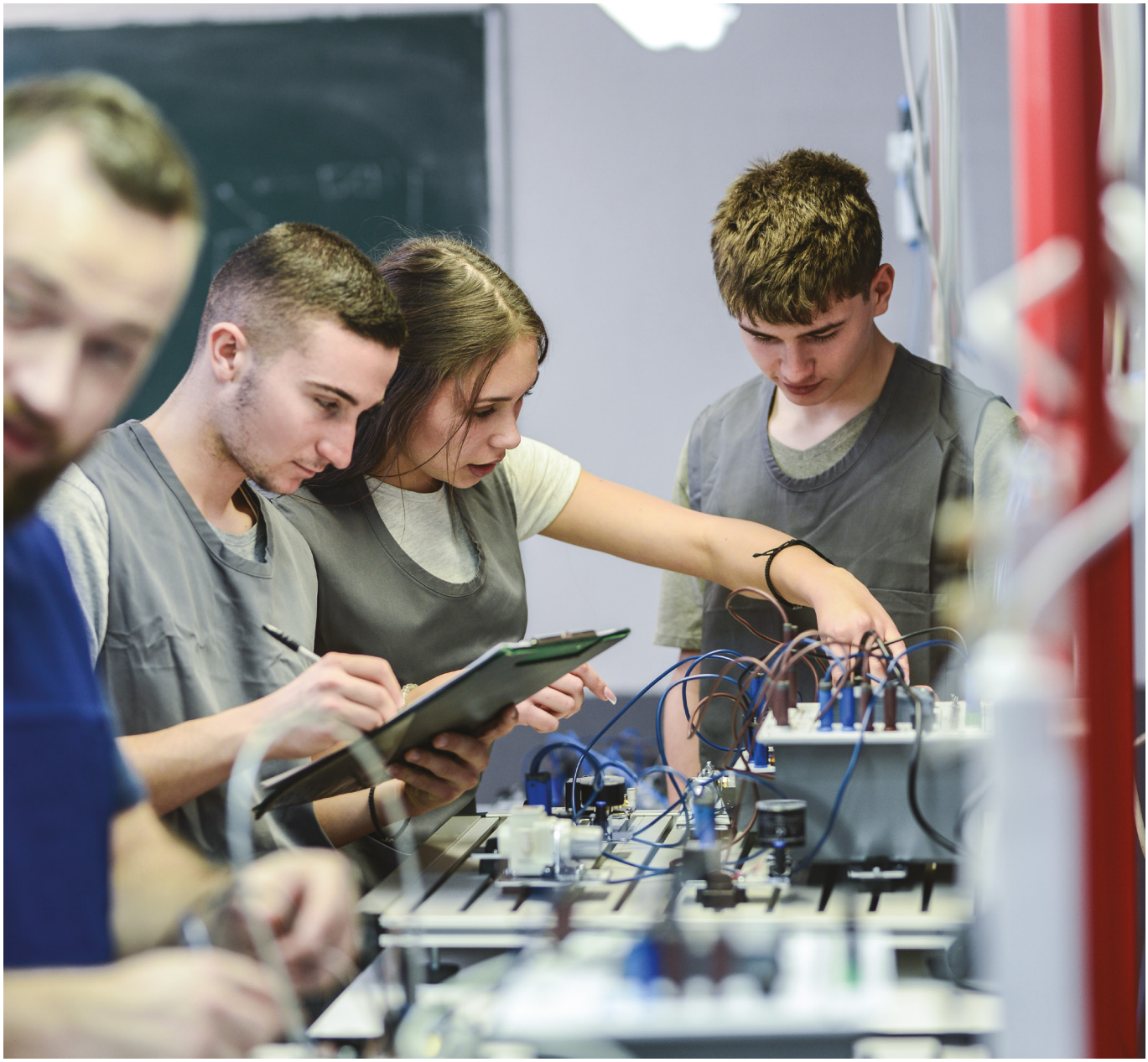
innovate
summer academy

Faculty of Engineering and Science



Programme title	Faculty of Engineering and Science
Location	University College London
Class size	12 students per class
Contact hours	30 Hours per week (including core lessons, guest speakers, masterclasses, project preparation etc)
Programme dates	6 July – 20 July 2025 20 July – 3 August 2025 3 August – 17 August 2025

Programme Overview

The Engineering and Science Faculty at Innovate Summer Academy immerses students in fundamental concepts of engineering and applied science. This programme combines rigorous theoretical learning with dynamic, hands-on experiences across fields like mechanics, sustainability, and innovation.

