Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 2 (FHEQ LEVEL 5)

CHEMICAL ENGINEERING

DEGREE PROGRAMMES

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2022-23

DISCLAIMER

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

The 22-23 academic year begins on 19 September 2022

Full term dates can be found here

DATES OF 22-23 TERMS
19 September 2022 – 16 December 2022
9 January 2023 – 31 March 2023
24 April 2023 – 09 June 2023

SEMESTER 1

19 September 2022 – 27 January 2023

SEMESTER 2

30 January 2023 – 09 June 2023

SUMMER

12 June 2023 – 22 September 2023

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism**, **Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity. You should also refer to the Faculty of Science and Engineering proof-reading policy and this can be found on the Community HUB on Canvas, under Course Documents.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

This has been a challenging period for everyone. The COVID-19 pandemic has prompted a huge change in society as well as how we deliver our programmes at Swansea University and the way in which you study, research, learn and collaborate. We have been working hard to make sure you will have or continue to having an excellent experience with us.

We have further developed some exciting new approaches that I know you will enjoy, both on campus and online, and we cannot wait to share these with you.

At Swansea University and in the Faculty of Science & Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone. Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic staff, administrators, and your fellow students - I'm sure you will find many friendly helping hands ready to assist you.

We all know this period of change will continue and we will need to adapt and innovate to continue to be supportive and successful. At Swansea we are committed to making sure our students are fully involved in and informed about our response to challenges.

In the meantime, learn, create, collaborate, and most of all – enjoy yourself!

Professor Johann (Hans) Sienz
Interim Pro-Vice Chancellor/Interim Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
School of Engineering and Applied Sciences **Head of School: Professor Serena Margadonna**	
School Education Lead	Professor Simon Bott
Head of Chemical Engineering	Dr Enrico Andreoli
Chemical Engineering Programme Director	Dr Matt Barrow M.S.Barrow@swansea.ac.uk
Year 2 Coordinator	Dr James Titiloye j.o.titiloye@swansea.ac.uk

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 9am-5pm.

The **Student Support Team** provides dedicated and professional support to all studentsin the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 and 01792 6062522 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to otherresources:

https://myuni.swansea.ac.uk/fse/coe-student-info/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 22-23 handbooks to ensure that you have access to the most up-to-date versions. Access to print material in the library may be limited due to CV-19; your reading lists will link to on-line material whenever possible. We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under "Modular Terminology" on the following link - https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-info-taught-students/your-programme-explained/

Year 2 (FHEQ Level 5) 2022/23
Chemical Engineering
BEng Chemical Engineering[H831,H835]
BEng Chemical Engineering with a Year Abroad[H800]
MEng Chemical Engineering[H801]
MEng Chemical Engineering with a Year Abroad[H802]

Semester 1 Modules	Semester 2 Modules
EG-200 Separation Processes 10 Credits Dr RC Butterfield CORE	EG-203 Biochemical Engineering I 10 Credits Dr JJ Ojeda Ledo CORE
EG-206 Instrumentation Measurement and Control 10 Credits Dr CO Phillips CORE	EG-204 Reactor Design 10 Credits Prof DL Oatley-Radcliffe CORE
EG-210 Thermodynamics of Process Design 10 Credits Dr S Sarp CORE	EG-208 Process Design and Simulation 10 Credits Dr RC Butterfield/Dr JO Titiloye CORE
EG-211 Fluid Flow 10 Credits Prof PR Williams CORE	EG-215 Process Modelling 10 Credits Dr R Van Loon CORE
EG-220 Process and Pilot Plant Operations A 10 Credits Dr PM Williams/Dr P Esteban CORE	EG-230 Process and Pilot Plant Operations B 20 Credits Dr PM Williams/Dr P Esteban/Dr CO Phillips CORE
EG-285 Statistical Techniques in Engineering 10 Credits Dr M Evans CORE	
Total 120 Credits	

Year 2 (FHEQ Level 5) 2022/23
Chemical Engineering

BEng Chemical Engineering with a Year in Industry[H832]
MEng Chemical Engineering with a Year in Industry[H890]

Semester 1 Modules	Semester 2 Modules
EG-200 **Separation Processes** **10 Credits** **Dr RC Butterfield** **CORE**	**EG-203** **Biochemical Engineering I** **10 Credits** **Dr JJ Ojeda Ledo** **CORE**
EG-206 **Instrumentation Measurement and Control** **10 Credits** **Dr CO Phillips** **CORE**	**EG-204** **Reactor Design** **10 Credits** **Prof DL Oatley-Radcliffe** **CORE**
EG-210 **Thermodynamics of Process Design** **10 Credits** **Dr S Sarp** **CORE**	**EG-208** **Process Design and Simulation** **10 Credits** **Dr RC Butterfield/Dr JO Titiloye** **CORE**
EG-211 **Fluid Flow** **10 Credits** **Prof PR Williams** **CORE**	**EG-215** **Process Modelling** **10 Credits** **Dr R Van Loon** **CORE**
EG-220 **Process and Pilot Plant Operations A** **10 Credits** **Dr PM Williams/Dr P Esteban** **CORE**	**EG-230** **Process and Pilot Plant Operations B** **20 Credits** **Dr PM Williams/Dr P Esteban/Dr CO Phillips** **CORE**
EG-285 **Statistical Techniques in Engineering** **10 Credits** **Dr M Evans** **CORE**	
EG-233 **Placement Preparation: Engineering Industrial Year** **0 Credits** **Prof GTM Bunting/Dr CME Charbonneau/Dr P Esteban/Dr SA Rolland/Dr V Samaras/Dr S Sharma**	
Total 120 Credits	

EG-200 Separation Processes

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr RC Butterfield

Format: 20 hours of Synchronous Activities
Directed private study: 80 hours

Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Theory, concepts, worked examples and self study activities will be provided asynchronously via the virtual learning environment CANVAS.
Synchronous activities will take the form of problem classes and seminars. There will have the opportunity to engage in the synchronous activities either remotely or through booking place on a face to face session.

