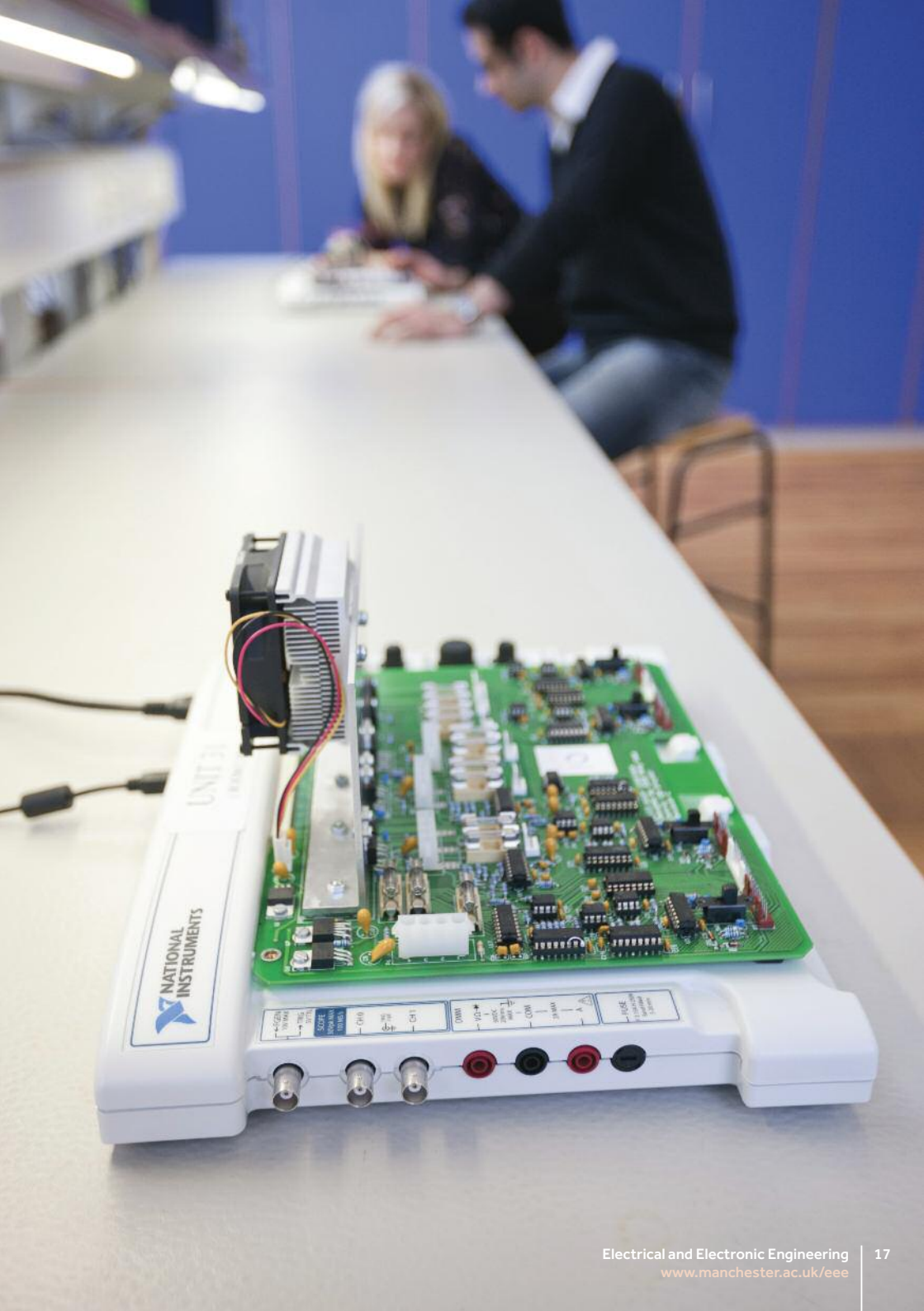
Also mentioned were:

"The development of a strong sense of community within the School with extra-curricular activities, including 'EEESoc' and the Electronics Club."

