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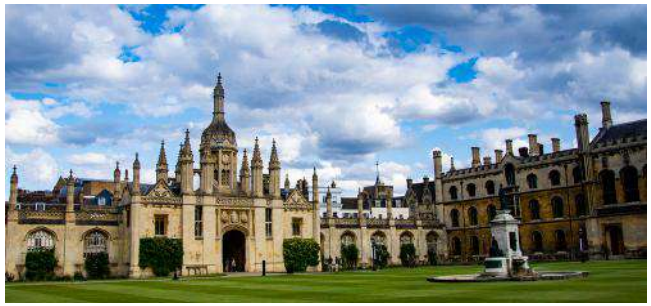

Engineering

SYLLABUS OVERVIEW
16-18 YEARS OLDS

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About Immerse

Immerse Education is an award-winning academic summer school provider offering programmes for 16-18 year olds in centres of academic prestige.

The aim of these programmes is to provide participants with academically challenging content that develops their understanding of and passion for their chosen discipline. Through 40 hours of academic sessions, the programmes also offer young students unique and valuable insights into what it would be like to study their chosen subject at university.

This Syllabus Overview provides a summary of the topics and subject areas that participants can encounter during their studies with Immerse. It has been carefully created by our expert tutors who are current members of world-leading universities, and who have experience in teaching undergraduate students.

Academic Sessions

The academic sessions at Immerse are arranged into modules to enable participants to explore a broad range of topics over the course of two weeks. The modules included in this syllabus overview are indicative but not prescriptive.

Tutors are encouraged to include their own specialisms and also focus on any particular areas of interest expressed by participants within the class. They may choose to provide further detail on a specific topic, or they may include new material and information that builds on the knowledge already developed during the programme.

Personal Project

Each programme includes an element of individual work, generally termed the 'Personal Project'. This can take many forms but is commonly an essay or presentation delivered on the final day of the programme. Participants will receive feedback on this work which may also be mentioned in the participant evaluation which is provided in writing by the tutor once the programmes have ended.

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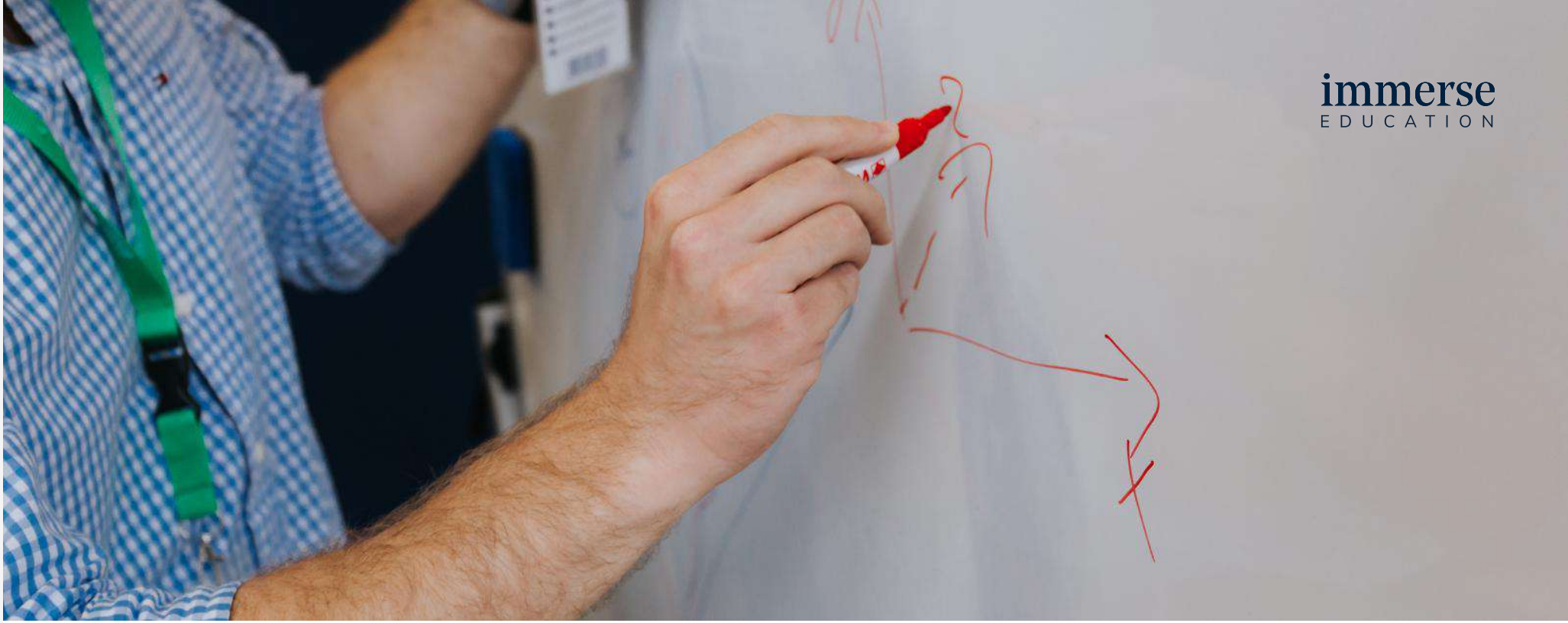
Preparatory work

