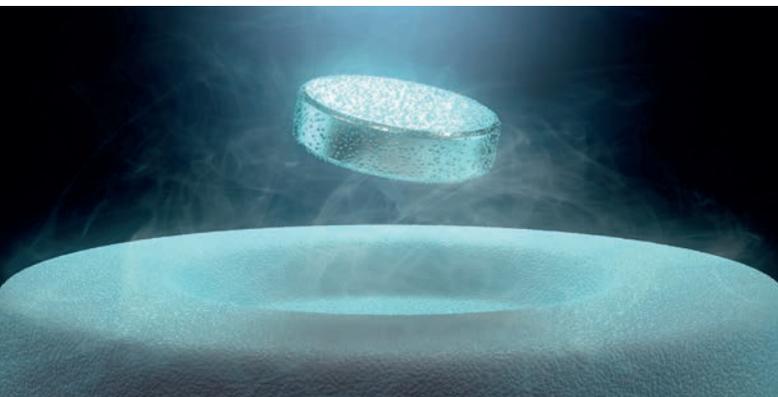
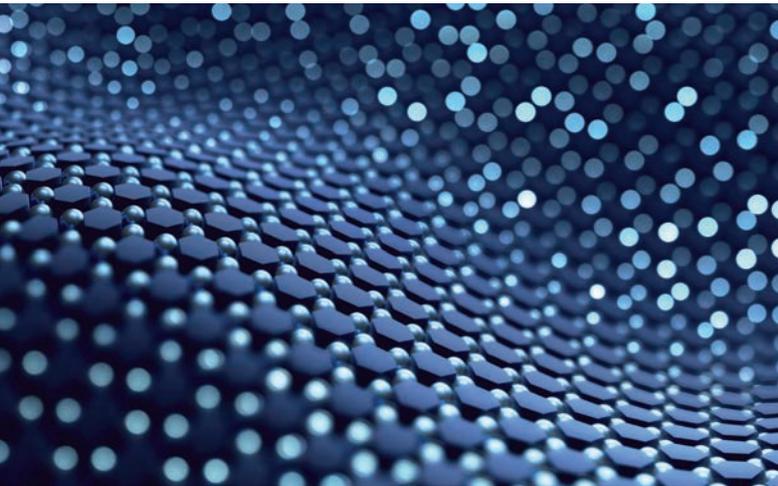




UNIVERSITY OF  
BIRMINGHAM

SCHOOL OF  
METALLURGY  
AND MATERIALS

# MATERIALS SCIENCE AND ENGINEERING



# Welcome

## I AM PROUD TO INTRODUCE THE MATERIALS SCIENCE AND ENGINEERING PROGRAMMES WE OFFER IN OUR SCHOOL.

If your mind is already settled on studying materials science and engineering, you have made an excellent choice: demand for well-qualified graduates in this field is increasing, and we see our students progress onto stimulating and promising careers. If, on the other hand, you are still considering a range of disciplines, I hope this brochure will provide you with some inspiration, and encourage you to study this discipline at undergraduate level. Materials Science and Engineering offers some fantastic opportunities to students with a very wide range of skills and interests, leading to careers in science and across the wider engineering sector.

The School of Metallurgy and Materials has been going through some exciting transformations. Our facilities have recently received an investment of over £35 million, I have recently taken over as Head of School, and we have just completed restructuring and reshaping our undergraduate programmes. Our hard work has not gone unnoticed, and Birmingham is increasingly recognised as one of the best places to study materials science and engineering. We will keep working hard over the coming years as we aspire to be the best place to study materials science and engineering in the country.

Above all, I hope this brochure will highlight some of the opportunities you will have as a student in our School. These include entry scholarships of up to £3,500, paid summer internships within one of our wide-ranging research groups, placements at partner industrial companies both in the UK and abroad, and the option to continue your studies at postgraduate level, such as via a fully funded PhD degree. Our aim is to recruit highly motivated and passionate students, and develop them to become the next generation of professional engineers and scientists, providing impetus for the UK economy through continuous innovation.

I look forward to meeting you at our Open Days or Offer-holder Visit Days.