"The significant improvement in the School's National Student Survey results in the last three years."

"Several staff have been shortlisted for IET Innovation awards."

"Several staff have obtained awards for the quality of their teaching."





# 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](http://www.manchester.ac.uk/eee/undergraduate/courses)**

### Year 1

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

#### Microcontroller Project

Introduces you to the practical issues associated with the design, electronic assembly, mechanical fabrication and testing of electronic systems. You will assemble and test a microcontroller development system, based on the PIC18F4520. This is then used as a teaching vehicle in other 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 MATLAB and LabVIEW, widely used programming and computing platforms 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.

#### Microcomputer Engineering I

Explores the internal design of 8-bit microprocessors and microcontrollers, and using a PIC18F4520 microcontroller development system. It also gives you a practical introduction to assembly language programming and digital interfacing.

#### Java Programming

Gives you a foundation in practical programming skills with an emphasis on problem solving, data structures and algorithms, using object-oriented techniques. Java is a modern object-oriented programming language used in applications for a wide range of platforms, including desktop computers, servers and mobile phones.

#### 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.



Partway through my A-levels I became sure that my future was in engineering, as it was the perfect balance between Maths and Physics, and played a key role in the real world. Choosing Manchester for Electrical Engineering was a decision I finalised after visiting the EEE department on my interview day. The strong links with industry combined with the broad-based first year made Manchester the perfect choice for me.

“So far, the most enjoyable part of my course would be the microcontroller project. We experience every element of its production, from the theory of how the chip works through to the design and finally the manufacture of the board itself. After some 12 weeks of study, the ability to hold up a completed circuit board – gloriously jam-packed with all of its various components – and being able to say ‘I actually understand what all of this does’ is quite a delightful achievement.

“To see university simply as a means to higher education would be wrong. It’s a much greater step than that: a step up into the real world, where most students – for the first time – feel the independence and responsibility of their own lives. And because everyone’s in the same boat, the environment is booming with activity and opportunities. Undoubtedly for me, the greatest skills I have gained from my course would be the constant opportunities to talk with potential employers and gain a deeper insight into the industrial world of engineering. Being a part of the swimming club and various societies, and working on different types of projects with different types of people, has enriched my character and even expanded my CV! Manchester offers a perfect work-life balance for everyone, so it’s down to the individual to ensure they can uphold that balance.

“Without a doubt, the greatest benefit I see from studying at Manchester in particular is the diversity in the students here. It’s extraordinary to think that I now know more international students than UK students! The different cultures and characters this brings together are phenomenal; and the way the world works today: with communication and transport links between all corners of the globe, means that having global contacts is key. And fortunately for us, Manchester certainly puts you up in the right seat to build this for your future.

“With regards to the course itself, I would say it’s very well designed. We have a nice balance between lectures and tutorials for theory, and then practical lab sessions and projects where we apply the theory we’ve learnt. We generally are timetabled more hours than other courses; however, I usually find that the amount of self-study I need to do is a lot less, and having a professional talk me through something rather than me read through it myself certainly makes things a lot easier. There is also an EEE society that organises various socials and other events. And with everything else on at University, you’ll probably find that your weeks are very packed out!



**Obaidah Sheikh, first year student**  
**MEng Electrical and Electronic Engineering**

# Electrical and Electronic Engineering

## Year 2

The first semester is common for all three courses, while the second semester introduces the topics that lead to the specialisations of each course.

The theme of practical application and project work continues with the Embedded Systems 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	EEE	EE	MTE
Digital System Design II	C	C	C
Electronic Circuit Design II	C	C	C
Engineering Mathematics III	C	C	C
Microcomputer Engineering II	C	C	C
Signals and Systems	C	C	C
Analogue and Digital Communications	C	C	C
Control Systems I	C	C	C
Embedded Systems Project	C	C	C
Machines, Drives and Power Electronics	C	C	C
Transmission Lines and Optical Fibres	C	C	C
Generation and Transport of Electrical Energy	C		
Microelectronic Components		C	
Materials and Structures			C
<b>C = Compulsory course unit</b>			





When I first visited Manchester, I knew I had found where I wanted to study. It had all the things I was looking for in a university: a good academic reputation, central campus, diverse student body, and with the added bonus of being in an exciting city. It was somewhere I could see myself living for four years.

