



QUEEN'S
UNIVERSITY
BELFAST

FACULTY OF
ENGINEERING
AND PHYSICAL
SCIENCES

INTERNATIONAL VIRTUAL SUMMER SCHOOL 2022

25 July to 5 August
2022



QUEEN'S
UNIVERSITY
BELFAST

qub.ac.uk



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SHAPING
A BETTER
WORLD
SINCE 1845

RUSSELL
GROUP





WE'RE A RUSSELL GROUP UNIVERSITY

This means you'll be taught by world-leading academics and that your course content will be informed by the latest research, making it as relevant as it can be.



WE'RE IN THE UK'S BEST CITY

Queen's is based in Belfast, a buzzing capital city with the lowest student cost of living in the UK (Times and Sunday Times Good University Guide 2020). What could be better?



YOU'LL FIND A PLACE TO BELONG

With over 200 student-led clubs and societies on campus, you are sure to find your tribe.

CONTENTS

- X **PSYCHOLOGY**
- X **MECHANICAL AND AEROSPACE ENGINEERING**
- X **CIVIL ENGINEERING**
- X **ELECTRONICS, ELECTRICAL ENGINEERING AND COMPUTER SCIENCE**
- X **CHEMISTRY AND CHEMICAL ENGINEERING**
- X **MATHEMATICS AND PHYSICS**
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SPEND TWO WEEKS WITH US IN A UNIQUE VIRTUAL ACADEMIC EXPERIENCE

Since 2014, the Faculty of Engineering and Physical Sciences (EPS) has welcomed over 500 students from China and across the globe to the annual summer school. In spite of restrictions on travel in 2021, the faculty of EPS successfully launched a virtual summer school.

Almost 200 students were welcomed and joined the online programmes. Building on the success of 2021, we are delighted to launch the 2022 virtual summer school.

Students can pursue their interests in one of six tailored EPS summer school programmes:

- **PSYCHOLOGY**
- **MECHANICAL AND AEROSPACE ENGINEERING**
- **CIVIL ENGINEERING**
- **ELECTRONICS, ELECTRICAL ENGINEERING AND COMPUTER SCIENCE**
- **CHEMISTRY AND CHEMICAL ENGINEERING**
- **MATHEMATICS AND PHYSICS**

This year, the EPS summer school will also provide students the opportunity to take our additional professional skills module on Entrepreneurship. This is an optional programme delivered in week three, 8-12 August 2022, for summer school students who want to build entrepreneurial skills and awareness of the Sustainable Development Goals.





THE FACULTY OF ENGINEERING AND PHYSICAL SCIENCES



UNIQUELY PLACED TO TACKLE
THE ENVIRONMENTAL AND
CULTURAL CHALLENGES FACING US
IN THE 21ST CENTURY



TOP 150 IN THE WORLD FOR
COMPUTER SCIENCE
(TIMES HIGHER EDUCATION WORLD
UNIVERSITY RANKINGS 2021)

Psychology

Research Skills and Contemporary Issues in Psychology

Lecturers

Dr Paddy O'Connor
Mr Matthew Johnston

Learning outcomes

Understand foundational and emerging questions in contemporary psychology, spanning health, development, wellbeing, and personality.
Gain knowledge of methodological and ethical issues in each area.
Design practical elements of a research project: experimental design, ethics application, questionnaire design, and using online recruitment systems.

Course Schedule

Day 1: Welcome and Introduction
Day 2: Developmental Psychology
Day 3: Personality Development
Day 4: Psychological Models of Health
Day 5: Wellbeing
Day 6: Experimental Design in Psychology
Day 7: Writing an Ethics Application
Day 8: Designing Online Questionnaires
Day 9: Poster Presentations
Day 10: Next Steps

Course materials:

- Lecture notes
- Pre-reading materials
- Activity instructions
- Poster template
- Remote access to QUB software

Assessment will involve the following elements:

Poster content (research design, critical thinking, potential ethical issues): 70%
Poster design (ideas presented clearly): 10%
Multiple choice questionnaires: 10%
Attendance: 10%

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Mechanical and Aerospace Engineering

Project on Mechatronics and Robotics

Lecturer

Dr Savko Malinov

Learning outcomes

Understand general principles of Mechatronics as interdisciplinary topic between Mechanical Engineering, Electrical Engineering and Computer Science.
Gain knowledge of basic terms in Dynamic Systems, including Degrees of freedom, Motions, Velocity, Accelerations, Forces, Torque and Gears.
Gain basic knowledge in electrical devices such as sensors and motors.
Get experience in use of computer software to train Robots.

