WHTC University application subject guides

Chemical Engineering

This guide has been written to help support you in your application to university. It contains the following information relevant to your subject to help you decide where to apply and put together the best application that you possibly can:

1. Links to the top courses for this subject in the UK (according to
2. Entrance requirements
3. Recommended A-levels
4. Admissions tests
5. Recommended reading
6. Interesting MOOCs
7. Useful additional resources
8. Related courses
9. Oxbridge example interview questions

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1. Course links

Below are links to the top courses for this subject in the UK (according to The Complete University Guide). Click on the links to find information about what the course is like, what you'll learn, and loads of information about things such as fees and accommodation. However, remember that there are loads of other great universities out there, so check out The Complete University Guide or just google studying your subject at university.

1. University of Cambridge
2. University of Oxford
3. Imperial College London
4. University College London
5. Lancaster University

6. University of Nottingham

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2. Entrance requirements

Here are the grades that the university suggests you need to get in to that course, and the likely offer that they will give you.

1. Cambridge: A*A*A (Offer varies depending on college see here for more information)
2. Oxford: A*A*A (with the A*s in Maths, Further Maths or Physics)
3. Imperial College London: A*A*A overall (A* in Chemistry / Mathematics, A in Biology, Business Studies, Economics, Further Mathematics or Physics)
4. UCL: AAA (Maths and Chemistry required)
5. Lancaster: ABB
6. Nottingham: A*AA - AAA

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3. Recommended A-levels

Different universities may differ as to what A-levels they ask you for. Some might list one subject as ‘essential’, while another might list the same subject as just ‘helpful’, so make sure to check out the course page (under Section 1 of this document, or on the university website) to be sure what your chosen university expects!

Maths: Almost all courses require you to have Maths. However, some universities offer an engineering degree with an integrated foundation year, designed for people who want to do engineering but don't have the correct qualifications.

Further Maths: For more mathematical courses (e.g. Cambridge), Further Maths is strongly recommended, although not absolutely essential.

Chemistry/ Physics: Almost all courses require you to have either Chemistry or Physics or any Natural Science (University of Lancaster). Some universities like Cambridge require you to do both Physics and Chemistry.

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4. Admissions tests

What admissions tests are you typically required to sit in addition to submitting your application? This also differs from uni to uni, so if your chosen university isn't on this list, make sure you check out the course page so you know exactly what you need to apply.

1. Cambridge (2 hour written assessment, different assessment depending on whether you are going through the Natural Sciences or Engineering Route)
2. Oxford (2 hour written assessment)
3. Imperial (No test, short interview)
4. UCL (None)
5. Lancaster University (None)
6. Nottingham (None)

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5. Recommended reading

Reading some relevant books or articles is a really great way to demonstrate your passion for your chosen subject in your personal statement, and show how you've gone beyond the curriculum. Plus, if you really want to spend three years or more studying this subject at university, it should be enjoyable! Try

taking notes and jotting down your thoughts as you're reading so that you can share some of this in your personal statement

Textbook-like Books

1. **Solen and Harb, Introduction to Chemical Engineering: Tools for Today and Tomorrow** – you will be led step-by-step through a chemical engineering project that illustrates important aspects of the discipline and how they are connected. At each step, you will be presented with a new aspect of chemical engineering and have the opportunity to use what you have learnt to solve engineering problems and make engineering decisions

2. **Denn, Chemical Engineering: An Introduction** - designed to enable the student to explore the activities in which a modern chemical engineer is involved by focusing on mass and energy balances in liquid-phase processes. Problems explored include the design of a feedback level controller, membrane separation, hemodialysis, optimal design of a process with chemical reaction and separation, washout in a bioreactor, kinetic and mass transfer limits in a two-phase reactor, and the use of the membrane reactor to overcome equilibrium limits on conversion.