Some tutors may ask participants to complete some preparatory work, such as reading or a series of exercises in advance of the programme. Participants are strongly encouraged to complete this work since it will be included in the opening sessions of the programme. Any preparatory tasks will be provided in advance of the programme directly to the participant.

Academic Difficulty

As all of our programmes are designed to provide a unique introduction to advanced material, the syllabus will be academically challenging at times.

This is something to be excited about and all of our tutors will encourage and support participants throughout the programme. Immerse Education aims to develop every participant regardless of ability, and our tutors will adapt their teaching to individual needs.



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Aim of the Engineering Programme

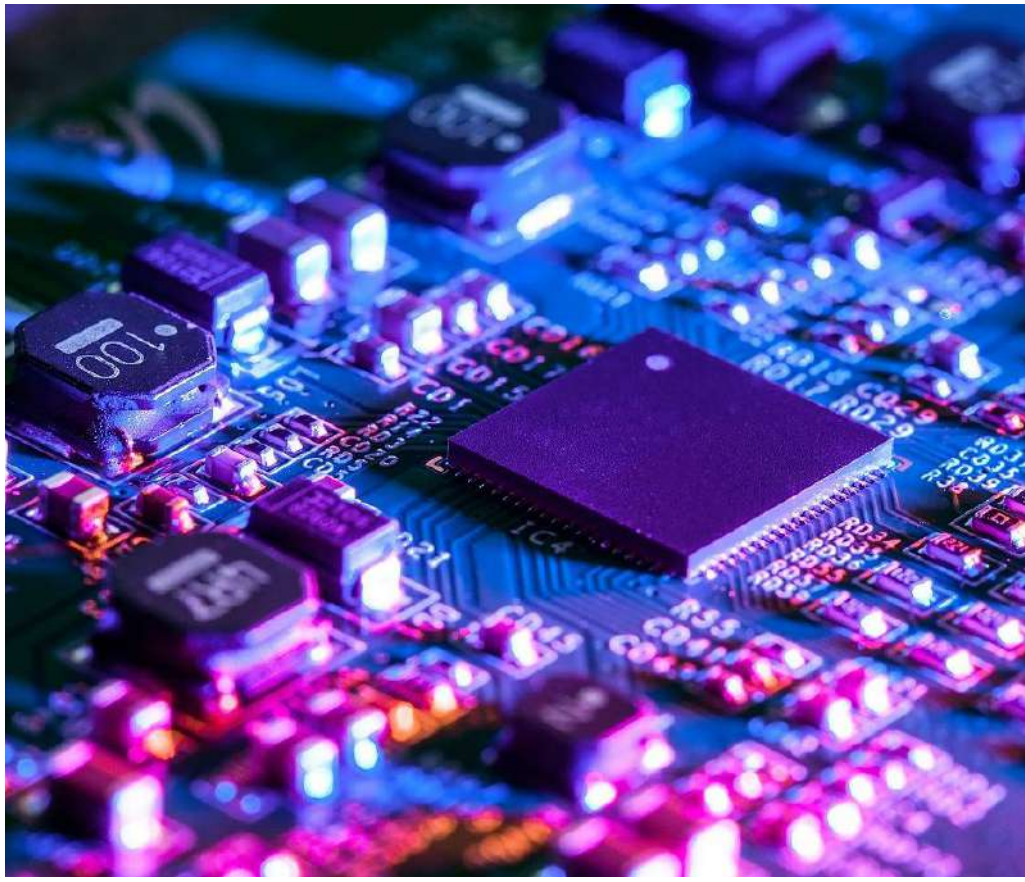
The Immerse Education Engineering programme is designed to build upon the science, maths, and problem-solving skills that participants have already gained in a traditional classroom environment and highlight how this can be used to inspire further interdisciplinary study at university. Participants are encouraged to explore new material in-depth and to form independent and considered opinions and ideas based on sound research and practical knowledge. By the end of the programme, participants will have a good understanding, not only of university-level content, but also the variety of degree programmes available in subjects related to engineering. Beyond this, participants also explore the career opportunities available to graduates in this field.