Course Schedule

Day 1: Welcome and Introduction
Day 2: Introduction and build of one degree of freedom mechanism.
Day 3: Learning and practicing basic control principles and software.
Day 4: Decide robot configuration and develop the mechanisms. Submit Worksheet 1.
Day 5: Finalise the mechanisms and the robot and prepare for Test day 1.
Day 6: Test day 1.
Day 7: Focus on robot positioning. Fix bugs from Test 1.
Day 8: Test day 2. Submit Worksheet 2.
Day 9: Presentations of the Robots.
Day 10: Next steps

Course materials:

- Lecture notes
- Project briefing presentation
- Examples of Robots
- Tool kit and software instructions
- Access to QUB software
- Examples of Worksheets
- Examples of Presentations

Assessment will involve the following elements:

Attendance: 10%
Worksheets: 30%
Tests: 40%
Presentations: 20%

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Civil Engineering

Building for Net Zero

Civil engineers provide and develop the technical skills and infrastructure to support and sustain life whilst protecting both the built and the natural environment.

The Civil Engineering Summer School at QUB is a fantastic opportunity to develop your knowledge and experience in this important area. The course will blend theory with practical and fun 'design and build' exercises. This year's programme will provide a comprehensive overview of structures theory and application, putting it into context of net-zero ambitions. Students attending this course will also gain an insight into on-going research at QUB and opportunities for future study.

Lecturer

Dr Carwyn Frost

Learning outcomes:

Basic principles of structural design.
Principles of engineering drawing (hand drawing and CAD).
Understand load paths for simple structures.
Innovation, from concept to testing.
Carbon consciousness.

Course Schedule

Day 1: Welcome and Introduction
Day 2: Project Brief, overview of key materials
Day 3: Design Workshop - Detailed Drawing Submission
Day 4: Design Workshop - Final Design Submission
Day 5: Bridge Strength Prediction
Day 6: Presentation preparation
Day 7: Bridge Testing
Day 8: Evaluation Workshop
Day 9: Presentations
Day 10: Next steps

Course materials:

- Lecture notes
- Tool kit instructions
- Presentation template
- Remote access to QUB software

Assessment will involve the following elements:

Attendance: 10%
Design Submission: 20%
Final Design: 30%

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Electronics, Electrical Engineering and Computer Science

Microcontroller Programming and Control System Design

Lecturers

Dr Wasif Naeem
Dr Mien Van

Learning outcomes

Introduction to microcontroller programming using 'C'.
Basic principles of interfacing digital and analogue circuits to microcontrollers.
Understand the design of simple feedback control systems.

Course Schedule

Day 1: Welcome and Introduction
Day 2: Introduction to microcontrollers and the Tinkercad simulation environment
Day 3: Digital signal inputs and simple serial communications
Day 4: Further digital input signals
Day 5: Practical analogue signals for microcontrollers
Day 6: Serial Communications and Practice assessment
Day 7: Assessment Lab
Day 8: Matlab/Simulink tutorial
Day 9: Automatic control system design using Matlab/Simulink
Day 10: Next Steps

Course materials:

- Lecture notes will be provided for the daily lecture (1 hour)
- Lab worksheets will be provided for the daily laboratory session (2 hours)
- Each student will be required to create their own student account on the Tinkercad site
- Each student will be required to download and install a copy of Matlab on their personal computers/laptops

Assessment will involve the following elements:

Lecture and Lab Attendance: 30%
Assessment Lab: 70%

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Chemistry and Chemical Engineering

Solving Global Challenges with Chemistry and Chemical Engineering

Lecturers

Professor Steven Bell, Dr Andrew Doherty, Dr Stephen Cochrane, Dr Haresh Manyar, Dr Bo Xiao, Dr Efrosyni Themistou, Dr Meilan Huang, Professor David Rooney, Professor Peter Nockemann, Dr Chunfei Wu and Dr Patricia Marr.

Learning outcomes

Gain knowledge of sensors in disease diagnosis, next generation of antibodies, and computer-aided molecular design.
Gain knowledge of design, preparation of functional materials and their applications in sustainable development such as renewable energy, CO2 capture/conversion.
Gain critical thinking, problem-solving, teamwork skills from group-based workshops/mini-projects.
Enhance oral presentation skills.