Designed for future problem-solvers and inventors, the programme emphasises collaboration, creativity, and practical problem-solving. By the programme's conclusion, students will have a solid understanding of engineering principles, exposure to real-world challenges, and an appreciation for how engineering shapes the world.

Core Objectives

- Provide foundational knowledge in key engineering disciplines, including mechanical, civil, electrical, and environmental engineering.
- Cultivate hands-on problem-solving and design skills through experiential learning.
- Foster innovation and teamwork in addressing global engineering challenges.
- Explore the ethical and societal impact of engineering decisions.
- Inspire students to pursue academic and professional careers in science and engineering.

Core Module 1:

Introduction to Engineering and Design

This module introduces students to the engineering design process, focusing on problem identification, brainstorming, prototyping, and testing. Students explore how engineers apply creativity and analytical thinking to solve real-world problems. Students will also examine how constraints like cost, materials, and environmental factors shape design choices.

Learning Outcomes

- Understand the principles of the engineering design process.
- Identify how constraints impact engineering solutions.

Sample Activity & Team-based Projects:

Students work in collaboration to construct a bridge using limited materials. The activity emphasises creative problem-solving, teamwork, and iterative improvement, culminating in a strength test to evaluate the bridge's performance under load.

Core Module 2:

Mechanics and Materials Science

Students learn how materials respond to forces such as tension, compression, and shear, focusing on concepts like stress, strain, and elasticity. Through case studies, they explore how material selection impacts the design and functionality of bridges, vehicles, and everyday products.

Learning Outcomes

- Analyse how materials behave under different forces.
- Evaluate material properties for specific engineering applications.

Sample Activity & Team-based Projects:

Students test the tensile strength and elasticity of various materials, like aluminium, rubber, and plastic. Using hands-on experiments and data analysis, they evaluate which materials are best suited for specific engineering purposes.

Core Module 3:

Thermodynamics and Fluid Mechanics

This module introduces students to energy transfer principles and the behaviour of fluids in motion. Topics include heat exchange, fluid dynamics, and pressure systems. Students examine how these principles are applied in industries like energy production, aviation, and environmental engineering.

Learning Outcomes

- Explain key principles of thermodynamics and fluid mechanics.
- Apply concepts to solve engineering problems related to energy and motion.

Sample Activity & Team-based Projects:

Students design small aerodynamic models and test them in a wind tunnel, observing drag and lift forces. They adjust their designs based on data to optimise performance.

Core Module 4:

Electrical Engineering Fundamentals

This module introduces students to the basics of electricity, circuits, and power systems. Students learn how electrical systems power modern technology, focusing on current, resistance, and energy efficiency. Examples from renewable energy systems, such as solar panels and wind turbines, are used to show real-world applications.

Learning Outcomes

- Understand basic electrical principles and circuit components.
- Design and analyse simple electrical systems.

Sample Activity & Team-based Projects:

Using breadboards, resistors, and LEDs, students build a functional circuit that powers a small device, like a light or fan. They test and troubleshoot their designs, learning hands-on electrical engineering principles.

Core Module 5:

Environmental Engineering

Environmental engineering focuses on solving global challenges like pollution, water scarcity, and climate change. Students examine strategies such as renewable energy development, waste management, and conservation efforts. Real-world case studies illustrate how engineering projects improve community resilience and environmental sustainability.

Learning Outcomes

- Assess environmental problems and evaluate engineering solutions.
- Understand the role of renewable energy and waste management systems.

Sample Activity & Team-based Projects:

Students design and construct water filtration systems using materials like sand, charcoal, and fabric. After testing their systems on contaminated water samples, they refine their designs for optimal performance.

Core Module 6:

Structural and Civil Engineering

This module examines how engineers design infrastructure like buildings, bridges, and dams. Students learn about structural integrity, load distribution, and earthquake resistance. Case studies on famous infrastructure failures and successes highlight the importance of robust engineering practices.

Learning Outcomes

- Analyse the forces acting on structures and their impact on stability.
- Apply principles to design simple, resilient structures.

Sample Activity & Team-based Projects:

Students construct model buildings using materials like wood and straws, testing their designs on a shake table to simulate seismic activity. They analyse why certain designs perform better under stress.

Core Module 7:

Robotics and Automation

Students explore how robots are designed and programmed to perform tasks across industries, from manufacturing to healthcare. The module covers sensors, actuators, and basic coding for robotics. Real-world applications like self-driving cars and industrial robots are discussed. Students gain hands-on experience in building and programming simple robotic systems.

Learning Outcomes

- Understand the basic components of robotic systems.
- Program robots to complete specific tasks.

Sample Activity & Team-based Projects:

Students program a robot to navigate through a maze using sensor data, focusing on problem-solving and iterative testing.

