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

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_2 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

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

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%

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

Demonstrators: Peter Morrow pmorrow07@qub.ac.uk
Ryan McGovern rmcgovern03@qub.ac.uk

Learning outcomes:

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- 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)
19th 30th 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 and g.gribakin@qub.ac.uk

Demonstrators/TAs: TBA

Learning outcomes:

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
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.

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

Cornel 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

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; 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%