“When it came to choosing a course, my path was less clear-cut and a bit daunting. I had studied on the IB program in sixth form, so I had a range of options for study. My preference was for a science-based course, having focused on Maths, Physics and Chemistry at school. However, for me the study of pure science, though interesting to read about, was too theoretical and lacked application. At school (and in life) I was always more interested in something for which I could see a practical use. Engineering is perfect for this, combining the scientific theory and practical skills.

“I researched different types of engineering, but ultimately my choice was based on just two factors. Firstly, in the year after sixth form I was offered a five-month work placement at a local firm specialising in electrical and electronic engineering. I loved my work there. The second factor, and probably the most influential, was my visit to Manchester’s EEE department when I came for interview. I met loads of truly enthusiastic and sincere people and I grew more impressed as I learnt more about the course units; it was obviously well planned out. I was certain it was an environment that I would do well in.

“My experience has, so far, fully lived up to my expectations. I would say that you really do have to put the hours in, but they are easily matched by the quality of teaching and facilities. The course is well structured with consideration of the skills we’ll need when we leave as engineers. On top of this, of all the environments I’ve studied/worked in, the EEE department is the most responsive to student input.

“I was surprised by the range of student backgrounds: each of us had come to the course with different skills and experience which means that we find different course units difficult. I’ll be honest, some of the material is hard and I’ve had to work at it. Yet at the same time, if it’s too much there are both students and staff I can go to for help.

“While it was important to me to study at a ‘good university’, I knew there were other questions I had to ask. For example, will I be happy living in this city for four years? Will I be motivated to come to lectures in the morning? Will I be academically stretched but still be able to lead a balanced life? Both the lifestyle Manchester could provide and the quality of the EEE course made me sure.

“I’m now coming to the end of my second of four years’ study and I really can say that I’m happy with the decision I made.



**Jessica Hart, second-year student  
MEng Electronic 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

Two of our third-year students kept a weekly blog following the progress of their projects (on hexapod robots and colour readers, respectively). You can view their blogs online:

[www.manchester.ac.uk/eee/blogs](http://www.manchester.ac.uk/eee/blogs)

Year 3 course units	EEE	EE	MTE
Individual Project	C	C	C
Analogue Electronics	E	E	
Computer Systems Architecture	E	C	
Concurrent Systems	E	E	E
Control Systems II (State Space and Digital Control)	E		C
Data Networking	E	E	E
Digital Mobile Communications	E	C	E
Digital Signal Processing	E	C	E
Electrical Drive Systems	E		E
Engineering Analysis	C	C	C
Leadership in Action or Manchester Leadership Programme	E	E	E
Mechatronic Analysis and Design			C
Mixed Signal Design	E	E	E
Power Electronics II	E		C
Power System Analysis	E		
Power Systems: Plant and Protection	E		
Robotics and Actuators			C
Sensors and Instrumentation	E	E	C
Sustainable Development	C	C	C
Tools and Techniques for Enterprise	C	C	C
VLSI Design		C	
<b>C = Compulsory course unit</b>			
<b>E = Elective course unit</b>			



The solution to nearly all challenges revolves around one thing: electricity. All the latest technologies (from mobile phones to power network monitors) have electronic components at the core. Everything is slowly becoming electronic and that kind of revolution needs smart, technical minds – this puts electrical engineers in strong demand. Being in demand means that my future is sure to be progressive and fruitful – and that’s exactly what EEE at The University of Manchester provides.

“At school and college I carried great potential in subjects related to engineering, but my aspirations towards studying EEE emerged from an unusual source: the British Army. I have always desired to have a technical and energetic career, and therefore decided to attend an Army Officer Insight course where I received guidance on how I should construct the next few years of my career. Engineering was the path I opted to take, as this would equip me with the knowledge and capability to fulfil the desire of having a dynamic career.

