



## Chemistry and Chemical Engineering

**Module Name:** Solving global challenges with chemistry and chemical engineering (CCE)

**Lecturers:** The lecturer info will be supplied in the due course.

Dr Meilan Huang (Assistant Professor, coordinator), Email: [m.huang@qub.ac.uk](mailto:m.huang@qub.ac.uk)

**Demonstrators/TAs:** TBA

### **Learning outcomes:**

- Gain knowledge of sensors in disease diagnosis, healthcare materials and preparation, computer-aided molecular design and next generation of antibodies
- Gain knowledge of design, preparation of functional materials and their applications in sustainable development such as renewable energy, CO<sub>2</sub> capture/conversion
- Dry practical skills from workshops/mini-projects
- Enhance critical thinking, problem-solving and teamwork skills

### **Course Contents and Schedules:**

- Day 1: Welcome and Introduction
- Day 2: Chemistry and disease diagnosis
- Day 3: Functional materials for healthcare
- Day 4: Computational chemistry and healthcare
- Day 5: Synthesis of therapeutics
- Day 6: Renewable energy
- Day 7: Carbon Capture and Utilization
- Day 8: Functional materials for sustainability
- Day 9: Sustainable Chemistry
- Day 10: Next steps and student experience talk

**Maximum capacity of the module: 60**

### **Course materials:**

1. Workshop notes
2. Software instructions
3. Poster template
4. Remote access to QUB software

### **Assessment:**

Assessment will involve the following three elements.

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



## Civil Engineering

**Module Name:** Practical Introduction to Structures

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' and laboratory exercises. The current programme is being finalised however it is anticipated the course will provide a comprehensive overview of structures theory and application. Students attending this course will also gain an insight into on-going research at QUB and opportunities for future study.

**Lecturers: TBA**

Dr Carwyn Frost (Assistant Professor, coordinator), Email: [c.frost@qub.ac.uk](mailto:c.frost@qub.ac.uk)

**Demonstrators/TAs: TBA**

**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

**Course Contents and Schedules:**

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

**Maximum capacity of the module: 36**

**Course materials:**

1. Lecture notes
2. Tool kit instructions
3. Presentation template
4. Remote access to QUB software

**Assessment:**

Assessment:	Weighting
Attendance	10%
Design Submission	20%
Final Design	30%
Presentation	40%

*Please note: This is a draft copy and is subject to change*



## Electronics, Electrical Engineering and Computer Science

**Module Name:** Microcontroller Programming (Arduino/Tinkercad Simulation)

**Lecturers:** Dr Michael Cregan (Associate Professor, coordinator), Email:  
[m.cregan@qub.ac.uk](mailto:m.cregan@qub.ac.uk)

**Demonstrators:** Peter Morrow [pmorrow07@qub.ac.uk](mailto:pmorrow07@qub.ac.uk)  
Ryan McGovern [rmcgovern03@qub.ac.uk](mailto:rmcgovern03@qub.ac.uk)

### **Learning outcomes:**

- Introduction to microcontroller programming using 'C'
- Basic principles of interfacing digital and analogue circuits to microcontrollers

### **Course Contents and Schedules:**

(Daily schedule: 1-hour lecture followed by a 2-hour laboratory)  
19<sup>th</sup> – 30<sup>th</sup> July 2021 09:30 – 12:30 BST (UK)

- 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
- Day 7: Practice assessment
- Day 8: 7-Segment Display
- Day 9: Assessment lab
- Day 10: Next steps and student experience talk

**Maximum capacity of the module: 50**

### **Course materials:**

1. Lecture notes will be provided for the daily lecture (1 hour).
2. Lab worksheets will be provided for the daily laboratory session (2 hours).
3. Each student will be required to create their own student account on the **Tinkercad** site (<https://www.tinkercad.com/login>).
4. The lectures and microcontroller programming laboratories will be conducted remotely using MS Teams and each student will be required to join the daily lecture and lab sessions.

### **Assessment:**

Assessment will involve the following two elements:

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



## Mathematics and Physics

**Module Name:** Simulation, Physical and Mathematical Analysis

**Lecturers:** Dr Gareth Tribello (associate professor) and Dr Gleb Gribakin (Professor), Email: [g.tribello@qub.ac.uk](mailto:g.tribello@qub.ac.uk) and [g.gribakin@qub.ac.uk](mailto:g.gribakin@qub.ac.uk)

**Demonstrators/TAs:** TBA

### **Learning outcomes:**

The module covers two topics "Mathematics of Rainbows" and "Monte Carlo Simulation".