Module Aims: This module aims to give the student the standard methods to solve problems using specific key design parameters for a range of separation processes (Distillation, gas-liquid absorption, liquid-liquid extraction and evaporation). The module explains the underlying theoretical background to solving separation problems and then demonstrates how problems are solved for a range of simple two component systems.

Module Content:
Distillation: Vapour-liquid equilibrium for binary systems (revision); application and different types of binary distillation systems and equipment. Calculation of number of stages, column height, heat transfer in condenser and reboiler.

Gas Absorption: Application and different types; gas-liquid equilibrium (revision); two film theory; diffusion through stagnant gas, diffusion in liquid phase; rate of absorption, film and overall coefficients, mass transfer correlations; process design of a column to find the height and diameter of the column, required solvent rate.

Liquid-liquid Extraction: Application and different types; solvent selection. Ternary diagrams; cross-current and counter-current operations; calcuations to find minimum required solvent.

Evaporation: Application and different types. Heat transfer taking into account boiling point rises for solutions. Equipment selection, single or multiple effect arrangements. Design of evaporator systems to determine required areas of heat transfer and the steam economy.

Intended Learning Outcomes:
1. Apply knowledge of the physical phenomena, theoretical concepts and design aspects of mass transfer in the separation processes covered in the course.

2. Be able to consider the many factors that can impact the choice of equipment to be designed for a separation problem. These factors include, but not limited to, economic evaluation, equipment operation, physical properties of the chemical species involved, health & safety, environmental impact.

3. Analyse the importance and operation of the separation processes covered in the course. Performing the necessary design calculation to assess the respective unit operation.

Assessment: Assignment 1 (10%)
Assignment 2 (20%)
Examination 1 (70%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Assignment 1: CANVAS Quiz to assess knowledge of material balances, energy balances, vapour liquid equilibria and fundamental concepts such as Raoult's Law, Henry's Law and Dalton's Law, worth a total of 10% - Assesses learning outcome 1 Assignment 2: Hydraulic design of a sieve tray for use in a distillation column. Will be expected to specify the mechanical details of the tray, tray spacing and produce the relevant mechanical drawing using CAD, worth a total of 20% - Assesses learning outcome 1 &3 Examination: A closed book examination will form 70% of the module mark.
Moderation approach to main assessment: Universal second marking as check or audit
Assessment Feedback: Formal feedback of the assessed assignments will be provided through the virtual learning environment CANVAS.. Formal feedback of the examination will be provided following completion of the final exam in line with standard Faculty of Science & Engineering policies.
Failure Redemption: Redemption for the module will take the form of a supplementary examination worth 100% of the module mark.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. Available to visiting and exchange students. The Faculty of Science & Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EG-203 Biochemical Engineering I

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JJ Ojeda Ledo

Format: Lectures 20 hours
Example classes/tutorials 10 hours
Private study 70 hours

Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

On campus lectures and example classes.

The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

Module Aims: To provide an understanding of Biochemical Engineering as a sustainable activity concerned with the safe economic processing of biological materials and feedstocks, to make products for a healthy and prosperous quality of life. Topics will cover biochemical reaction kinetics, fundamentals of enzymatic and microbial processes, reactor design principles for enzyme and fermentation systems, recovery and purification of products, sterilisation techniques.

Module Content:
Biocatalysts and Biocatalyst Optimisation:
Chemical and Biochemical Kinetics, Enzyme inhibition, Enzymatic processes, Enzyme immobilisation.

Cell Kinetics:
Continuous and Batch cultures, Growth phases, Kinetics and stoichiometry of cell growth and product formation.

Bioreactors, Heat and Mass transfer in Biological processes:
Bioreactors, Effects of mixing, Diffusion, Bubbling Gas-Liquid reactors, Gas dispersion, Heat transfer, Scale-up and its difficulties, scale-down, Inoculation and aseptic operations.

Bioprocess Optimisation:
Instrumentation and control of bioprocesses, aeration, agitation, downstream processes, cell liquid separation, sterilisation, kinetics of thermal death of cells.

Intended Learning Outcomes:
After completing this module students should:
- be able to describe enzymatic processes, calculate kinetics of enzyme catalysis and identify different forms of enzyme inhibition;
- be able to explain and distinguish growth patterns and kinetics in batch and continuous cell culture, and predict cell kinetics, stoichiometry of cell growth and product formation;
- apply the fundamentals of heat and mass transfer to biological processes, compare modes of bioreactor operation and their relative merits;
- compare and select adequate downstream processes, recovery and purification of products, and sterilisation techniques in different bioprocess scenarios;
- identify and evaluate appropriate methods to solve common bioprocess problems (eg inhibition of enzymes or cell growth, optimal conditions to maximise product formation, adequate separation processes, sterilisation routes and disposal of waste).
- apply chemical and biological principles to the solution of engineering problems; express ideas in a logical and coherent manner.

Assessment:	Examination 1 (80%) Assignment 1 (10%) Assignment 2 (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: The following assessments are all course requirements.
(i) Two (2) Assignments on CANVAS of 10% each, giving a total of 20% of the final mark.
(ii) End of year examination giving 80% of the final mark.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: Feedback is given during the class tutorials by model answers to problems and marked assignments.