“My third-year individual project is a bespoke concept, using specialist software and a custom-made user interface to study the effect of electric vehicles and solar panels on the electricity grid. For my second-year project, I worked on a three-wheeled buggy that autonomously follows a white line using sensors and an on-board microprocessor. When I mention these projects in applications and interviews, employers love the fact that the university provides excellent opportunities and facilities for students to fulfil their ambitions.

“Apart from having an outstanding reputation for providing excellent engineers to industry, the School of Electrical and Electronic Engineering’s links with the industry’s best companies are incredibly strong and very well maintained by its wonderful and helpful staff. I undertook a summer placement at an engineering company between my second and third year and was surprised to experience how the teaching at university set me apart from the other people at my level. Upon return to university, I brought back essential skills to apply to my university activities, such as organisation skills for my project and leadership for extra-curricular activities.

“Knowing that the School is a top ranking institution in the UK, it had always been my first choice of study. The University provides all the extra-curricular opportunities I require to enhance my skills, while I develop new talents through coursework. For example, I am involved in the PASS scheme, where I facilitate first-year students with their study programmes. These activities have prepared me to deal with situations I would face in a working environment and have made me a competent individual.

“The School also provides a substantial amount of eight-week summer placements within the University for its engineering students. I spent a summer constructing a giant display to be used on UCAS open days. These experiences help me place myself above other candidates when it comes to job applications and interviews.

“The course supplies a perfect blend of practical and theoretical tasks which aid me to develop a clear-cut understanding of the industry I am about to step into. Overall, Manchester provides all the opportunities for you to succeed, and I could never disagree with the fact that 96% of students who graduate from the University have been ‘truly satisfied’ with Manchester!



**Syed Jafri, third-year student**  
**MEng Electrical and Electronic Engineering**

# 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.

An example of a recent project includes:

### Wireless Sensor System for Industrial Gas Turbine Engines

The aim of this project was to develop wireless communication technologies to support the development of industrial gas turbine engines, and to design, implement and characterise a prototype Wireless Sensor Network capable of working effectively within the complex Radio Frequency environment found within these engines. The project was undertaken in collaboration with Rolls-Royce and NI.

For further information on fourth year projects please see [www.manchester.ac.uk/eee/undergraduate](http://www.manchester.ac.uk/eee/undergraduate)

Year 4 course units	EEE	EE	MTE
Group Project	C	C	C
Advanced Power Electronics	E		E
Advanced Technology Enterprise	C	C	C
Analysis and Modelling of Electrical Systems	E		E
Antennas and RF Systems	E	E	
Design of Electrical Machines	E		E
Digital Image Processing	E	E	E
High Speed Semiconductor Devices		E	
Integrated Circuit Technology		E	
Intelligent Control and Robotics	E		E
Microwave Systems Engineering	E	E	
Nanoelectronic devices		E	
Power System Analysis	E		
Power System Operation and Economics	E		
Power System Protection	E		
Process Control and Automation	E	E	E
Sensing and Transduction	E	E	E
Solar Energy Technologies	E	E	E
System Identification	E	E	E
Tomography Engineering and Applications	E	E	E
Understanding Energy as a System Driving Modern Society	E	E	E
Wireless Communication and Mobile Networks	E	E	
C = Compulsory course unit E = Elective course unit			





Enjoying Mathematics and Physics at school meant that when it came to choosing a university course, engineering was the obvious choice. I also had an interest in business and professional services but didn't want to be tied down to one career at such a young age. Having researched all the different types of engineering I discovered that, of all the engineering disciplines, Electronic Engineering was the most relevant in this technological age that we live in.

If you cast your mind back to 15 years ago there were no mobile phones or internet readily available and iPhones weren't even a thought! Technological innovation creates and makes available so much of what we take for granted in our daily lives. The speed at which technology has moved is astounding and one can only imagine what the future will bring. Studying EE brings you to the forefront of this exciting, constantly evolving industry and by pursuing such a career I am excited with the possibilities and opportunities new technological advances will bring.