With best wishes,

**Professor Alison Davenport OBE**  
Head of School



## KEY FEATURES OF MATERIALS AT BIRMINGHAM:

- Exciting new programme structure, building on our experience of teaching materials science and engineering for more than 100 years
- Research-led teaching, embedded within one of the best centres for materials science and engineering research in the country (REF 2014)
- Paid placements both within our research groups and at our industrial partners
- Accredited by IOM3 as routes to Chartered Engineer status
- High-quality teaching rated TEF Gold

## MORE THAN A DEGREE...

- The University is based within a campus only six minutes away from the city centre by train
- A £55 million sports centre provides world-class facilities, including a 50-metre swimming pool
- The University is committed to providing the best facilities to support student experience, which is why plans are underway to build a brand-new Learning and Teaching building in the heart of campus
- The Green Heart parkland was completed in 2019, and is a peaceful green space to relax and meet friends

## LEARN MORE



### Admissions tutor information:

Dr Alessandro Mottura  
School of Metallurgy and Materials  
University of Birmingham  
Birmingham, B15 2TT

Tel: +44 (0)121 414 5235

Email: [materials-admissions@contacts.bham.ac.uk](mailto:materials-admissions@contacts.bham.ac.uk)

[www.birmingham.ac.uk/materials](http://www.birmingham.ac.uk/materials)



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@myepslife



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Accredited by



The Institute of Materials,  
Minerals and Mining

# Introduction to Materials Science and Engineering

New materials underpin development and progress across a wide variety of sectors. New technologies, from planes to batteries, from hip implants to electronic devices, are made possible, and often limited by, the materials we currently know and use. Materials scientists and engineers work hard to understand how and why materials behave the way they do, and exploit this knowledge to develop new materials with amazing properties.

As a materials scientist and engineer, you will have ample opportunities to be at the leading edge of a field that is undergoing continuous developments.

The role of a materials scientist is to develop knowledge of the link between the structure of materials and their performance and properties in a variety of conditions. A materials scientist will study, for example, the interaction between a biomaterial and the human body, or how temperature affects the mechanical properties of alloys. As a result, the discipline combines some knowledge of physics and chemistry to explain the behaviour of all matter.

The role of a materials engineer is to design new materials based on acquired knowledge, and develop the necessary processing routes to obtain and manufacture materials in a

competitive manner. A materials engineer will, for example, take centre-stage in developing safer and higher-capacity battery technology, or more efficient hydrogen fuel cells.

The two roles are inseparable, as deep knowledge of the science and behaviour of materials is required to transform how we use materials and manufacture components and devices. This is what makes materials science and engineering fascinating: the need to explore the fundamentals of how nature works in order to turn this understanding to good use across a variety of sectors.

To the outside observer, materials science and engineering often seems a rather narrow field, but the opposite is true in reality. The vast majority of engineering and technology companies employ materials scientists and

engineers, in addition to companies whose role is to produce and manufacture materials. Aerospace, automotive, energy, microchip, electronics, sports equipment, pharmaceutical and biomedical companies represent a small fraction of those who employ our graduates.