Failure Redemption: A failure can be redeemed via a supplementary exam in August - 100% weighting.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION.
Photocopies of lecture notes are available.
Available to visiting and exchange students.

EG-204 Reactor Design

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof DL Oatley-Radcliffe

Format: Lectures 20 hours; Example classes / Tutorials 10 hours; Directed private study 70 hours

Delivery Method: Notional lectures will be available online and asynchronously via the VLE. These will be supported by assigned reading and alternative online resources where appropriate. Online synchronous worked examples classes and drop in sessions will be scheduled to support student learning. Students will be expected to follow the scheduled workload of learning materials.

Module Aims: The chemical reactor is the ‘heart’ of the chemical process and this module aims to demonstrate how the performance of the reactor is key to successful chemical process design and optimisation. The principles of chemical equilibrium, reaction kinetics, mass balances and thermodynamics are applied to the design of the basic types of chemical reactors (batch reactors, tubular flow reactors, and continuous stirred tank reactors) in order to show how the design of the reactor influences the productivity, selectivity and economics of the chemical process, leading to the development of safe and sustainable production facilities. Practical physical design of tanks and tubular reactors is also considered, along with typical industrial configurations and relevant safety systems.

Module Content: Introduction: The objectives of reactor design and safety considerations. What constitutes a chemical reactor? Types of industrial reactors, typical operation methodologies and conditions.

Chemical equilibrium and manipulation to achieve higher yields. Chemical kinetics, the rate of reaction, analysis of chemical data, summary of the rate laws.

Batch reactors: The components and configuration of the batch tank, liquid mixing in vessels and scale-up, solid-liquid mixing in vessels and scale-up, scale-down considerations, modelling the performance of the ideal batch reactor to calculate batch time and production rates, examples of industrial processing from the fine chemicals and pharmaceutical industries, heat transfer in batch vessels including isothermal, non-isothermal and adiabatic modes, safety considerations for batch vessels including reaction enthalpies and adiabatic temperature rise, reaction calorimetry, control and emergency procedures for batch reactors, design of safe sustainable processes. Mechanical design of batch reactors.

Continuous flow reactors: The components of a continuous flow system, liquid mixing in continuous flow and the use of static mixers, modelling the performance of the ideal continuous reactor (CSTR and PFR) to calculate residence times and production rates, examples of industrial processing from the fine chemicals and oil and gas industries, gas reactions in continuous flow, non-ideal behaviour in continuous flow, the F-curve, C-curve and calculation of dispersion, the tanks in series model. Mechanical design of tubular reactors

So which reactor do I chose, comparative analysis of different reactors, series and parallel reactions, throughput considerations and economic sense.

Intended Learning Outcomes:

1. Knowledge and understanding of the basic chemical reactor types, i.e. batch, continuous tubular and tank reactors. Knowledge of the relevant reactor theory as applied to isothermal and non-isothermal conditions. To identify these reactors and their constituent components in both the laboratory and industrial settings.
2. An ability to analyse reactor performance using relevant reactor theory, mass and energy balances via chemical kinetics, equilibrium and thermodynamics to derive reactor performance and design data.
3. The ability to design chemical reactors for a novel duty; data mining the literature for required data, selecting an appropriate reactor type and size, comparative analysis of the alternative options, and basic mechanical design of vessels and tubular reactors, including configurations and associated equipment.

Assessment: Examination 1 (90%)
Coursework 1 (10%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination 1: 90 End of year examination accounting for 90% of the total mark. Coursework 1: 10 A series of typical questions relevant to topic areas (numerical calculations on various topics delivered throughout the course): 10% total Redemption mechanism: Students who fail the primary exam will receive a supplimentary to redeem this failure. Success will be treated as a threshold pass in-line with College guidelines.
Moderation approach to main assessment: Universal second marking as check or audit
Assessment Feedback: Formative feedback will be provided during synchronous contact sessions. Formal summative feedback will be provided following completion of the final exam in line with standard College of Engineering protocols.
Failure Redemption: Students who fail the primary exam will receive a supplimentary in order to redeem this failure. Success will be treated as a threshold pass in-line with College guidelines.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment. Available to visiting and exchange students. Knowledge of chemical kinetics, mass balances and mathematics to 1st year university level is assumed. This module is assessed by a combination of examination and coursework. Note: If you pass the exam but have failed the coursework, you may still fail the module, depending on the marks achieved, so do the coursework.

EG-206 Instrumentation Measurement and Control

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules: EG-209

Lecturer(s): Dr CO Phillips

Format: Typically this is lectures 20 hours with incorporated example sessions 5 hours. Directed private study 75 hours
Contact Hours will be delivered on-campus

Delivery Method: On campus lectures

Module will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week.

Module Aims: This module covers the fundamental operating principles behind the various types of measuring instruments, pumps and valves in common use in the processing industries, and the criteria for correctly selecting and specifying them. Concepts of process control in terms of architecture and control modes are covered from a mainly qualitative point of view as well as analogue and digital signal types. Drawing of P&IDs is built upon.