"When I decided that EE was the course for me, the choice of university was easy. I had been offered a place at every university I applied for, including Imperial College London. For me, though, the University of Manchester offered both a leading academic record and an amazing social side. The course is also accredited by the IET. After I received my offer from Manchester I applied for an IET scholarship and was successful. I receive £1,000 per year and free student membership of the IET.

"Over the years I have worked in my summer holidays in electronics companies, financial services firms and in the university. In my year in industry I worked as a Radio Systems Researcher specialising in Wireless Sensor Networks. Being exposed to this wide range of professions meant that when I came into my fourth year and had to start applying for jobs I knew exactly what I wanted to do. I had enjoyed the consultancy role I had in the financial services firm; however, I didn't feel that it was using enough of the technical engineering skills I had picked up. I really enjoyed my year placement in wireless sensor networks, and did consider applying for a PhD in the area but I have found a company which provides a mix of the two worlds. It is a communications engineering consultancy, based in Manchester, and I was lucky enough to be offered a job before I even sat my January exams. This took some of the pressure off me in my final year.

"This course has been by far the most difficult yet most enjoyable thing I have ever done. I have been pushed to reach my full potential by the academics who have taught me and the vibrant social life provided by the EEE Society, while the city of Manchester as a whole has helped me with my communications skills. The team project in the fourth year, which has been sponsored by industry, prepares you extremely well for the world of work, with the team having its own office and lab facilities.

"Deciding to study EE at The University of Manchester was the best decision I ever made and I can't thank the staff here enough for the effort they put in to ensure we all reach our full potential. My advice to any new students starting is to ask for help when you need it – all the lecturers are extremely approachable – and get involved in some extracurricular activities, whether it is EEEsoc or the Electronics Club or whatever else takes your fancy! In today's competitive job market little things like this will set you apart from the competition.

**Maria McKavanagh, fourth year student**  
**MEng Electronic Engineering**



# Student-run activities

## EEE Society

Our EEE Society (EESoc) 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 May. 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 EESoc get up to, add us on Facebook: [\*\*www.facebook.com/eesoc\*\*](https://www.facebook.com/eesoc)



## 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 project. Find out more at the E4C webpage: [\*\*www.manchester.ac.uk/eee/e4c\*\*](http://www.manchester.ac.uk/eee/e4c)

## The Orb

The Orb is our School's student magazine. Published quarterly, it covers a diverse range of topics, including arts and entertainment, reviews of technical gadgets, student survival guides, cookery, quizzes and competitions, and interviews with students and staff. The magazine is written by students for students, so if you would like to combine journalism with your course, then this is your chance.



Electronics Club is an excellent opportunity for students hoping to be a little more creative with the material they're studying. It's a great way

of having some fun with electronics and experiencing project work. Building my project has helped me develop other engineering skills, such as working with motors and mechanical systems, which I didn't know much about before coming to university.

"I chose to come to The University of Manchester because of its excellent academic reputation and research. One particular advantage of the University is its connections to industry; I was lucky enough to win a Power Academy scholarship, which is only available at a handful of universities. Also, I like that Manchester is a nice city with plenty of shops and opportunities for nights out. Living in Manchester has been great fun and I've met lots of interesting people. I highly recommend both this university and my course.

**Oliver Woolland**  
**Third-year student**  
**MEng Electrical and Electronic Engineering**



We've embarked on building a zero-emission, all-electric vehicle this year. This will be a platform for future technologies like super-capacitors and fuel cells.

**Abhi Mittal**  
**Formula Student team member**  
**BEng Electronic Engineering**  
**with Industrial Experience**



Seeing your project actually being used on a high-performance racing car is a big motivator. You'll work with a variety of engineers, greatly broadening your understanding.

## 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.

Find out more:

**[www.wiset.eps.manchester.ac.uk](http://www.wiset.eps.manchester.ac.uk)**  
**[www.wisecampaign.org.uk](http://www.wisecampaign.org.uk)**

# 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; and who better to help with this than our students, who 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.

## 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 typically 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**



We actively recruit Electrical and Electronic Engineering graduates from Manchester, as we consider the skills, knowledge and quality of these graduates to be exceptionally good.