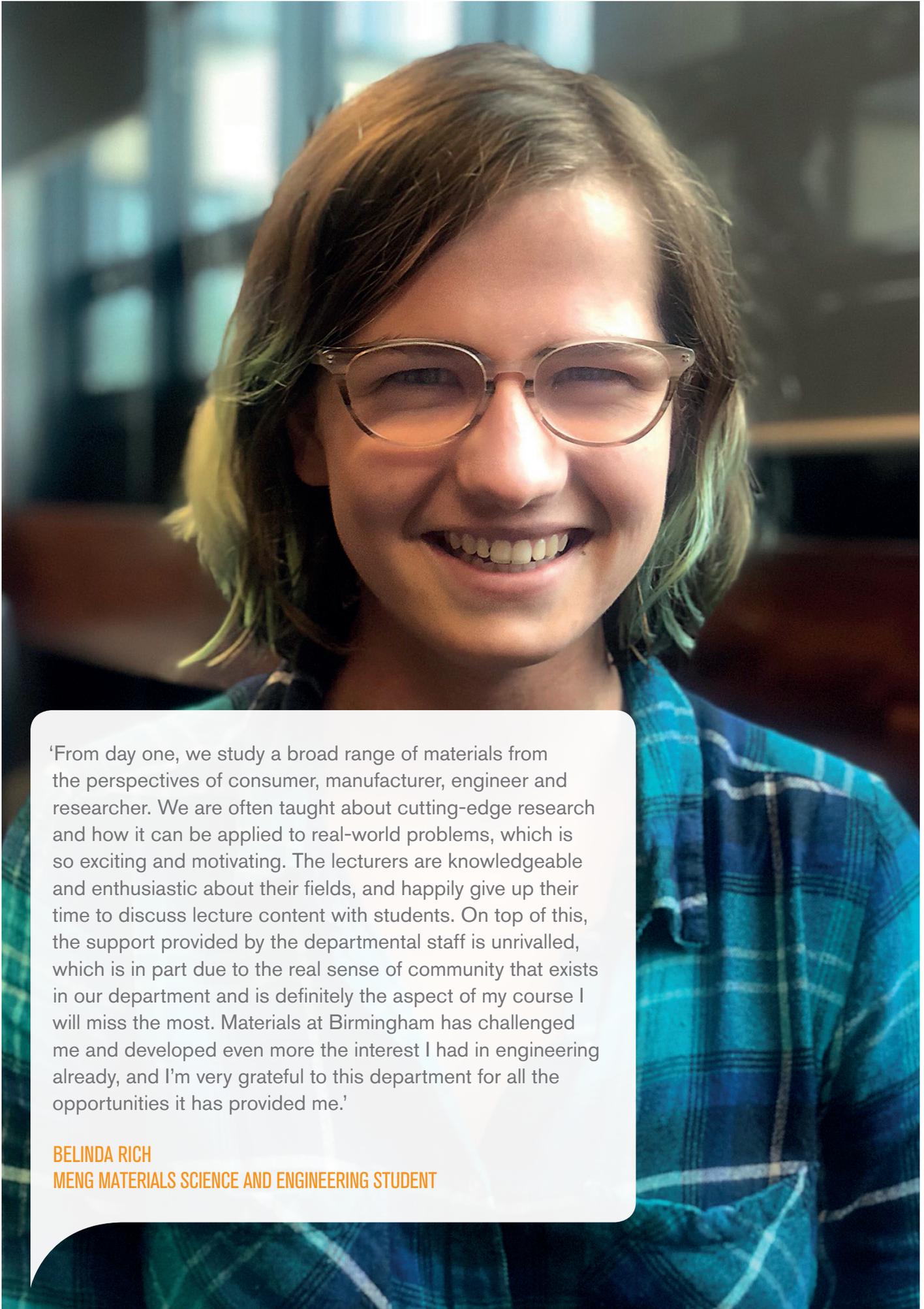
In addition to this, the creative, numerate, communication and problem-solving skills you will garner during a Materials Science and Engineering degree will allow you to access professional positions in top management, finance and consulting companies.

## MATERIALS SAVE THE DAY

- Glass screens on mobile devices are only possible thanks to the development of high-toughness glasses made by implanting large foreign ions on the surface of normal glass. These ions place the outer surface of the glass in compression and impede the formation of scratches and cracks.
- Fuel burn in modern jet airliners can be lower than 2L/100km per passenger, less than a third of the earliest jet airliners, thanks to the use of lighter composite materials for the fuselage and wings, and nickel-based high-temperature superalloys in jet engines.
- New rare-earth magnets are more than ten times as powerful as ferrite magnets common in the 1960s, which has led to smaller motors and significantly higher motor efficiencies, making battery-operated vacuum cleaners and electric and hybrid cars a reality.
- Lithium-ion batteries can store ten times as much energy as lead-acid batteries thanks to the development of new cathode and electrolyte materials, enabling the portable technology available to us today.

FACT





'From day one, we study a broad range of materials from the perspectives of consumer, manufacturer, engineer and researcher. We are often taught about cutting-edge research and how it can be applied to real-world problems, which is so exciting and motivating. The lecturers are knowledgeable and enthusiastic about their fields, and happily give up their time to discuss lecture content with students. On top of this, the support provided by the departmental staff is unrivalled, which is in part due to the real sense of community that exists in our department and is definitely the aspect of my course I will miss the most. Materials at Birmingham has challenged me and developed even more the interest I had in engineering already, and I'm very grateful to this department for all the opportunities it has provided me.'

**BELINDA RICH**  
**MENG MATERIALS SCIENCE AND ENGINEERING STUDENT**

# Where will your degree take you?

As a materials science and engineering graduate, the skills you develop at the University of Birmingham will allow you to seek employment across a variety of sectors. A degree in materials science and engineering unlocks career pathways in materials engineering firms such as Special Metals or Morgan Advanced Materials, manufacturing companies such as Rolls-Royce and Jaguar Land Rover, general engineering firms such as Atkins and Frazer-Nash, as well as in the financial sector with firms such as PwC and Deloitte. We have classified the skills into seven categories to highlight their importance. These are the skills you will primarily develop during your undergraduate degree in Materials Science and Engineering at the University of Birmingham.