Module Content:
Reasons for automation, piping and instrumentation diagrams [1]
Certification/accreditation, hygiene and cleaning [1].
The role of digital and analogue control signals [1].
Pressure – units, industrial measuring equipment and pressure relief devices [1].
Flow measurement- electronic flow meters and switches, theory of differential pressure meters, application to examples such as venturi, orifice meters and rotameters. Flow in open channels [2].
Level measurement - Industrial instruments for liquids and solids covering switches, floats, differential pressure and electronic level measurement [3]
Temperature measurement – contact and non-contact methods of temperature measurement, housing and installation. [2]
Pumps – Types of pump required for different media, operating characteristics, sizing, installation, seals and additional equipment. [2]
Measurement of composition – using photometric (absorbance, turbidity, refractive index, Brix) and electrochemical methods (pH, conductivity, Redox) [2]
Process control - introduction of basic principles on-off, open loop, concept of feedback, qualitative characteristics of feedback and feed forward control, introduction to three term proportional, integral and derivative control, concepts of gain, offset and load change, basic tuning characteristics, measurement, signal transmission. [2]
Control valves – types of control valve, valve characteristics, pneumatic and electrical actuation
Operation, safety critical and non-return valves. [2]
Control system architecture – distributed control systems, HART, Profibus and programmable logic controllers [2].

Intended Learning Outcomes: On successful completion of this module, students will be able to:
• Explain the role of automation and certification in the running of a processes plant.
• Interpret and design piping and instrumentation diagrams.
• Relate the fundamental concepts behind measurement of temperature, pressure, level, flow and composition to the operational principles of various types of measurement equipment.
• Compare and choose from, a comprehensive range of measurement equipment depending on application requirements.
• Assess the suitability of various types of pumping equipment based on application requirements.
• Demonstrate the principles of control systems from a qualitative perspective including closed loop control, the principles of proportional, integral and derivative term controllers and operation of control valves.

Assessment: Examination 1 (90%)
Assignment 1 (10%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description:
Assignment 1 (This is a group piece of coursework) 10%

Exam 90%

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: Assignment will be marked and returned to the student within 3 weeks. Exams marks will be returned to the students via the intranet in the usual way.
Failure Redemption: A supplementary examination will form 100% of the module mark.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities with delivery on-campus. Available to visiting and exchange students. The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EG-208 Process Design and Simulation

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: EG-200; EG-210

Lecturer(s): Dr RC Butterfield, Dr JO Titiloye

Format: Lectures 10 hours; Computer Laboratory 20 hours; Directed private study 70 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

A blended learning approach will be taken to deliver the content of the module utilizing the virtual learning environment CANVAS.

Theory, concepts and practice exercises will be delivered asynchronously, with opportunities for synchronous activities where students can seek support from staff and apply their knowledge in utilizing the software covered in the course.

The module utilizes the following software:
Aspen Plus
Aspen HYSYS
Honeywell Unisim

Module Aims: This module provides consolidation of earlier studies of material & energy balances, thermodynamics and separation processes. Commonly available process simulation software packages will be utilized to verify hand calculations performed to design chemical engineering unit operations. Utilising the process flowsheeting functions of these simulation packages, this module will highlight the ability to simulate and optimize the design of a chemical engineering unit operation or process.

Module Content: Overview: The module utilises a process design computer packages Aspen Plus, Hysys and Unisim to support learning in process design and optimisation. Case studies grow in complexity culminating in a complete process simulation exercise with design variable sensitivity study. The laboratory time is hands-on computer time.
Specific topics are:
- Introduction to computer simulation and PFD simulation.
- Verify design calculations by hand and simulator.
- Material Streams, energy balances and flow sheeting on computer.
- Physical property data bases and predictive methods.
- Degrees of freedom in problem solution.
- Unit operations design using PFD simulation.
- Design with recycles.

Intended Learning Outcomes: 1) Utilize pinch technology to determine potential energy recovery savings for a process flowsheet.
2) Know the features of Aspen Plus, Hysys and Unisim simulation packages
3) Apply knowledge of thermodynamic models to choose and utilise the appropriate physical and thermodynamic property packages or predictors suited to the design conditions being simulated; obtain thermodynamic and physical property data eg vapour liquid equilibria, ternary equilibria etc.
4) Verify hand calculations utilising the available simulation packages
5) Utilise a simulation package such as Aspen Plus, Hysys, or Unisim to simulate a process and produce a viable design. Recognise the capability and limitations of these programs in process design.

Assessment: Coursework 1 (25%)
Coursework 2 (75%)
Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Coursework 1: This is an individual assignment assessing learning outcome 1. Coursework 2:. The coursework will involve a mixture of group and individual components. This assessment will address learning out comes 2, 3, 4, & 5

This module is continually assessed, there is no formal examination.

Redemption for this module will take the form of an individual piece of coursework.

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students will be given continuous feedback during the examples classes on the use of the simulation software.

Feedback on the assessed work will be given via overall marks and written comments.

Failure Redemption: Redemption of failure in this module will take the form of an individual piece of coursework worth 100% of the module mark.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

NOT available to visiting and exchange students.
The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

The PC classes that feature in this module are there to provide student contact with academic staff and to support the learning outcomes of the module. Therefore attendance to these classes is highly recommended and will be monitored.

EG-210 Thermodynamics of Process Design

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr S Sarp

Format: Lectures 20 hours
Example classes/Tutorials 10 hours
Directed private study 70 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

2 hour lecture (in person) and 1 hour example class (in person)

No pre-recorded lectures or online delivery

Module Aims: This module continues to develop further the fundamentals of thermodynamics studied in the Year 1 course (EGA114). It will develop the general applications needed in process engineering with particular reference to reactor design, separation processes, flow processes, heat engines and energy balance techniques.

Module Content: Delivery of EG-210 module content will be preceded by a synopisis of Introductory Thermodynamics concepts

Section 1 : Carnot engine, simple air standard cycles for engines, system efficiency, P-V and T-S diagrams; Steam power cycles, including Rankine cycle, reheat and regeneration systems; refrigeration cycles; Case studies.