Core Module 8:

Innovation and Product Development

This module emphasises creativity and innovation in engineering, teaching students how to identify problems and develop unique solutions. Students examine famous inventions and the engineering processes behind them. They also explore the role of prototyping, testing, and iteration in product development.

Learning Outcomes

- Develop creative engineering solutions for real-world problems.
- Understand the stages of product development from concept to prototype.

Sample Activity & Team-based Projects:

Students design prototypes for products aimed at solving everyday problems, presenting their designs to peers for feedback.

Core Module 9:

Ethics and Sustainability in Engineering

Students explore the ethical considerations engineers face, such as balancing cost with safety and environmental sustainability. Case studies include controversial projects like hydroelectric dams and urban development. This module emphasises the responsibility engineers have to society and the environment.

Learning Outcomes

- Evaluate ethical dilemmas in engineering decisions.
- Propose sustainable solutions to engineering challenges.

Sample Activity & Team-based Projects:

Students debate a real-world engineering issue, such as the construction of a dam, weighing its environmental, societal, and economic impacts.

Core Module 10:

Capstone Project: Da Vinci Engineering Challenge

The capstone project integrates knowledge and skills from all modules, challenging students to address a significant engineering problem. Teams design, prototype, and present solutions, emphasising collaboration and innovation. The project consists of three main stages:

Research: Teams conduct research, gather data, and analyse their findings.	**Solution Development:** Students brainstorm and design a solution, integrating insights from their research and previous modules.	**Presentation:** Teams present their solution to peers, faculty, and potentially external evaluators (e.g., professionals in the field).

***These are sample modules and may be subject to change**

Project Submission

- A written summary or executive brief outlining the problem, research findings, proposed solution, and its implementation.
- A team presentation, which may include slides, prototypes, visual aids, or role-playing demonstrations to illustrate their ideas.

Suggested Projects:

- Design an energy-efficient building.
- Create a prototype for a renewable energy device.
- Develop a flood-resistant urban infrastructure model.

Approach to Learning

The Innovate Summer Academy employs Bloom's Taxonomy[1] to guide the development of learning outcomes and activities, ensuring a balance between foundational knowledge and higher-order thinking skills. Each module is designed to progress from understanding basic concepts to applying, analysing, evaluating, and creating through hands-on activities and collaborative projects.

Key Teaching Strategies

- **Core Modules:**
  Core concepts are introduced through engaging lectures every morning (Monday – Friday) that encourage active participation and critical questioning.
- **Project-Based Learning (PBL):**
  Hands-on activities and team-based projects are integral, fostering collaboration, problem-solving, and creativity.
- **Experiential Learning:**
  Weekly site visits, guest lectures, and real-world industry simulations allow students to connect theory with practice.
- **Discussion and Debate:**
  Ethical dilemmas, case studies, and group discussions are used to develop analytical and communication skills.
- **Reflective Learning:**
  Students are encouraged to reflect on their learning through journals, peer feedback, and mentor guidance.

1 Armstrong, P. (2010). Bloom's Taxonomy. Vanderbilt University Centre for Teaching. 18th November, 2024 from https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Assessment and Feedback

Assessment is formative, focusing on student growth and progress throughout the programme:

Assessment Type	Weighting	Description
Participation	20%	Students are evaluated on their involvement in core modules, discussions, and team activities. Consistent effort and willingness to engage are emphasised.
Skill Development	20%	Measures progress in applying core concepts, solving problems, and articulating ideas. Feedback focuses on personal growth and mastery of essential skills.
Project-Based Learning (PBL)	30%	Assessed through group projects or simulations within core modules. Students focus on real-world applications, focusing on both process and outcomes.
Capstone Project	30%	The culmination of the programme, the capstone assesses students' ability to synthesise learning into innovative, real-world solutions. Presentations to a panel are required.

Academic Support & Wellbeing

At Innovate Summer Academy, we are committed to fostering an inclusive, supportive, and equitable environment where all students feel valued and empowered to thrive. We celebrate diversity and actively promote respect and understanding across cultures, perspectives, and identities.

The programme is tailored to accommodate varying levels of English language proficiency, learning styles, and abilities, ensuring inclusivity and engagement:

Visual Learners:

Materials such as infographics, detailed diagrams, and dynamic multimedia presentations are provided to support understanding of complex concepts in an engaging and accessible way.

Kinaesthetic Learners:

Activities like practical experiments, role-playing debates, and collaborative simulations are incorporated to engage students who thrive through active participation.