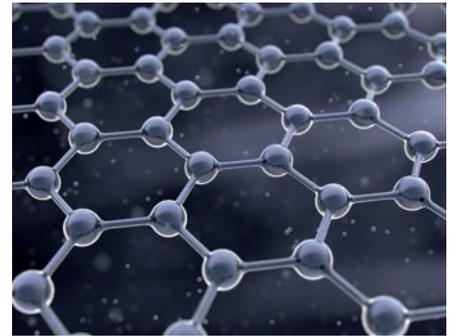
## MEASUREMENT

Graduates will be able to select and carry out appropriate measurements of the properties and characterise the structure of materials.



## DESIGN

Graduates will be able to design new materials and structures, and exploit new developments in the field of materials science and engineering.



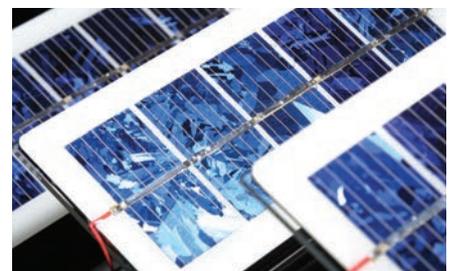
## SELECTION

Graduates will be able to select appropriate materials for a given application or component, and ensure the material selected can be manufactured in the desired shape.



## FAILURE ANALYSIS

Graduates will be able to investigate and understand why and how components have failed while in service, and advise on how such failures may be avoided.

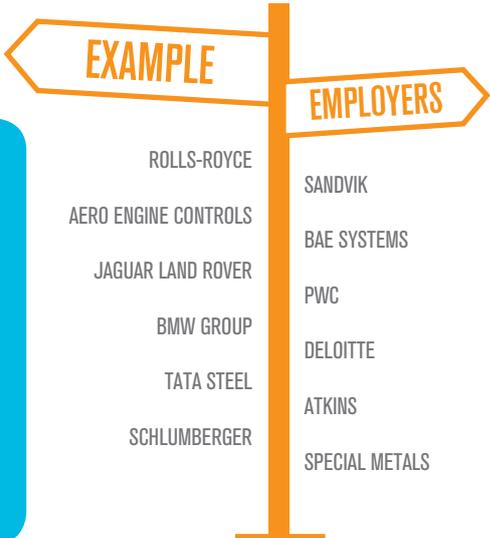


## MANUFACTURING

Graduates will be able to determine an appropriate manufacturing method for a component to achieve the required performance in a range of materials.

'Rolls-Royce has recruited a significant number of students from Birmingham at both graduate and postgraduate level. Undergraduates are able to experience real-life industrial situations via vacation attachments in the company. We are pleased with the quality of Birmingham graduates; they are stimulating change and making an impact on the output of the Materials Group. They possess a good balance of technical, interpersonal and IT skills.'

**MIKE HICKS**  
**ROLLS-ROYCE, CHIEF TECHNOLOGIST-MATERIALS**



**ANALYSIS**  
 Graduates will be able to build links between the structure of materials, their properties and how these are affected by the chosen manufacturing route.

**COMPUTATION**  
 Graduates will be able to use appropriate analytical and computational techniques to aid with their work.



**ACCREDITATION**

All our degree programmes are accredited by the Institute of Materials, Minerals and Mining (IOM3) on behalf of the engineering council.

# Our programmes

Our Materials Science and Engineering programmes have been restructured to ensure our graduates remain at the forefront of the discipline. We have placed a strong focus on developing the skills of our graduates in such a way that they will be able to tackle the challenges they will face once they join industry. Optional modules in Year 3 and Year 4 allow you to tailor your programme to your passions and interests. Group and individual projects provide our students with the opportunity to explore topics at the forefront of materials science and engineering.



## OUR PROGRAMMES

- BEng Materials Science and Engineering (J5F2)
- BEng Metallurgy (JJ25)
- MEng Materials Science and Engineering (F2H1)
- MEng Materials Science and Engineering with Industrial Experience (J200)

### YEAR 1

In Year 1, you will start to link the behaviour and properties of materials to fundamental knowledge of their structure. You will learn why some materials deform while others do not, why some materials conduct electricity while others do not. You will study how properties arise from the structure of materials at a variety of length-scales. You will start to understand how materials may be designed and modified to improve their properties or tailor them to a specific application. Concurrently, you will develop the required mathematical, computational and laboratory skills required to become an effective scientist and engineer.