- Understand the physical and mathematical reasons behind the phenomenon of rainbows
- Be able to calculate the path of light through a spherical rain droplet and predict the position and order of colours in the first and second rainbows, the nature of the Alexander band and the physical origin of the supernumeraries
- To able to examine the behaviour of a simulation model as parameters are changed, and to plot graphs using matplotlib and describe what these graphs show
- Students will be able to build python functions that use for loops, 1D NumPy arrays and if statements
- Learn how to use LaTeX to write mathematical reports, and produce a report on the results of the investigation using this tool

### **Course Contents and Schedules:**

Day 1: Welcome and Introduction

Day 2: Introduction to the problem, development of the mathematical solution, LaTeX workshop

Day 3: Development and analysis of the mathematical solution of the problem. Plotting on results on graphs (MATLAB) to aid with the analysis

Day 4: Completion of the analysis of the problem and work on the report

Day 5: Introduction to Python programming: functions, if, for and 1D NumPy arrays

Day 6: Generating random variables with python: uniform, Bernoulli, binomial, geometric and normal random variables

Day 7: Understanding distribution functions: calculating averages, histograms and error bars

Day 8: Analysing simulation results: discussing how the results of a simulation depend on parameters and ensuring results are reproducible

Day 9: Final project: Modelling an agent playing the game Don't Stop

Day 10: Next steps and student experience talk

**Maximum capacity of the module: 40**

### **Course materials:**

1. LaTeX notes and Lecture notes on wiki
2. Access to QUB software: MikTeX, MATLAB
3. Programming exercises provided through repl.it
4. Report templates
5. Video lectures

*Please note: This is a draft copy and is subject to change*



**Assessment:** Each topic will be assessed with the following elements:

**Topic I. Mathematics of Rainbows**

- Attendance: and participation: 20%
- Presentation: 30%
- Report: 50%

**Topic II. Monte Carlo Simulation**

- Cornell notes about day 4: 10%
- Short descriptions of results obtained on days 5, 6 and 7 (peer marked): 20%
- Final report (approx 3 pages): 50%
- Reflective diary: 20%



## **Mechanical and Aerospace Engineering**

**Module Name:** Project on Mechatronics/Robotics

**Lecturers:** Dr Savko Malinov (Associate Professor, coordinator), Email:  
[S.Malinov@qub.ac.uk](mailto:S.Malinov@qub.ac.uk)

### **Learning outcomes:**

- Understanding 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 Contents and Schedules:**

- 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 and student experience talk

**Maximum capacity of the module: 100**

### **Course materials:**

1. Lecture notes
2. Project briefing presentation
3. Examples of Robots
4. Tool kit and software instructions
5. Access to QUB software
6. Examples of Worksheets
7. Examples of Presentations

### **Assessment:**

Assessment will involve the following elements:

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



## Psychology

**Module Name:** Contemporary Topics and Skills in Psychology

**Lecturers:** Dr Tony Benson (assistant professor), Dr Ruth Lee (assistant professor). Email: [ruth.lee@qub.ac.uk](mailto:ruth.lee@qub.ac.uk); [t.benson@qub.ac.uk](mailto:t.benson@qub.ac.uk)

**Demonstrators/TAs:** Postgraduate researchers at the School of Psychology

**Learning outcomes:**

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

**Course Contents and Schedules:**

- Day 1: Welcome and Introduction
- Day 2: Developmental psychology
- Day 3: Experimental design
- Day 4: Health psychology
- Day 5: Writing an ethics application
- Day 6: Personality and identity
- Day 7: Designing questionnaires using Qualtrics and managing online data
- Day 8: Wellbeing
- Day 9: Poster presentations
- Day 10: Next steps and student experience talk

**Maximum capacity of the module: 40**

**Course materials:**

1. Lecture notes
2. Activity instructions
3. Poster template
4. Remote access to QUB software

**Assessment:**

Assessment will involve the following three elements:

- Attendance: 10%
- Tasks: 60%
- Poster: 30%