**Robert Morton Managing Director  
National Instruments,  
UK and Ireland**







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**



The essence of a Manchester graduate is a sound grounding in electrical engineering with a focus on power engineering – which, in our experience, enables them to impact on our business immediately.

“The links with National Grid and the Power Academy mean that Manchester graduates are part of a strong network and have a wider appreciation of the exciting challenges faced by the energy industry. This means they add real value to our business, as we seek to play our part in balancing the critical issues of security of supply, affordability and sustainability.

**Chris Murray Director  
UK Transmission National Grid**



Career 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, Deloitte
- 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/postgraduate](http://www.manchester.ac.uk/eee/postgraduate)**



## Graduate profiles

Read on for information on what some of our students have gone on to do since graduating. You can also check our website for these profiles and more:

[www.manchester.ac.uk/eee/undergraduate/studentprofiles](http://www.manchester.ac.uk/eee/undergraduate/studentprofiles)

# 95%

of our graduates are in work/further study six months after graduation



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.

"When applying for jobs, I found that companies were particularly interested in this range of acquired skills. The questions that were asked in the interviews focused on giving examples of where these skills have been demonstrated. The application processes also involved team exercises and presentations.

"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 really enjoying these projects and am excited for work to begin onsite in a few months' time.

"Other work I have been involved in includes producing literature reports on smart grids, electric vehicles, fault level management and voltage control, as well as the management of office relocation for the HVDC interconnector project between Ireland and Wales.

"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**



## Graduate profiles



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 DoWin3 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**



This is an exciting time to recruit new engineers for the business. Not only are we seeking technical experts [such as Kevin] we also have great opportunities for those, with the correct professional background, to join at an entry level and to be well placed to build their career as our business continues to grow.

Graduates who come to work within Alstom Grid have the opportunity to undertake further training within Alstom Grid's Technical Institute. From this they will gain a better further understanding of different engineering disciplines.

**Suzanne Morris, HR Manager, Alstom Grid**







I have been on the Rolls-Royce professional excellence programme for just over six months after graduating from The University of Manchester in July 2011. 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**





# Research at Manchester

## What our research means for you

As part of a research-led university, research is naturally very important to our School. You may think that this is of no concern to undergraduate students, but this is definitely not the case.

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 Omar Abdel Rehim's graduate profile on page 32). 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

The RAE measures the quality of research conducted in universities and other higher education institutions in the UK against international standards of excellence. In the latest RAE (2008), our School confirmed its world-class research reputation, being ranked second in the UK in terms of research quality. The University of Manchester is ranked third overall in the UK in terms of research power.

### 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 groups

We have six internationally recognised research groups, whose activities enrich our undergraduate degrees with leading-edge lecture courses and projects.

### 1. Control Systems

This group is internationally recognised for its 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

One of the foremost power engineering groups in the world, this makes 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

This group has 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

This group 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





During my time at The University of Manchester, I have been through both the undergraduate and postgraduate experiences as part of the School of Electrical and Electronic Engineering, as well as taking a year out in industry. Starting in 2006, I started as a direct-entry second-year student and immediately believed it was the right move. Being part of a vibrant city and learning through a far more practical and structured approach has only increased my enthusiasm for the field.

"I then went on to a year in industry with Microsoft, which was an eye-opener to the working environment in the field of software engineering. I then followed with a summer placement at BP the following year, gaining an insight into the larger integration of EEE in oil and gas. These placements helped realise my ambition and gave my future a slight sense of direction.

"During my last two years as an undergraduate, I was involved in two very exciting projects. My third-year project investigated a potential method of testing the health of aero-engines by analysing the plume using lasers. The project was closely related to industry and gave me a grounding of research projects in industry and academia. The fourth-year project focused on applying new techniques to metal detection to aid humanitarian demining. The project managed to display the concept and potential of applying a newly developed technique by The University of Manchester to detection tools. This resulted in a launch of greater research by the University and secured funding to pursue further development and potential implementation.

"The topic of my fourth year project really attracted me to continue with a PhD in the area, as the involvement and backing behind the project was really encouraging, as well as the outstanding reputation The University of Manchester has in research.