Section 2: Clausius-Clapeyron equation; Gibbs free energy; Chemical potential and activities; Maxwell's equations; Chemical reaction equilibria: free energy of reactions; reaction and equilibrium isotherms; Van't Hoff isochore and isotherm. Case studies of chemical equilibria for industrial catalytic reaction systems for chemical product design.

Section 3: Phase equilibria for separation process engineering design; Thermodynamics of molecular mixtures (enthalpy, entropy, free-energy and volume); General liquid-vapour equilibrium models; Bubble and dew point prediction and the De-Priester nomogram; Ideal and non-ideal mixtures; Models for predicting activity coefficients of liquid solutions (Van-Laar, Wilson etc.); Maximum and minimum boiling-point mixtures; Azeotropes and distillation; Henry's Law; Effects of pressure, temperature and composition on equilibria. Case studies

Intended Learning Outcomes:
Upon completion of this module students should:
1) be able to demonstrate knowledge and understanding of the essential facts, concepts, theories and principles of thermodynamics
2) have the knowledge to apply appropriate science, engineering and mathematical tools to the analysis of problems arising in thermodynamics
3) have an understanding of the wider context of the underlying theory of thermodynamics, including its applications to engineering design and application to real world problems

Assessment: Examination 1 (85%)
Coursework 1 (15%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description:
Examination: End of year examination accounting for 85% of the total mark

Coursework - 15%

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: Exam feedback will be given via exam results and the exam feedback forms. Coursework feedback will be given via coursework marks, individual written comments on the coursework scripts and provision of model answers on Canvas
Failure Redemption: A supplementary examination will form 100% of the module mark.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment. Available to visiting and exchange students. This module will be supported with Canvas.

EG-211 Fluid Flow

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-160

Co-requisite Modules:

Lecturer(s): Prof PR Williams

Format: Lectures 20 hours
Example classes / Tutorials 4 hours
Directed private study 76 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Assessment: 100% end of semester closed book examination

Module Aims: This module aims to extend the previous Fluid Mechanics (EG-160) module, to introduce the flow of fluids around particles, through porous media, pipes and devices (with special reference to the design and operation of differential head flowmeters) to provide a balance between theory and practical aspects of equipment used in chemical engineering, such as mixing impellers (with special reference to the Rushton-turbine type mixer) and packed beds (spherical particles). The module also addresses elements of non-Newtonian fluid flow in terms of the Power-Law Model and the Bingham-Plastic Model (for yield stress materials) and considers the flow of these materials in pipes.

Module Content:
Module content: [lecture hours]
* Basic Conservation Equations
* Flow Measurement
* Fluid Agitation and Mixing
* Laminar Flow in Newtonian and non-Newtonian Fluids
* Flow around submerged Bodies, including wings, drag, lift, etc
* Porous Media
* Similarity. Concept of dynamic similarity and its significance in practical fluid mechanics, Reynolds, Froude numbers, model testing.

Intended Learning Outcomes:
A knowledge and understanding of:
Basic conservation equations, flow measurement, agitation and mixing, laminar flow in Newtonian and non-Newtonian fluids, flow around submerged bodies and similarity.

An ability to: identify flow types and from first principles derive solutions for a wide variety of fluid flow problems.

An ability to: apply conservation equations appropriately to analyse fluid flow behaviour. Use dimensional analysis and similarity concepts and apply them to engineering fluid flow problems. Solve problems in the areas of flow measurement and laminar flow for Newtonian and non-Newtonian fluids as well as for flows around submerged bodies and in porous media.

An ability to: study independently, use library resources and manage working time.

Assessment: Examination 1 (100%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: 100% end of semester examination.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: Feedback on the examination will be given via a proforma that will be available following the exam period.

Failure Redemption: A supplementary examination will form 100% of the module mark.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION.

Available to visiting and exchange students.

EG-215 Process Modelling

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr R Van Loon

Format: Lectures:20 hours
Revision: 2 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Theory and Examples: 2 hour classes taught over a 10 week period.
Revision: A 2 hour session during week 11.

Module Aims: The module aims to develop the ability to construct mathematical models of processes so as to be able to predict their performance and optimise their design. Models of simple processes will lead to ordinary (or partial) differential equations, with special reference to biochemical and biomedical engineering processes, as well as environmental and general engineering systems..

Module Content:
Module content: [lecture hours]

• Introduction to process modelling: purpose of modelling, making assumptions, deriving ordinary differential equations (ODEs) from conservation laws, dependent, independent variables and parameters, steady versus unsteady problems. Mathematical similarity between various physically different processes [8]

• Analytical solution of ODEs models: revision and extension with emphasis on recognition of order, degree and linearity as determinant of method of solution, homogeneous versus non-homogeneous equations, linear and non-linear first order equations, second order equations with x or y missing, linear n-th order equations with constant coefficients. [4]

• Numerical Solution of ODE models: When numerical methods are needed, Euler (explicit and implicit) methods, numerical stability and accuracy, truncation error by Taylor expansion, accumulated truncation and round-off error as functions of step size, Runge-Kutta methods. [4]

• Solving non-linear models: Second order equations, fixed-point iterations, Newton Raphson, Systems of equations (derivation and application). [4]

Some examples through which these topics can be taught are: mixing in a continuous stirred tank (CST), heating/cooling in a continuous stirred tank (CST), fluidisation/sedimentation, draining/filling a tank, drug delivery, oxygen exchange in the lung, cell growth in a bioreactor, and coffee making.