### YEAR 2

As you progress to Year 2, you will develop a more complete understanding of how materials may be modified to suit our needs. You will learn how steels may be processed to reach ultra-high strengths, how superconductors can be changed to increase the temperature at which they act as superconductors, and how polymers may be designed to be biodegradable. You will study how materials are affected by environmental and complex loading conditions. You will be challenged to use your computational and analysis skills to solve complex problems to determine the performance of materials in applications and during processing. Finally, you will be exposed to cutting-edge research in materials science and engineering.

At the end of Year 2, you will make a final choice as to whether you would like to graduate with a BEng degree, or stay longer and obtain the MEng degree. Students are allowed to transfer or stay on the MEng programme provided they have a 55% weighted average at the end of Year 2. This is done to ensure successful completion of the MEng degree programme.

### YEAR 3

During Year 3, you will learn how high-performance materials have been designed to maximise their properties. You will also develop a detailed understanding of how materials may be affected by complex and challenging environments, as well as how such behaviour may be predicted. You will also develop skills necessary to design experiments and carry out your own projects. During group projects, you may be challenged by our industrial partners to solve outstanding technical issues that are impeding further development of their products. Finally, you will deepen your understanding of specialist topics through the choice of your optional modules.



### YEAR 4

In Year 4, you will fully develop into a materials scientist and engineer, ready for a career in research. You will refine your project and laboratory planning skills during your individual research project. It is expected you will be an expert in your project area by the end of your degree, having carried out novel research in the area. You will also synoptically apply knowledge gathered in the previous three years to a variety of case studies. Alongside this, you will develop in-depth understanding of advanced materials and modelling concepts, as well as further deepen your knowledge of specialists topics.



MEng programmes are accredited by the Institute of Materials, Minerals and Mining (IOM3) on behalf of the Engineering Council for the purposes of fully meeting the academic requirement for registration as a Chartered Engineer.

BEng programmes are accredited by IOM3 on behalf of the Engineering Council for the purposes of fully meeting the academic requirement for registration as a Incorporated Engineer and partially meeting the academic requirement for registration as a Chartered Engineer.



#### Module/years table:

Year 1	Year 2	Year 3	Year 4
Fundamentals of Materials Science	Physical Materials Science	Advanced Failure Analysis and Characterisation	High-Toughness Ceramics
Design for Structural Applications	Fracture, Fatigue and Degradation	High-Performance Materials and Advanced Manufacturing	Biomaterials
Non-crystalline Materials 1	Non-crystalline Materials 2	Materials for Challenging Environments	Advanced Materials in Sports Equipment
Design for Functional Applications 1	Design for Functional Applications 2	Group Project	Advanced Electronic Materials
Communications and Critical Reasoning	Modelling Materials Behaviour	Four modules from our choice of options (samples below)	Four modules from our choice of options (samples below)
Mathematics	Forefront of Materials Science and Engineering		

#### Sample Year 3 options:

- High-Toughness Ceramics
- Biomaterials
- Advanced Materials in Sports Equipment
- Advanced Electronic Materials
- Process Metallurgy

#### Sample Year 4 options:

- Materials for Sustainable Environment Technology
- Surface Engineering
- Irradiation Materials Science
- Nuclear Fuel Cycles, Life Extension and Nuclear Waste

Students on the BEng Metallurgy programme have to do the option in Process Metallurgy and a Group Project on a Physical Metallurgy or Process Metallurgy topic.

#### EXAMPLES OF INDIVIDUAL RESEARCH PROJECTS:

- Planar fault energy predictions in Ni-based superalloys
- Polymerisation of dopamine: kinetics and polymer morphology
- In-situ alloying during selective laser melting and additive manufacturing
- The production and characterisation of oriented nano-cellulose fibres
- Production and evaluation of recycled carbon fibre/polypropylene composites
- Synthesis and characterisation of graphene using the liquid metal approach
- A new critical state model for superconducting wires

#### INTERCALATED YEARS

Students on our programmes have a wide range of options for intercalated years, which offer them an opportunity to develop further during their degree course. These options include an intercalated year abroad, an intercalated year in industry, and an intercalated year in computer science. These opportunities are usually taken between Years 2 and 3. It is also possible to do more than one intercalated year if you wish to do so. For the intercalated year abroad, our students have gone to McGill University, University of Melbourne and University of Illinois. For the intercalated year in industry, we have had students join AMG Mercedes, the European Space Agency and many other companies.