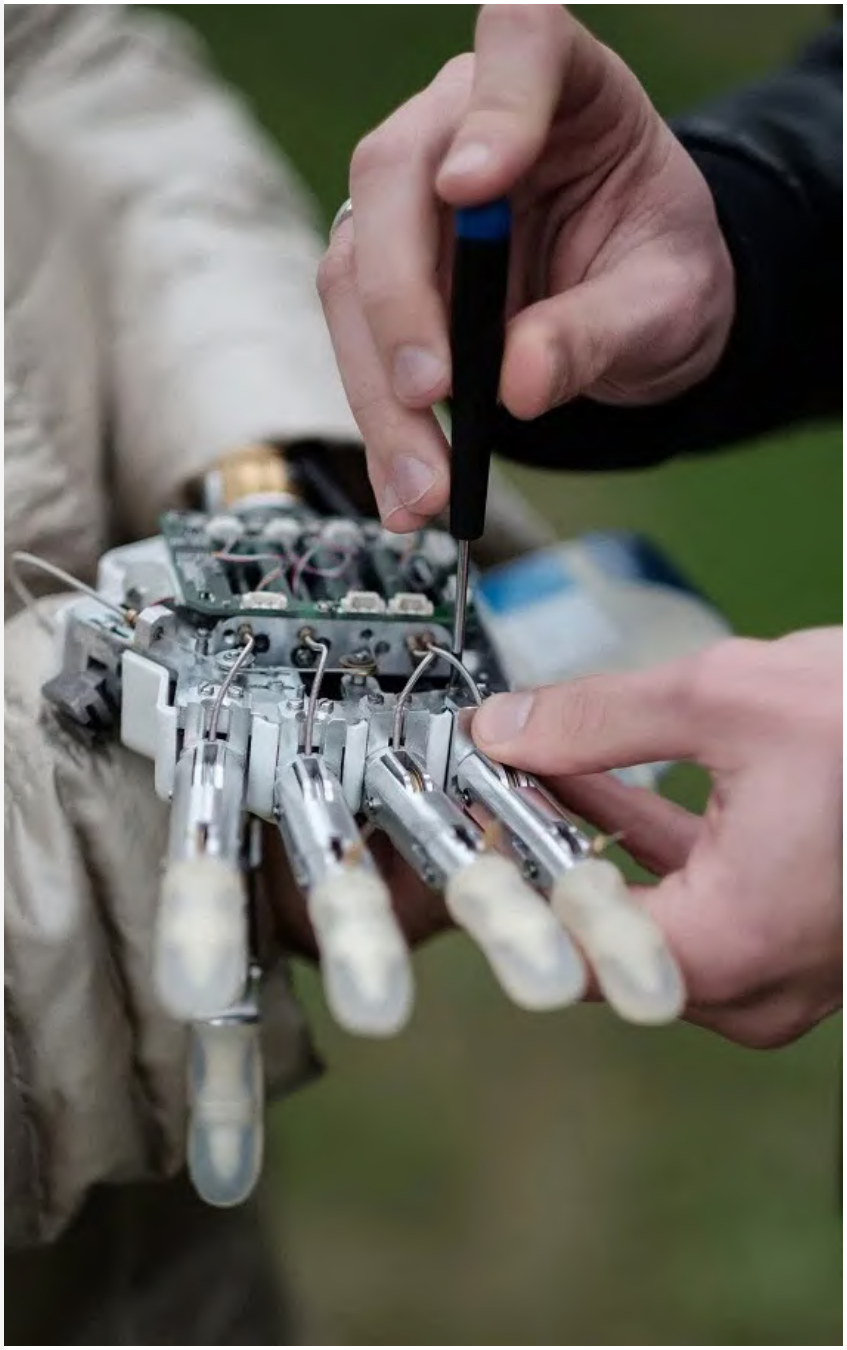
Introduction to Engineering

Engineering is an ingenious and creative scientific discipline, which is able to find solutions to complicated scientific problems and everyday issues. In this introduction, participants are introduced to the different applications of engineering with several practical examples and case studies. Key scientific discoveries in the history of science will be examined and the influence of visual arts and philosophy on engineering will be illustrated. We will discuss the basic mathematical and physical concepts useful for every engineering discipline and establish the demands of the programme. Finally, participants will explore the socio-economic impact of engineering together with the current challenges for science.