Intended Learning Outcomes: Technical Outcomes
On successful completion of this module, students should be able, at threshold level, to:
- Demonstrate a knowledge and understanding of how ordinary and partial differential equations can be defined from conservation laws and how they can be used to describe simple biomedical and biochemical engineering processes with a view to understanding the process, predicting its performance and optimising its design. The processes will mostly involve fluid dynamics, mixing/reaction and heat transfer problems typically found in bioprocesses and everyday life processes, and one learning outcome will be a reinforced and deeper understanding of these fundamental areas, already introduced in other modules - evaluated in Assessment and Exam (SM3b, SM5m, EA1b)
- Solve (non)-homogeneous and/or (non)-linear ODEs using various analytical and numerical approaches - evaluated in Exam (SM2b)
- Interpret the results by sketching a graph of the solution, by manipulation of the final equation(s) and by relating these equations to the physics in the process. Finally, use the equations to predict/control the physical process. Analyse physical processes - evaluated in Exam (SM5m, EA1b, EA2)

Accreditation Outcomes (AHEP)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)

Assessment:	Examination 1 (80%)
	Assignment 1 (20%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: A group assignment will be set in week 4 or 5. The emphasis of this assignment will lie on conservation laws and the formulation of ODEs from them for given processes.

The examination will consist of a number of questions, all of which need to be solved. The examination will be closed book.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: The students will receive their marked work back and the answers to the assignment will be discussed in class. Typical mistakes will be highlighted to prevent repetition in the final exam.

Feedback on the final examination is via the University feedback form.

Failure Redemption: A supplementary examination will form 100% of the module mark.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

Notes, worked examples and past papers for this module can be found on Canvas.

Students must have completed Year 1 maths modules in order to take this module.

EG-220 Process and Pilot Plant Operations A

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr PM Williams, Dr P Esteban

Format: Contact Hours will be delivered through a blend of live activities and online briefings. For this module the sessions include: Introductory Lecture (online live, ~ 1 1/2 hrs). 4 compulsory EA1 lab sessions comprised of 2 morning and 2 afternoon sessions.
The sessions run Tuesday and Thursday in a week. A 1 hr optional live office hour (time to be decided).

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities. Live attendance to the lab sessions are compulsory for this module.

Module Aims: As a chemical engineer an understanding of how to design and operate processes is vitally important. In one half of this module, students will design a rig based on a given brief. Once designed, the rig will be built and run by the students, and experimental results from tests on the rig will be obtained. In the other half of the module students will be required to research into and report on a given industrial process. The module will involve a range of activities to enhance team work, report writing, time management and presentation skills as well as to further the understanding of subjects covered in taught modules.

Module Content: Engineering Applications 1 (EA1): In EA1 you will be required (within a group of 5) to design and commission a rig from an initial process brief. This will involve, drawing a P&ID from the initial brief, building and commissioning of the rig, writing start-up and shut-down processes for the operators to follow, running the rig to obtain experimental data (centrifugal pump curve and orifice plate experiments) and writing an instruction manual for the small pilot plant.

Literature Research Project: In the Literature Research Project, you will be required to carry out research into a chemical process (examples of which include the production of benzene, the production of sulphuric acid etc.). This is an individual research exercise where the student is required to write a technical report to educate the reader on the report topic.

Intended Learning Outcomes: On successful completion of this module, students will be able to:

• Analyse process descriptions to make sketches, drawings and PFD’s proficiently (Coursework 1).
• Identify pilot scale apparatus and components (Coursework 1).
• Write clear and concise operating procedures to run apparatus (Coursework 1).
• Perform risk and safety analyses and understand the importance of Health and Safety in the workplace (Coursework 1).
• Work in a team and manage their time effectively (Coursework 1).
• Present their work in writing (Coursework 1 and 2).
• Conduct and write-up their own research into an Industrial Process within the Chemical Engineering field (Coursework 2).

Assessment: Coursework 1 (50%)
Coursework 2 (50%)
Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Coursework 1 (50%): EA1 - The students will be in a group (~5 members) and the group will design and write operating instructions for a pilot rig from a given brief. This component includes elements such as the team work, health and safety, design, start-up/shut-down and a written operating manual.

Coursework 2 (50%): Literature Research Project - The project will involve research into an appropriate topic within chemical engineering (this is an individual assignment) and a subsequent write-up of this research.

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Verbal feedback is given throughout the module during the lab sessions. Students are advised throughout the module on what is expected. Written feedback will be given on the final operating manual and individual project report documents.

Failure Redemption: An opportunity to redeem failure in EG-220 is provided only for those students who have attended at least 3 of the 4 practical sessions associated with the EA1 component, in those cases a failure may be redeemed by the writing of an individual report in the summer.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

NOT AVAILABLE TO VISITING AND EXCHANGE STUDENTS.

The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EG-230 Process and Pilot Plant Operations B

Credits: 20 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr PM Williams, Dr P Esteban, Dr CO Phillips

Format: Contact Hours will be delivered through a blend of live activities and an introductory online lecture. For this module the sessions include: Introductory Lecture (online live, ~ 1 1/2 hrs), 4 x Unit Operations Laboratory (UOL) Compulsory Lab Classes (students will work in pairs) with each lab class consisting of ~7.5 hrs work in the Pilot Plant.

Delivery Method: All programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Live attendance to the lab sessions are compulsory for this module.

Module Aims: This module supports and amplifies lectures by providing practical experience of process equipment, its operation and performance. The Unit Operations Laboratory (UOL) experiments are carried out in pairs. Overall, each pair of students will conduct 4 different experiments on 4 different pieces of pilot plant apparatus and will be required to produce 4 experimental reports. In each session, each pair of students will conduct various experiments on a piece of pilot plant equipment to obtain experimental data which they will need to analyse and write-up within a lab report. Online videos of will be provided giving guidance on writing reports, handling error and risk assessment.