'Materials science and engineering is not just about knowing what stuff is made of. What's most interesting is learning how advanced processing and manufacturing techniques are used in order to obtain certain properties. I had a chance to learn some of these through a Summer Internship at Birmingham and my third-year project. Furthermore, I will soon begin a 12-month placement at Mercedes AMG HPP, where I will assist the Materials Team in determining reasons and solutions to prevent failure of F1 engines. I believe this course has prepared me really well by constantly stimulating my interest and motivating me to learn.'

**LORENZO LUERTI**  
MENG MATERIALS SCIENCE AND ENGINEERING STUDENT

# Teaching, learning and assessment



We constantly review our content to ensure it is kept up-to-date, ensuring that both fundamental knowledge and modern developments are covered within our programmes. We also ensure our delivery and assessment methods are diversified, in order to promote skills development amongst our students. The University was awarded TEF Gold at the most recent Teaching Excellence Framework, with the panel commending the University for the excellent student outcomes.

Throughout the programme, you will be exposed to a variety of teaching methods. Some of the content is delivered through traditional lectures. Most of these will be recorded, whenever possible, and the recording will be available to you through our interactive virtual learning environment (Canvas). There will be many opportunities for hands-on learning through laboratories and workshop sessions. You will also practise problem-solving and exercises through tutorial sessions and small classroom teaching. Some of the content may be delivered via a flipped classroom approach: you will receive content in video or other formats, and contact time will be spent ensuring the concepts are understood, with a chance to practise applying these to real-world problems. Whenever appropriate, formative assessment opportunities will be provided. These will be a chance for you to submit coursework which is assessed for your benefit, without the mark counting towards your final degree.

## SAMPLE COURSEWORK ASSIGNMENTS

- Problem sheets
- Literature review
- Lab reports
- Diagnostic quizzes and tests
- Group challenges
- Case studies



## ASSESSMENT

### YEAR ONE

**57%**  
exam

**38%**  
individual  
coursework

**5%**  
group  
coursework

### YEAR TWO

**58%**  
exam

**35%**  
individual  
coursework

**7%**  
group  
coursework

### YEAR THREE

**66%**  
exam

**26%**  
individual  
coursework

**8%**  
group  
coursework

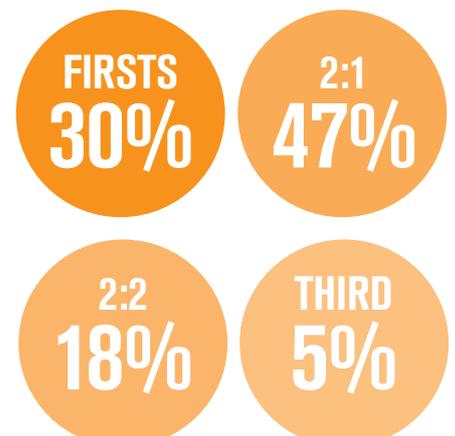
### YEAR FOUR

**50%**  
exam

**46%**  
individual  
coursework

**4%**  
group  
coursework

## OUTCOMES



## Quotes from our graduates

**RICHARD CULWICK**  
MENG MATERIALS SCIENCE AND ENGINEERING STUDENT

'The small community of the department means lecturers take a genuine interest in the learning of the students, encouraging students to take an active part in the work of the department, meaning we don't just sit in lectures all day'

**DEBORAH HARRIS**  
MENG GRADUATE, ROLLS-ROYCE, GRADUATE MATERIALS  
ENGINEERING TRAINEE

'I've completed three placements as part of my grad scheme. The first was in repair technology, which looked at working with universities and small/medium companies to develop new technologies for current and future engine programs. I then completed a design and make project where I built a manoeuvring room simulator for a nuclear submarine for the Royal Navy. Now I'm developing their new hydro-mechanical strategy line.'