Electronic Engineering

Electronic engineering is a wide branch of engineering which applies the general principles of electromagnetism to digital circuits, sensors, actuators, mobile telecommunications, optic fibres etc. Participants will be introduced to basic electronic components and systems, and we will collaborate to briefly describe their working principles in scientific terms. We will explore digital circuits at the base of modern laptops and smartphones and assess their relative limitations. Successively, we will turn our attention to the practical design of a simple radio receiver and the working principle of the main analog circuits.





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Bio-inspired Engineering

Bio-inspired engineers look at the natural world and its evolution during millions of years to find ideas and solutions to current engineering problems. This is a new field of research that combines the life sciences with engineering and the physical sciences. Bio-inspired engineers develop devices by mimicking highly effective natural processes and living systems and producing innovative technological solutions. For example, the structural performance of thin egg shells or honeycombs, the thermal behaviour of termite houses, and the efficiency of the photosynthesis of plants are a few examples of phenomena that can be compared to modern engineering solutions incorporated into man-made constructions.

Electrical Engineering

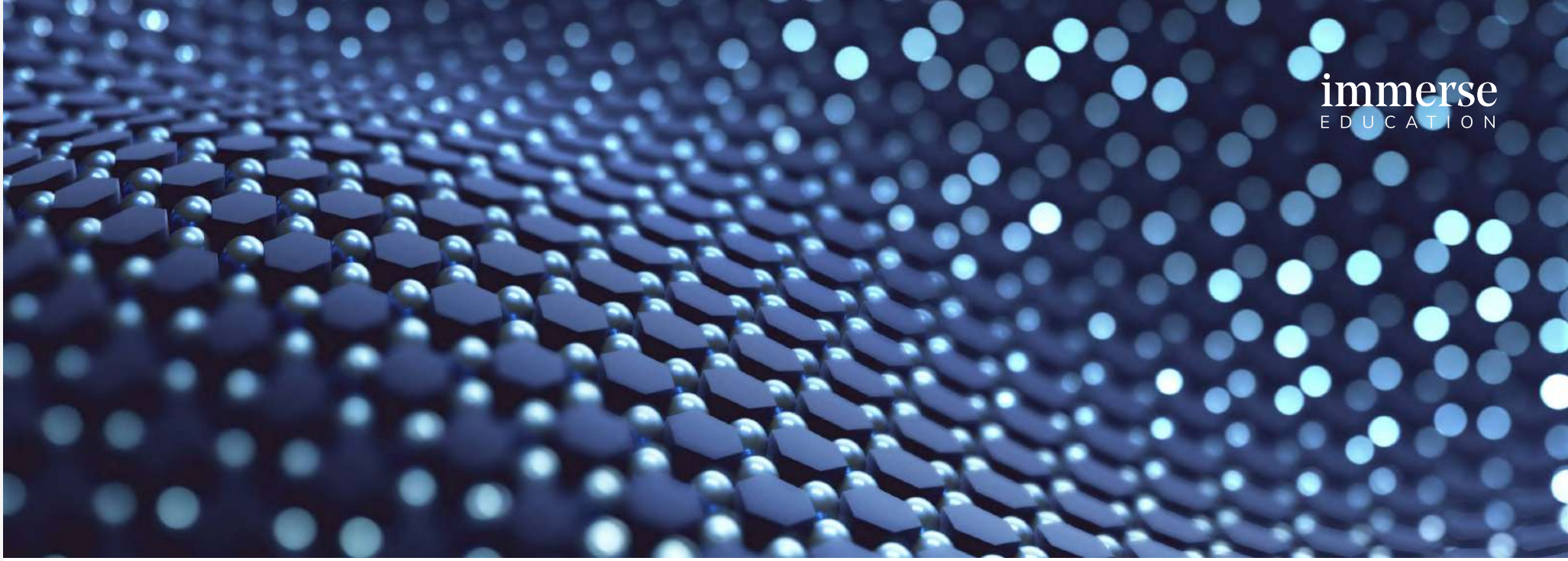
Electrical engineering is one of the newer branches of engineering, and dates back to the late 19th century. It is the branch of engineering that deals with the technology of electricity and its applications to high power circuits, control and instrumentation design. Participants will explore the physics and the new challenges of power devices and circuits. They will uncover the design of instrumentation to measure the main electro-thermal parameters such as currents, temperature, and voltage. Finally, one of the most famous microcontroller platforms (Arduino) will be introduced with explanations of simple projects (temperature sensor, light sensor, etc.).