Course Schedule

Day 1: Welcome and Introduction
Day 2: Reporting skills in chemistry
Day 3: Sensor & Antimicrobial therapies
Day 4: New techniques in Synthesis and Delivery of API
Day 5: Computer-directed molecular design
Day 6: Basics of renewables generation
Day 7: CO2 capture, utilisation and storage technologies
Day 8: Energy storage technologies
Day 9: H2 storage through CO2 conversion
Day 10: Next Steps

Course materials:

- Lecture notes
- Pre-recorded video

Assessment will involve the following elements:

Attendance: 10%
Poster: 40%
Presentation: 50%

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Mathematics and Physics

Simulation, Physical and Mathematical Analysis

Lecturers

Dr Ryan Milligan, Dr David Wilkins, Dr Raymond McQuaid, Dr Anna Zhigun and Dr Daniele Margarone

Learning outcomes

The module will cover a variety of topics, ranging from machine learning, mathematical analysis to chemical physics.

Gain knowledge of some applications in science and technology, such as photons, particles, nuclear decay and nuclear fusion.

Sharpen your mathematical analysis skills and deepen your understanding of convergence of series.

Understand the basics of how machine learning can be used for the properties of molecular systems, incorporating symmetry.

Understand different types of observations of the Sun from space at different wavelengths, and the impacts of solar activity on our planet.

Course Schedule

- Day 1: Welcome and Introduction
- Day 2: Radiation interaction with solid matter, plasma, and Applications
- Day 3: Nuclear Reactions, Nuclear Fusion, and Applications
- Day 4: Absolute and conditional convergence of series
- Day 5: Absolute and conditional convergence of series
- Day 6: Mechanical properties of materials from a microscopic perspective
- Day 7: Phase transitions in solids
- Day 8: Machine Learning Methods in Chemical Physics
- Day 9: Solar Observations and Solar Activity
- Day 10: Next Steps

Course materials:

- Lecture notes
- Video Lectures
- Example programs, access to QUB software

Assessment will involve:

an online assessment or report

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The Enterprise Challenge

Build Your Professional Skills around Entrepreneurship

Delivered by Venture Folk and Queen's Enterprise SU

Learning outcomes

Gain tools and techniques to stimulate creative thinking and problem solving.

Experience working in a team and using systems and processes to work effectively together.

Develop an entrepreneurial approach to project development.

Learning about how to get and give useful feedback.

The Enterprise Challenge is an additional module delivered in week three, 8-12 August 2022, designed to build entrepreneurial skills and awareness of the Sustainable Development Goals.

Students will attend a 1-2 hour workshop each day and gain support to work in teams through a series of tasks towards the end goal of a business proposal. Students can share their progress and learning with the other teams and receive peer feedback.

Sessions will be delivered live online with lots of interaction. Teamwork sessions will also be guided by our team who will monitor progress online as tasks are completed and provide coaching for each team.

WHY JOIN OUR SUMMER SCHOOL?

What our students say:

“Thanks to the 2-week summer school, I made new friends via group discussion and oral presentation. Via the virtual programme, not only my English language skills were improved and but also my field of vision in Chemistry and Chemical Engineering was broadened.”

Jiale Fan
Zhejiang University
Chemistry and Chemical Engineering



IMPORTANT INFORMATION

FEES

The tuition fee includes full tuition and an electronic certificate. We are offering an early commitment discount of 20% for payment received by Friday 6 May 2022.

Early Commitment Fee before Friday 6 May 2022:	£200
Regular Fee from Saturday 7 May 2022:	£250
Additional Entrepreneurship Module Fee:	£80

The deadline for payment is Friday 3 June 2022

APPLICATION

Entry requirement: The summer school is designed for students currently studying an undergraduate degree at stage 1 or 2 in a subject area relevant to their selected programme.

Whether you are a student applying individually or you are a member of staff from a university who would like to send a group of students, we would love to welcome you!

Apply for the EPS International Summer School via our website:

<http://go.qub.ac.uk/EPSSummerSchool>

The deadline for applications is Friday 20 May 2022.

LOYALTY SCHOLARSHIP AT QUEEN'S

Students who have attended the EPS Summer School who return to an undergraduate programme via one of our collaboration models or a full-time postgraduate taught programme, receive a 20% tuition fee reduction on first year of study

Exclusions apply

20% tuition fee reduction on year 1

Application necessary

Queen's Loyalty Scholarship can only be used once and cannot be used in conjunction with other scholarships

CONTACT

We would love to hear from you. If you have any questions or require further information, please do not hesitate to get in touch with a member of our team:

epssummerschool@qub.ac.uk