**MATTHEW RIBBANS**  
BENG GRADUATE, PHD CHEMICAL ENGINEERING  
WITH INTEGRATED STUDIES

'I originally applied to Birmingham as I really liked the small Materials department and also because of the University's location – being ten minutes from the city centre and on a campus with a great student area. Materials is such an interdisciplinary subject, as such my course gave me the skills to work with a wide range of people from all sorts of backgrounds. Since I graduated, I have started a PhD where I am looking into the use of certain biological products (bone marrow concentration and platelet-rich plasma) for the regeneration of bone and cartilage tissue. My research has a clear clinical application and knowing that really excites me.'

**DR STEPHANIE ANKRAH**  
MENG GRADUATE, NIKE UK,  
TECHNICAL REPRESENTATIVE

'I found the Birmingham materials course diverse; we were able to choose modules which enabled me to tailor my degree to my strengths and interests. A materials degree leaves your career options open and gives you lots of transferable skills that you can use in almost any area of work in the future.'

**ANDREW TARPEY**  
MENG GRADUATE, JAGUAR CARS,  
MATERIALS ENGINEER

'I chose materials as I enjoyed the mixture of physics, chemistry and engineering. I was also pleased with the way it explained both how and why everything around us, from atoms to whole structures, behaves as it does. What I appreciated about Birmingham was its spacious campus whilst being just a few minutes from the city centre with all the attractions that holds, whether you're looking for pubs, clubs, concerts, comedy – or simply to utilise the public transport links to get anywhere in the country.'

A student in a white lab coat and safety glasses is working in a laboratory. She is wearing yellow gloves and using a long metal rod to interact with a large, complex piece of machinery. The machinery has a cylindrical component with a white substance inside. A blue tag with the name 'DILVA' is attached to the equipment. In the background, there are metal railings and a sign that says 'ma.com'.

**EMMA NELISSEN**  
**BENG MATERIALS SCIENCE AND ENGINEERING STUDENT**

'I absolutely do not regret stepping out of my comfort zone and leaving Switzerland to study in Birmingham. From polymers to metal alloys as well as composites and ceramics, the Materials Science course offered me a great insight into today's industry and its challenges. I have learned how to investigate and optimise properties of materials for specific applications using metallurgy experiments, computing methods and my own creativity.'

**SAMUEL HOLDSWORTH**  
**MENG MATERIALS SCIENCE AND ENGINEERING STUDENT**

'I'd never encountered materials science ahead of my open day visit to the University of Birmingham. Since discovering the subject, I have found countless applications in everyday life where materials science has a vital role. The content covers a wide range of industries and I think it is a perfect blend of science and engineering where complex theory is applied to the real world. The department is always welcoming and supportive and the small lecture size means you're always able to ask questions if need be. I really love the community feel that having a campus-based university gives you and the endless societies and events will ensure you get the most out of your time at university.'

# Life at Birmingham

In Birmingham, our community is diverse and friendly, our people are genuine and as one of the original pioneering cities, Birmingham has developed into a melting pot for shopping, food and drink, nightlife, sport, culture and industry. With our very own railway station on campus, you'll be minutes away from the city centre.

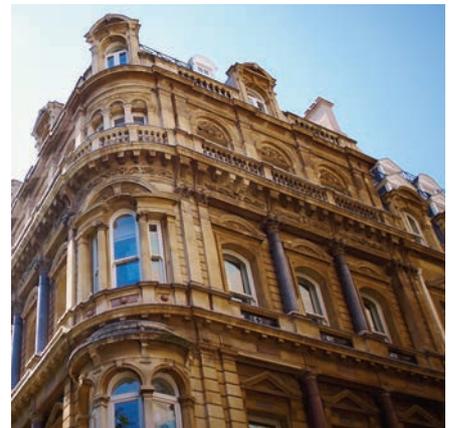
## RETAIL THERAPY

The city centre offers a first-class retail experience; from famous brands to independent stores, Birmingham has every shop you could ever need.



## FOOD

Digbeth Dining Club is the perfect place for foodies to try all the mouth-watering offerings of Birmingham. Check out [www.independent-birmingham.co.uk](http://www.independent-birmingham.co.uk) for some Birmingham favourites and hidden gems. Birmingham is home to the famous Balti Triangle, a must-visit place for curry lovers.



## AFTER DARK

As a thriving city for students and young professionals, when the sun sets, Birmingham has a vibrant nightlife and a huge selection of pubs, bars and clubs. As a student-friendly city, there are set student nights for every day of the week in Birmingham; with something for everyone.



## ART AND CULTURE

For the culture vultures out there, Birmingham has something to suit all tastes; whether it be Old Masters, contemporary artists or performing arts. The city regularly hosts a variety of music and cultural festivals including the annual German Market.