Module Content: Students prepare for, conduct and write up experiments on major unit operations of process engineering. The equipment is of industrial pilot plant scale. The work provides practical demonstrations of physical processes studied in lecture courses, and experience in the application of theory to the analysis of unit operations. Several key transferable skills are developed, including teamwork and time management. The Unit Operations Laboratory also provides an intellectual challenge, opportunities for independent thinking, and motivation to study process engineering. The experiments will be a selection from the following unit operations: Fluid flow (pipe flow or air duct); Heat transfer (air-water or water-water heat exchanger); Distillation (sieve tray or packed column) and absorption (packed bed column); Evaporation (single or multistage falling film); Process thermodynamics (heat pump or combustion); Miscellaneous (chemical reactor, process control, liquid mixing, water cooling tower, fluidised bed or membrane filtration).

Intended Learning Outcomes: On successful completion of this module, students will be able to:

- Use a range of process equipment unit operations (such as stirred vessels, packed towers, pumps etc.);
- Recognise and use flow measuring devices and be able to measure flow rates;
- Recognise and use pressure measuring devices and be able to measure pressure differences;
- Run experiments and collect data;
- Analyse experimental data and error using appropriate mathematical methods, in order to compare with theory;
- Evaluate and present their findings in detailed written technical reports;

Assessment:
Assignment 1 (25%)
Assignment 2 (25%)
Assignment 3 (25%)
Assignment 4 (25%)

Assessment Description: The weightings for the assignments are as follows:
Assignment 1 - 25%
Assignment 2 - 25%
Assignment 3 - 25%
Assignment 4 - 25%

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Verbal feedback and advice will be given in the lab sessions. Students are advised throughout the module on what is expected. Reports are marked and returned to the students with written feedback prior to their next laboratory session.

Failure Redemption: Due to the nature of this module there is no opportunity to redeem a failure.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

NOT AVAILABLE TO VISITING OR EXCHANGE STUDENTS.

The Faculty of Science & Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EG-233 Placement Preparation: Engineering Industrial Year

Credits: 0 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof GTM Bunting, Dr CME Charbonneau, Dr P Esteban, Dr SA Rolland, Dr V Samaras, Dr S Sharma

Format: 11 hours consisting of a mix of seminars and workshops. 11 one hour drop-in advice sessions. Review of CV and cover letter.
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

This module is delivered through directed and self-directed learning, careers resources, interactive workshops, reflective learning practice and drop-in advice sessions. The module is delivered on the Bay Campus.

Module Aims: This generic cross-disciplinary module is for all students who have enrolled (or transferred) onto the Engineering Year in Industry scheme. The module focuses on the underpinning and fundamental requisites required to gain, enter and progress effectively through an industrial placement. Learners will be introduced to a) sourcing placements, CV writing and application techniques; (b) interview techniques - how to pitch yourself and be successful; (c) workplace fundamentals and IP awareness, behaviours and expectations; (d) key employability skills; getting the most from your Industrial Placement; and (e) health and safety in the workplace.

Module Content:
The module will focus on the key requirements to gain and be successful whilst on a placement. Directed and self-directed activity will address the following topics;

1) Engineering Industrial Placements - what they are, how to search and how to apply.
2) CV writing, cover letters and application processes.
3) Assessment centres, interview techniques and mock interviews.
4) Recognising and developing employability skills.
5) Reflecting and maximising the placement experience.
6) One to one meeting with careers and employability staff.
7) Health and safety in the workplace.

Intended Learning Outcomes:
Technical Outcomes
By the end of this module, students will:
- Know how to find and apply for placements, create a CV and complete a placement application.
- Understand the interview process and gain interview experience.
- Discuss and share what is expected within the workplace including behavioural and professional conduct.
- Identify personal employability skills and how these will be used in a workplace setting.

Accreditation Outcomes (AHEP)
EL5b Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues
EL6b Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk,

Assessment: Class Test 1 - Coursework (0%)
Placements (100%)

Assessment Description:
Students are required to attend the health and safety lecture. Students who do not attend and have no valid reason will not be permitted to continue on an Engineering Industrial Placement Year programme of study.

Moderation approach to main assessment: Not applicable

Assessment Feedback:
N/A: students will however be able to discuss and seek feedback/advice on their search for an industrial placement, during the drop-in sessions.

Failure Redemption:
Successful completion of this module depends upon attendance at, and engagement with, the health and safety lecture. Therefore there will normally be no opportunity to redeem failure. However, special provision will be made for students with extenuating or special circumstances.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

This module is only available for students enrolled on the Engineering Year in Industry scheme.

EG-285 Statistical Techniques in Engineering

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr M Evans

Format: Lectures: 20 hours
Computer-based example classes: 20 hours
Directed private study 25 hours
Preparation for assessment 35 hours

Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: This module will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and/or self-directed online activity, with live and self-directed on-campus activities each week.

The asynchronous lecture material on line (Canvas) will replace the normal 2 hours of lectures per week. This material is comprised of a number of bite sized segments containing a mixture of condensed notes, videos and worked examples. These must be read (on a weekly basis) before each of the weekly PC classes

The weekly 2 hour long PC class will be held over Zoom. You will be invited to join weekly zoom classes where you will need to have access to a computer that has Excel installed. You can attend these Zoom classes from the timetabled PC rooms on Bay Campus if you so wish, where a demonstrator and/or lecturer will be on hand for further help and guidance.

On Canvas there will be weekly discussion boards and an office hour - via Zoom sessions (where you can meet the lecturer on a 1 to 1 basis (or as a member of a small group if your prefer) for additional help and support.