"I believe I will graduate with a pool of technical and transferable skills, gained throughout my technical and personal development during my undergraduate course and industrial placements, along with a research mindset and experience that reinforces the belief of the endless applications of EEE in every aspect of life."

**Omar Abdel Rehim**  
**MEng Electronic Systems Engineering with Industrial Experience**  
**Currently studying for a PhD**





# Student funding

### 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 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:

- ABB
- Atkins Power
- Culham Centre for Fusion Energy (CCFE)
- EA Technology
- Mitsubishi Electric
- National Grid
- Northern Ireland Electricity (NIE)
- Northern Powergrid
- Rolls-Royce
- RWE npower
- Scottish & Southern Energy
- Scottish Power
- Siemens
- Western Power Distribution

For more information and a video on what Rolls-Royce thinks about the Power Academy scheme, visit our website:

**[www.manchester.ac.uk/eee/undergraduate/fees/poweracademy](http://www.manchester.ac.uk/eee/undergraduate/fees/poweracademy)**

### 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 Electronics or Electrical Engineering. Successful candidates are matched with sponsoring companies for scholarships that include: an annual bursary of up to £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](http://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](http://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](http://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.

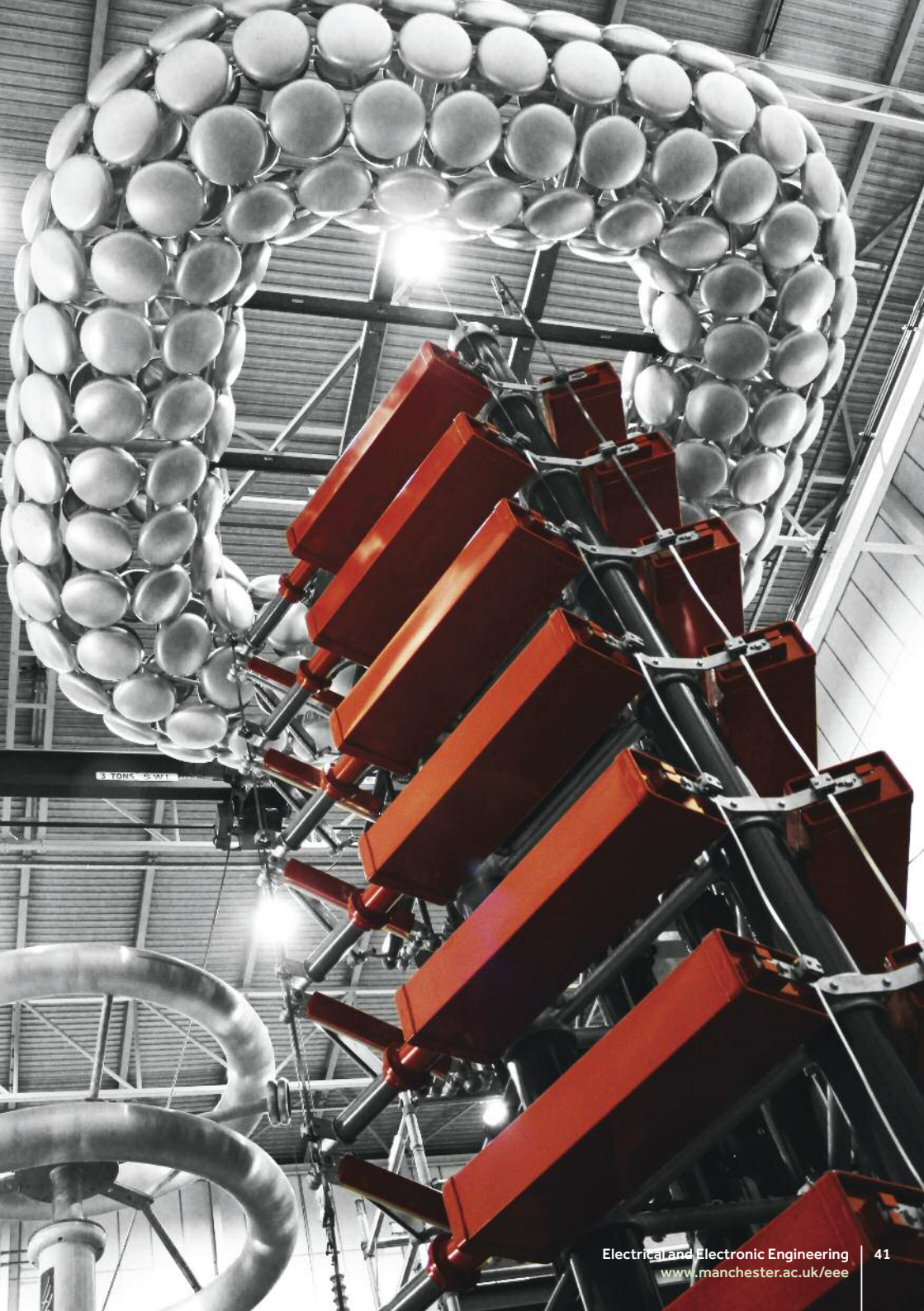
### Industry-linked facilities and funding