3. **Kirk-Othmer Encyclopedia of Chemical Technology** - Covers all areas of the chemical industry and allied fields including properties, manufacturing, and uses of chemicals and materials, processes, and engineering principles, dealing with current research, emerging technologies and economic aspects. Environmental and health concerns are also covered.

Leisure Reading

4. **The New Science of Strong Materials – or Why You Don't Fall Through the Floor** - J. E. Gordon's classic introduction to the properties of materials used in engineering answers some fascinating and fundamental questions about how the structural world around us works.

5. **The Gecko's Foot: How Scientists are Taking a Leaf from Nature's Book** - Bio-inspiration is a form of engineering but not in the conventional sense. Extending beyond our established and preconceived notions, scientists,

architects and engineers are looking at imitating nature by manufacturing 'wet' materials such as spider silk or the surface of the gecko's foot.

6. **Invention by Design – How Engineers get from Thought to Thing** - intriguing stories about the engineering marvels around us, from the lowly pencil to the soaring suspension bridge.

7. **Why Things Break: Understanding the World by the Way It Comes Apart** - A fascinating exploration of what holds things together, what breaks them apart, and what this means in terms of our everyday lives explains what the field of materials science has revealed about cracks, fissures, faults, and other "materials failures" and what this meanins in terms of everything from the crash of hard disk drive to the Challenger explosion

8. **Joy of Chemistry: The Amazing Science of Familiar Things by Cathy Cobb** – this book introduces readers to the beauty and magic of chemistry. Starting with a bang a fantastic bottle rocket made from everyday objects found around the house the authors present the essential concepts of chemistry, from atomic structure to the vibrant universe of chemical reactions, using everyday experiences, friendly non-technical language, and hands-on demonstrations.

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6. Interesting MOOCs

Another great way of learning more about your chosen subject and demonstrating your interest is to take a MOOC, or Massive Open Online Course. These are free courses delivered by universities that you can take online. If the ones below don't take your fancy, try looking at Class Central - they have a huge list of different courses for every subject imaginable, and they're all free!

Exploring Everyday Chemistry (University of York)

This free online course explores a range of chemistry-based topics relating to our everyday lives, with an emphasis on the important role of organic chemistry – the study of carbon-containing organic compounds. Activities include

experimenting ‘in the kitchen’ with hands-on projects ranging from extracting a plant fragrance, to testing the activity of spices against microbes. The course will be particularly useful for sixth formers who are interested in developing independent learning skills to help the transition to university.

Discovering Science: Chemical Products (University of Leeds)

For centuries natural materials have been used by people to meet their daily needs. Discover how scientists are using their knowledge of the molecular structure of naturally occurring compounds to develop new and exciting materials. From clothing to tooth enamel, the possibilities are endless. You’ll also consider the chemistry behind the development of everyday consumer, and consider the ethics behind the products you use.

Chemical and Biological Reaction Engineering (MIT)

This course applies the concepts of reaction rate, stoichiometry and equilibrium to the analysis of chemical and biological reacting systems, derivation of rate expressions from reaction mechanisms and equilibrium or steady state assumptions, design of chemical and biochemical reactors via synthesis of chemical kinetics, transport phenomena, and mass and energy balances.

Process Dynamics, Operations, and Control (MIT)

This course introduces dynamic processes and the engineering tasks of process operations and control. Subject covers modeling the static and dynamic behavior of processes; control strategies; design of feedback, feedforward, and other control structures; and applications to process equipment.

Industrial Biotechnology (Edx)

As fossil-based fuels and raw materials contribute to climate change, the use of renewable materials and energy as an alternative is increasingly important and common. This transition is not a luxury, but rather a necessity.

7. Useful additional resources

There are loads of other great things out there that you might want to look at to develop your interest and strengthen your application, from videos to podcasts, to websites. Here are a few suggestions:

Scientific magazines and publications

Nature – www.nature.com

Free to access articles

Nature is a British multidisciplinary scientific journal, first published on 4 November 1869. It is one of the most recognizable scientific journals in the world, and was ranked the world's most cited scientific journal by the Science Edition of the 2018 *Journal Citation Reports* and is ascribed an impact factor of 43.070, making it one of the world's top academic journals.