Analytical Learners:

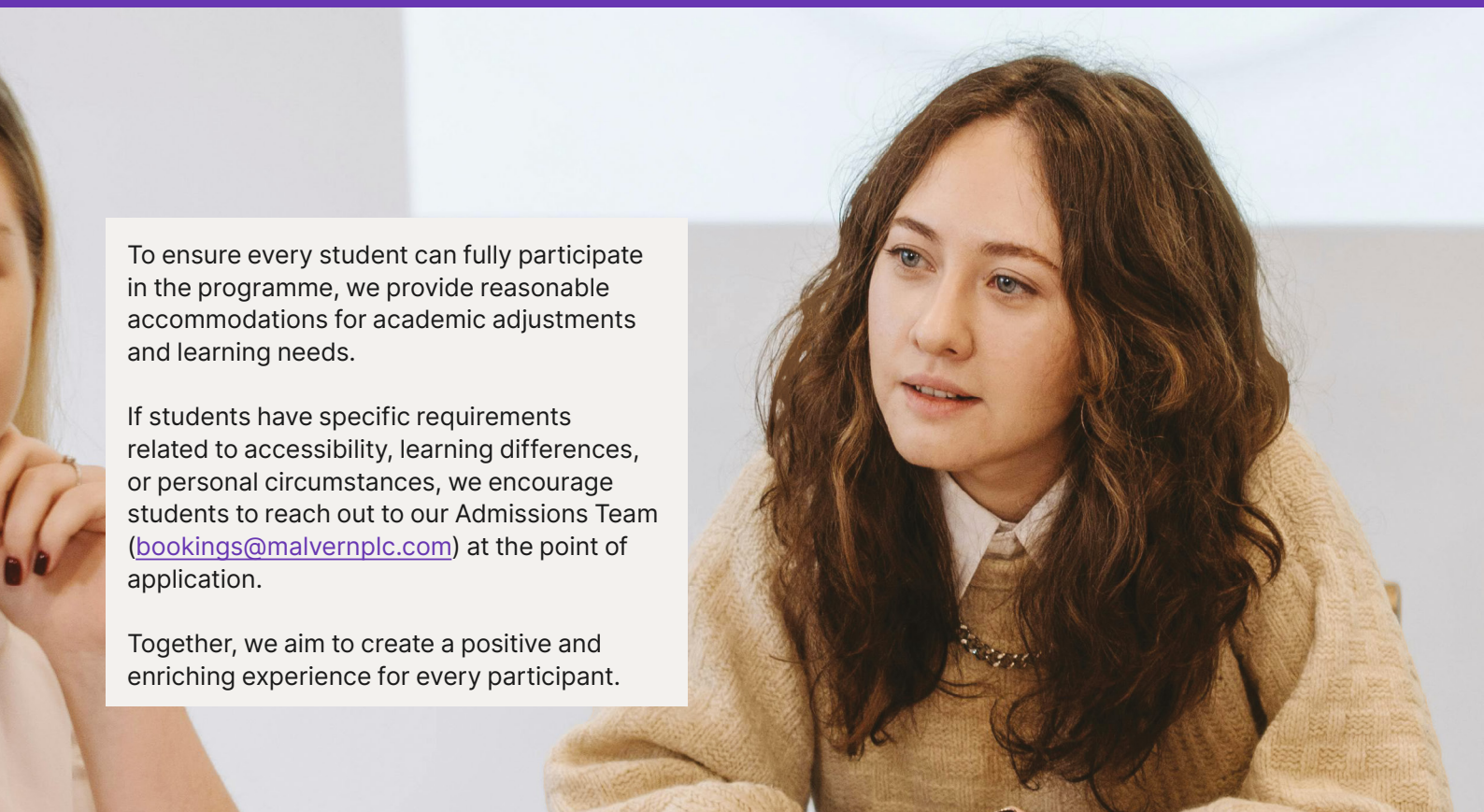
Structured tasks such as in-depth case studies, critical essays, and advanced problem-solving challenges provide opportunities to delve deeply into subjects.

Diverse Learning Paths:

Each core module includes opportunities to explore specific areas of personal or academic interest, allowing students to tailor their learning experience, and ensures that every student finds relevance in the material.

Inclusive Engagement:

One-on-one mentorship sessions and group discussions provide platforms for students to ask questions, share ideas, and learn from peers' perspectives. These interactions are designed to foster confidence, collaboration, and mutual respect among participants.



To ensure every student can fully participate in the programme, we provide reasonable accommodations for academic adjustments and learning needs.

If students have specific requirements related to accessibility, learning differences, or personal circumstances, we encourage students to reach out to our Admissions Team (bookings@malvernplc.com) at the point of application.

Together, we aim to create a positive and enriching experience for every participant.

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