Software and Computer Engineering

The tremendous growth of software-based companies is disrupting and overthrowing traditional businesses. This module will detail how software is changing many traditional industries and, in particular, the engineering disciplines. It will encourage aspiring engineers to develop complementary skills in software and also give an introduction to computer science theory, a fast-moving field that brings together disciplines including mathematics, natural sciences, and linguistics. Participants will be introduced to two emerging branches of modern technology, namely machine learning and artificial intelligence. We will investigate the success of famous software engineering companies, and students will be given the opportunity to share their ideas with the rest of the class.

Mechanics

Classical mechanics describes the motion of macroscopic objects such as machines, planet, projectiles and it is able to deterministically predict the movement of an object, as opposed to quantum mechanics. Firstly, we will review the basic concepts of kinematics such as the definition of velocity, material point, acceleration, together with the description of the different types of motion. We will explore practical examples of motions by means of mathematical formulas and intuitive considerations, such as the problem of the bullet trajectory. We will then study Newton's laws of motion before looking at rigid body dynamics for 2D/3D scenarios, introducing the concept of inertia and rotations.



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Material Engineering

Material engineering is an interdisciplinary field that deals with the study of matter and its properties as well as the discovery and design of new materials. Numerous engineering areas are limited by the available materials, and new materials create opportunities for innovation in other fields. This discipline incorporates elements of physics and chemistry and is at the forefront of nanoscience and nanotechnology research. We will look at the basic engineering materials and their uses; we will then consider more advanced materials, assessing their benefits and drawbacks. Materials testing techniques will be introduced, highlighting sources of variability and quality control.

Fluid Mechanics and Thermodynamics

Fluid mechanics is the branch of physics that studies fluids and the forces on them. It is a branch of continuum mechanics and models matter as a continuum (i.e., without considering that it is made out of independent atoms). Fluid dynamics is an active field of research with many unsolved or partly solved problems within it. We will derive and discuss analytical expressions for solving simple problems, particularly Bernoulli's equation for the conservation of energy along streamlines of a fluid. This equation, together with the concept of pressure and curvature of streamlines, will be used to explain the origin of forces acting on objects that are moving in a fluid.

TOPICS LIST

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Engineering Design and Modelling

Engineering is all about modelling, simulating, designing, and testing objects that people use in everyday life. In this session, we will discuss the modelling of complex engineering problems focusing our attention on the interaction between the designers and the consumers. We will then explore simulation technology which belongs to the fundamental tool set of every engineering application domain. We will discuss the crucial role of computer simulations, which help to reduce costs and increase the quality of products and systems. We will consider various case studies that best illustrate the design process and the challenges that come with it, finally, considering new commercial products and the testing process they undergo.

Personal Project

Throughout the fortnight, participants will be working on their own personal project. Having been provided with a brief, participants should research and prepare a presentation for their peers. This will build upon an aspect of the theory that they have learnt over the course of the programme and is also an opportunity to showcase the practical skills they have developed. The presentation is followed by questions from the audience and wider class discussion of particular points of interest. The tutor may also include feedback about the presentation in the written evaluation which is sent to participants after the programme has ended.

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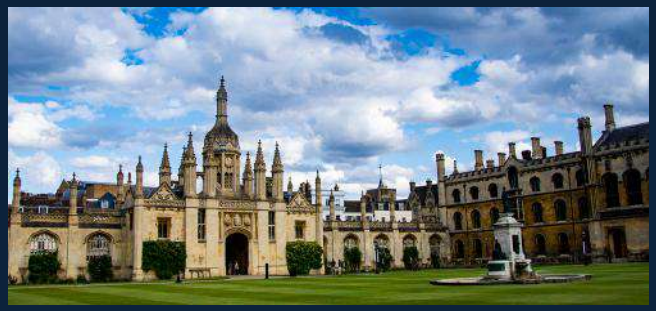


OUR AWARDS AND ACCREDITATIONS

THE QUEEN'S AWARDS FOR ENTERPRISE 2018

BAC ACCREDITED

COBIS SUPPORTING MEMBER | COUNCIL OF BRITISH INTERNATIONAL SCHOOLS

RoSPA Member

BETA British Educational Travel Association