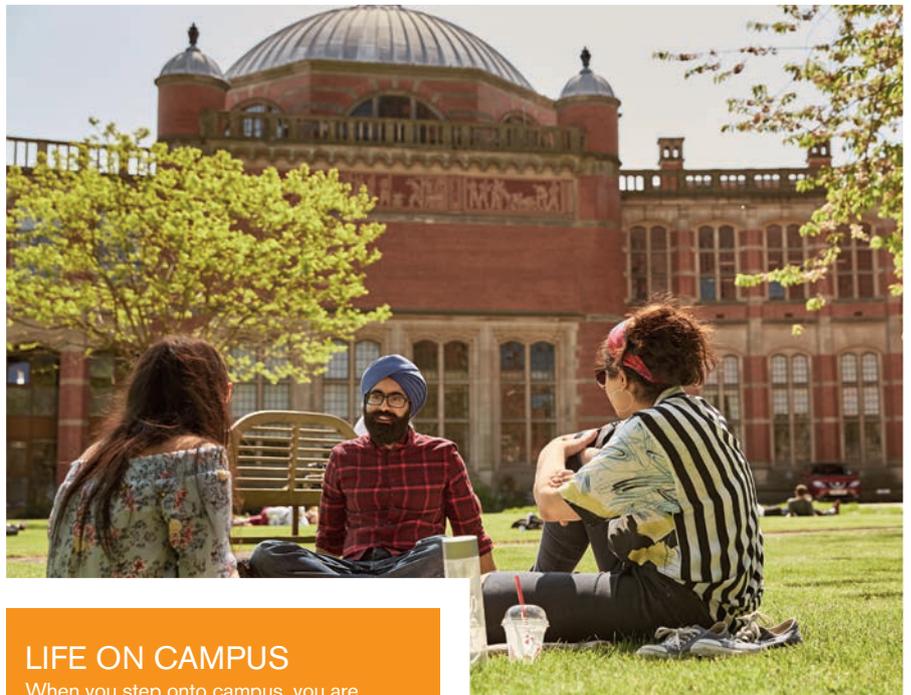
## ACTIVE BIRMINGHAM

Stay active during your time at Birmingham by getting involved in the huge variety of opportunities on offer. There are numerous park runs, local teams including hockey, tennis and rugby. Immerse yourself in sport in one of the iconic venues including Edgbaston Cricket Ground and Villa Park stadium.



## MUSIC

Birmingham is full of different beats to suit all tastes, from large arenas and big names in music to smaller more intimate venues, where you can hear everything from new artists to old favourites.



## LOCAL FAVOURITES

There is more to Birmingham than its city centre. You'll find plenty going on just a short walk from our Edgbaston campus. A student favourite, Harborne is home to a number of bars, restaurants and cafes. Nearby Moseley and Kings Heath are buzzing with bars and live music to discover.

## LIFE ON CAMPUS

When you step onto campus, you are immersed in our historic red-brick buildings and glorious green spaces. You'll find our Edgbaston campus both a peaceful and vibrant place to spend your time, whether it's studying on one of the lawns, or enjoying a drink in one of the many cafés.

## SPORTS CENTRE

Our recently opened sports centre encompasses an array of facilities including Birmingham's first 50-metre swimming pool, a large multi-sports arena, six glass-backed squash courts, a 10-metre climbing wall and five activity studios.



## NEW FACILITIES

We recently opened our Green Heart, a striking new parkland. Measuring over 12 acres, the Green Heart provides a unique space for performances, socialising, meeting and studying. The parkland also incorporates study spaces, a new cafe and grass auditorium. Find out more about our exciting campus developments here: [www.birmingham.ac.uk/building](http://www.birmingham.ac.uk/building)

## THE GUILD

The Guild of Students represents all of the students at the University. The Guild offers support and advice to all students, delivers fantastic student nights and entertainment, and has over 150 student groups and clubs for you to choose from.



# UNIVERSITY OF BIRMINGHAM

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[www.birmingham.ac.uk](http://www.birmingham.ac.uk)



This leaflet was written several months in advance of the start of the academic year. It is intended to provide prospective students with a general picture of the programmes and courses offered by the School. Please note that not all programmes or all courses are offered every year. Also, because our research is constantly exploring new areas and directions of study some courses may be discontinued and new ones offered in their place.

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