New Scientist – www.newscientist.com

Free to access articles

New Scientist, first published on 22 November 1956, is a weekly English-language magazine that covers all aspects of science and technology. Based in London, it publishes editions in the UK, the United States, and Australia. Since 1996 it has been available online.

Discover – www.discovermagazine.com

Free to access articles

Discover is an American general audience science magazine launched in October 1980 by Time Inc.

Science - https://www.sciencemag.org

Free to access scientific articles

Science, also widely referred to as Science Magazine, is the peer-reviewed academic journal of the American Association for the Advancement of Science and one of the world's top academic journals.

Women in STEM -
https://www.womeninstem.co.uk/campaign/engineering-maths/

Read more about women and girls in science, tech, engineering and maths.

Scientific journals

Chemical Engineering Science -
https://www.journals.elsevier.com/chemical-engineering-science/

Free to access articles

Chemical Engineering Science (CES) has been publishing papers on the fundamentals of chemical engineering since 1951. CES is the platform where the most significant advances in the discipline have ever since been published.

Talks

Ted Talks –

https://www.ted.com/topics/chemistry

https://www.ted.com/topics/engineering

TED is a nonprofit devoted to spreading ideas, usually in the form of short, powerful talks (18 minutes or less). TED began in 1984 as a conference where Technology, Entertainment and Design converged, and today covers almost all topics — from science to business to global issues — in more than 100 languages.

Sigma Aldrich - **https://www.sigmaaldrich.com/chemistry/chemical-synthesis/learning-center/cheminars.html**

Sigma Aldrich is one of the world's best-known suppliers of lab-grade chemicals. They offer web-based seminars describing the latest, innovative chemical synthesis technologies and products intheir catalogue. Excellent for any pursuing drug design, pharmacy or industrial chemistry.

Chemistry World - https://www.chemistryworld.com/podcasts

Chemistry World links the most peculiar everyday objects though their Chemistry.

Courses and Learning Resources

https://www.edx.org/course/subject/chemistry

https://www.edx.org/course/subject/physics

https://www.edx.org/course/subject/engineering

An incredible number of courses from Universities around the world in chemistry, physics, engineering, and everything else. This is a great way of sampling lots of different courses and working out what course you might like to go onto study after sixth form.

https://ocw.mit.edu/courses/#chemical-engineering

https://www.coursera.org/learn/intro-chemistry

Introduction to Chemistry – for those of you who might need a brush up on your Chemistry knowledge to aid that transition from A level to further study in a Chemistry related degree.

Khan Academy- Chemistry

https://www.khanacademy.org/science/chemistry

Khan Academy has an excellent course on chemistry which starts off with the basics and then gets into the more advanced concepts we study at A-level and beyond.

STEM Learning –

https://www.stem.org.uk/14-16-science-resource-packages

https://www.stem.org.uk/alevelscience

Is there a particular topic you want to practise more? This website contains a huge number of resources arranged by topic. Some are games, some are notes, some are lessons. Worth having a look.

Podcasts

Engineering Podcasts – STEM Sessions

A list of engineering podcasts. Have a look through and see which one interests you the most

https://www.borntoengineer.com/engineering-podcasts-stem-sessions

BBC Science and Nature - https://www.bbc.co.uk/podcasts/category/scienceandnature

Free to listen audio podcast series

The British Broadcasting Corporation is a British public service broadcaster. It is the world's oldest national broadcaster, and the largest broadcaster in the world by number of employees.