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:

- Arizona Microchip supports the teaching of microcontroller project work in the first two years of our courses
- 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, the IET and Centrica provide us with prizes and/or scholarships



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# Find out more online

## Accommodation

Discover your new home:

[www.manchester.ac.uk/accommodation](http://www.manchester.ac.uk/accommodation)

## Admissions and applications

Everything you need to apply:

[www.manchester.ac.uk/ug/howtoapply](http://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](http://www.manchester.ac.uk/library/learningcommons)

## Careers

Take control of your career:

[www.manchester.ac.uk/careers](http://www.manchester.ac.uk/careers)

## IT Services

Online learning, computer access, IT support  
and more:

[www.manchester.ac.uk/itservices](http://www.manchester.ac.uk/itservices)

## Library

We have one of the UK's largest and  
best-resourced university libraries:

[www.manchester.ac.uk/library](http://www.manchester.ac.uk/library)

## Maps

Find your way around our campus, city and  
accommodation:

[www.manchester.ac.uk/aboutus/travel/maps](http://www.manchester.ac.uk/aboutus/travel/maps)

## Prospectus

Download or order a copy of our prospectus:

[www.manchester.ac.uk/ug/courses/prospectus](http://www.manchester.ac.uk/ug/courses/prospectus)



## Childcare

Balancing your studies with your caring  
responsibilities:

[www.manchester.ac.uk/childcare](http://www.manchester.ac.uk/childcare)

## Disability support

Talk to us about any support you need:

[www.manchester.ac.uk/dso](http://www.manchester.ac.uk/dso)

## Funding and finance

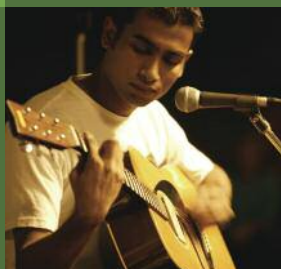
Get to grips with fees, loans, scholarships and more:

[www.manchester.ac.uk/studentfinance](http://www.manchester.ac.uk/studentfinance)

## International students

Let us help you prepare for your time here:

[www.manchester.ac.uk/international](http://www.manchester.ac.uk/international)



## Sport

Get active with our clubs, leagues, classes  
and facilities:

[www.manchester.ac.uk/sport](http://www.manchester.ac.uk/sport)

## Support

Let us help with any academic, personal,  
financial and administrative issues:

[my.manchester.ac.uk/guest](http://my.manchester.ac.uk/guest)

## Students' Union

Immerse yourself in societies, events,  
campaigns and more:

[manchesterstudentsunion.com](http://manchesterstudentsunion.com)

## Videos

Learn more about us on our YouTube channel:

[www.youtube.com/user/universitymanchester](http://www.youtube.com/user/universitymanchester)





## Contact details



### 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.

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

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For the most up-to-date course information, please visit our website:  
[www.manchester.ac.uk/eee](http://www.manchester.ac.uk/eee)

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