University of Oxford –

https://podcasts.ox.ac.uk/keywords/engineering

Free to watch video podcast series

The University of Oxford is a collegiate research university in Oxford, England. There is evidence of teaching as early as 1096, making it the oldest university in the English-speaking world and the world's second-oldest university in continuous operation

Documentaries

20 Best Engineering Documentaries you should watch

https://interestingengineering.com/20-best-engineering-documentaries-you-should-watch

Have a look at this list and watch those that interest you!

Youtube

Practical Engineering

https://www.youtube.com/user/gradyhillhouse

A youtube channel which focuses on civil engineering with some additional mechanical/aerospace engineering content too. Well produced videos which will make you look at the built up area around you a little differently.

Smarter Everyday

https://www.youtube.com/user/destinws2

Lots of fascinating videos about all sorts of things: science, animals, illnesses, medicine and engineering.

Stanford Chemical Engineering Lectures

https://www.youtube.com/watch?v=WgWNQVdhE9A&list=PLD2D34BCA5468DD9A

Use these to have a taste of what a Chemical Engineering Lecture is like – but don't watch all of it, leave some suspense for university!

Ted- Ed Chemistry playlist

https://www.youtube.com/watch?v=8m6RtOpqvtU&list=PLqOO1COTFHBtV_jPHcG_6ys0yN-_eANLJ

Royal Society of Chemistry - lots of interesting playlists (talks / experiments)

https://www.youtube.com/user/wwwRSCorg/playlists

American Chemical Society playlists

https://www.youtube.com/user/acswebinars/playlists

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8. Related courses

At university, there are loads of different combinations of subjects that you can do. Maybe you might find one of these alternatives more interesting? A few ideas are listed below with a sample link, but in most cases there are lots of universities that offer these different combinations so make sure to have a good look around!

There are many different types of engineering. A few a listed below, but this list is not exhaustive – search around to find many more examples.

You could consider doing pure Chemistry or a Natural Sciences degree. These courses offer a broader base, allowing you to specialise later on when you are sure about the path you want to follow.

Aerospace Engineering

Aerospace engineering is largely the design, construction and maintenance of aircraft, spacecraft, missiles and weapons systems. Main focuses can include flight safety, fuel efficiency, operating costs and environmental impact. Students of aerospace engineering apply concepts which can encompass maths, science and technology to the creation of aircraft and accompanying equipment. Specialisms include aerodynamics, avionics, propulsion and systems integration.

Automotive Engineering

If you're interested in cars, trucks, buses, motorcycles and similar motor vehicles, studying Automotive Engineering might be the right choice for you. Automotive engineers are concerned with the design and development of automobiles and their subsystems. With sophisticated, cutting-edge technology you will get to make products that are thrilling and bring more freedom in mobility to people. This subject is very hot right now with new, more environmentally friendly engine and drive technologies as well as the rise of self-driving technology.

Bioengineering & Biotechnology

Many exciting developments are taking place at the intersection of Biology and Technology. A degree in Biotech or Bioengineering lays out a future-proof career path for you. Biotechnology experts come up with quicker and better solutions to vital problems in medical practice and bio-renewable energy to enhance the life and welfare of humans. Studying Bioengineering or Biotechnology is the right choice for you if you are interested in medicine, biology, and how those disciplines relate to technology and engineering.

Civil Engineering & Construction

Roads, railways, bridges, canals, dams, airports and more: Civil Engineering is a field that covers more or less everything that is built around us. Civil engineering and construction professionals work on major infrastructure

projects that are usually large in scale. You should expect a Civil Engineering course to be heavy in Mathematics and Physics, too.

Environmental Engineering

Decades of pollution have left our environment in bad shape. Governments and businesses alike slowly realise that responsibility and sustainability are key imperatives for our future. That makes Environmental Engineering an exciting discipline with great career perspectives for years to come. As an Environmental Engineer, you will apply scientific and engineering principles to reduce industrial pollution and improve the environment for humans, animals and plants. Detrimental effects on the environment can be reduced and controlled by educating the public, promoting conservation of natural resources, defining and implementing regulations and by applying good, sustainable engineering practices.

Marine Engineering

If you have an interest in the research, development and construction of new marine craft and their components, a degree in marine engineering is an excellent option. Marine engineers are the people who design, build, test and repair boats, ships, yachts, underwater vessels, offshore craft, and drilling equipment, and they usually work hand in hand with naval architects.

Mechanical Engineering

The role of a mechanical engineer is to take a product from an idea to the marketplace. To accomplish this, the mechanical engineer must be able to determine the forces and thermal environment that a product, its parts, or its subsystems will encounter; design them for functionality, aesthetics, and durability; and determine the best manufacturing approach that will ensure operation without failure. Mechanical engineers play key roles in a wide range of industries including automotive, aerospace, biotechnology, computers,

electronics, microelectromechanical systems, energy conversion, robotics and automation, and manufacturing.

Materials Science

Materials Science is an interdisciplinary subject, spanning the physics and chemistry of matter, engineering applications and industrial manufacturing processes. Modern society is heavily dependent on advanced materials, for example, lightweight composites for faster vehicles, optical fibres for telecommunications and silicon microchips for the information revolution. Materials scientists study the relationships between the structure and properties of a material and how it is made. They also develop new materials and devise processes for manufacturing them. Materials Science is vital for developments in nanotechnology, quantum computing, batteries and nuclear fusion, as well as medical technologies such as bone replacement materials.

Chemistry

Chemistry is the study of matter and the chemical reactions between substances. Chemistry is also the study of matter’s composition, structure, and properties. Matter is essentially anything in the world that takes up space and has mass. Chemistry is sometimes called “the central science,” because it bridges physics with other natural sciences, such as geology and biology.

Natural Sciences

This degree is multidisciplinary, so you'll be able to study across the subjects of all three sciences and mathematics (and possibly even more). Different universities offer slightly different degree programmes so make sure you check carefully what your chosen university offers.

9. Oxbridge example interview questions

As you will know, applicants to Oxford and Cambridge have to take an interview in order to get a place. It is normal to get open-ended questions, as well as being given charts or pieces of writing to analyse. Here is a sample of the kind of questions you might get asked. Remember, you're supposed to not know the answer! They often deliberately choose topics that they think no one will have studied in order to make the questions fair. What they're looking for is to see how you think under pressure, and how you can present your ideas and your logic.

- What is the difference between Chemistry and Chemical Engineering?
- Tell me about the Haber process?
- Why is Le Chatelier's Principle important?
- What are the main differences between the engines in jet fighters and the engines in jet airliners; which type of engine is the more efficient, and (qualitatively) why?
- How would you design a gravity dam for holding back water?
- What would happen if you drilled through the Earth all the way to the other side and then jumped into the hole?
- Why did they used to make the mill chimneys so tall?
- Explain the following to someone with no knowledge of physics: force, momentum, power, work.
- What are the fundamental differences between Engineering and Physics?
- If you had a cylinder, sealed at both ends, with the pressure rising inside, would it blow at the end or split along the side first?
- If I am in a room with 5 people and guess all their birthdays what is the probability of getting (only) one correct?
- Sketch a velocity time graph for a skydiver jumping out of a plane.
- A rectangular sheet dimensions a x b is to be made into an open-topped box by cutting a square of side h from each corner and folding the 4 sides up. Find the value of h which allows the maximum volume of the box?
- Show the forces acting on a ladder

- Why do sausages split lengthways, rather than around the circumference?
- Talk about a light bulb
- How small can you make a computer? What are the limiting factors?
- How do you think you could calculate the number of calories that you have burnt after you have gone for a run?
- How does a fridge work?
- they had a toy car and propelled it by attaching a blown up balloon and releasing it, they asked my question on how to increase the speed, the flow of the air and momentum.
- What challenges do you think you would be facing as a formula 1 engineer in 10 years time?