Module Aims: This module offers a balanced, streamlined one-semester introduction to Engineering Statistics that emphasises the statistical tools most needed by practicing engineers. Using real engineering problems with real data taken from engineering journal publications, students see how statistics fit within the methods of engineering problem solving. The module teaches students how to think like an engineer when analysing real data.

Assignments and Quizzes, answered through Canvas, tailored to each engineering discipline, are intended to simulate problems that students will encounter professionally during their future careers. Emphasis is placed on Excel as a computer environment for tackling engineering problems that require the use of statistics.

Module Content: Week 1: Sample Statistics. Engineering method and statistical thinking (variability), mean, standard deviation, median, inter-quartile range and mode. Week 2: Displaying Data & Probability Theory. Stem-and-Leaf displays, box plots and histograms. The addition rule and mutual exclusivity, the product rule and independence, applications to product & process reliability.. Week 3: Discrete Probability Distributions. Discrete Random Variables, the Binomial distribution and the Poisson distribution. Week 4: Continuous Probability Distributions. Continuous Random Variables, the uniform, normal, triangular, exponential, Weibull and chi square distributions. Week 5: Estimation (Method of Moments). Populations and Sampling. Distinction between a population and a sample, population parameters and sample statistics, random sampling from a population, computer simulation of a random sample. Sample estimates of population parameters. The method of moments. The central limit theorem and the reliability of sample estimates through computer simulation. Week 6: The Student-t Distribution and Confidence Intervals for the Population Mean. The Student t Distribution, Confidence Intervals. Week 7: Least Squares Analysis. Simple Linear Regression. Correlation & Non-Linear Regression Analysis. The correlation coefficient, types of non linear models used within engineering and non-linear regression through data transformations. Week 8: Repairable Systems & Reliability Growth. Quality v Reliability. Repairable and Non-Repairable Systems. Reliability Growth. Parametric and Non-Parametric Estimation for Repairable Systems. HPP and NHPP models. Power Law and Exponential Law NHPP Model. Week 9. Probabilistic Failure Analysis for Non-Repairable Systems. Causes of Failure. Variability and Time Dependency. Failure Criteria for Overloaded Systems. Mean and Variability for Variable Combinations First Order Second Moment Methods. Week 10. Statistical Models for Degradation Processes. Model Building Techniques. A fatigue Limit Model. Accelerated Testing. Deterministic Models for Creep. A Wilshire-Weibull Stochastic model for Creep. A practical class will follow each week, where directed study will be provided to highlight how the techniques learnt in each lecture can be applied to Chemical and Materials engineering problems within Excel.	
Intended Learning Outcomes: B1. Apply knowledge of mathematics, statistics, natural science and engineering principles to broadly-defined problems. Some of the knowledge will be informed by current developments in the subject of study. B2. Analyse broadly-defined problems reaching substantiated conclusions using first principles of mathematics, statistics, natural science and engineering principles. B3. Select and apply appropriate computational and analytical techniques to model broadly defined problems, recognising the limitations of the techniques employed. B4. Select and evaluate technical literature and other sources of information to address broadly defined problems. B6. Apply an integrated or systems approach to the solution of broadly defined problems. B9. Use a risk management process to identify, evaluate and mitigate risks (the effects of uncertainty) associated with a particular project or activity. Specifically and within these AHEP specifications: • Think about, understand and deal with variability (assessed in coursework 1). • Ability to summarise, describe and present experimental data sets (assessed in coursework 1). • Ability to select appropriate distributions and then to use them for given problem statements (assessed in coursework 1). • Ability to estimate parameters associated with various distributions using sample data (assessed in coursework 2). • Ability to form confidence intervals (assessed in coursework 2). • Ability to quantify relationships between engineering variables for continuous process and product improvement (assessed in coursework 2). • Ability to carry out detailed reliability analysis on repairable and non-repairable systems (assessed in coursework 3). • Ability to carry out detailed probabilistic failure analysis (assessed in coursework 3). • Ability to carry estimate safe life from accelerated test data (assessed in coursework 3). More specific and tailored learning outcomes re given on the Canvas site.	
Assessment:	Assignment 1 (25%) Assignment 2 (25%) Coursework 1 (20%) Assignment 3 (30%)

Assessment Description: Assignment 1 (contributes 25% to module grade). Students will receive a series of multiple choice questions and numeric based questions via Canvas and will be expected to answer both theoretical questions and questions based on provided experimental data sets (using Excel to find answer to the numbers based based questions). Questions will be related to weeks 1-4. This is individual work. Assignment 2 (contributes 25% to module grade). Students will receive a series of multiple choice questions and numeric based questions via Canvas and will be expected to answer both theoretical questions and questions based on provided experimental data sets (using Excel to find answer to the numbers based questions). Questions will be related to weeks 5-7.This is individual work. Assignment 3 (contributes 30% to module grade). Students will receive a series of multiple choice questions and numeric based questions via Canvas and will be expected to answer both theoretical questions and questions based on provided experimental data sets (using Excel to find answer to the numbers based questions). Questions will be related to weeks 8-10.This is individual work. Coursework 1 (contributes 20% to module grade). This coursework will be spread over the whole teaching semester via short quizzes that follow at the end of each each PC class and tests your knowledge of the content of these classes (each quiz is worth 2% towards your module grade). To pass the module you must i. obtain an average mark of a least 40% in the coursework component and ii. obtain 40% overall for the module. If you do not meet the component level requirements for the module you will receive a QF outcome. This means that you will be required to take supplementary coursework even if your module mark is above 40%.
Moderation approach to main assessment: Universal second marking as check or audit
Assessment Feedback: Students will receive their grades, together with models answers, within 3 weeks of submission.
Failure Redemption: Failure to pass the module will result in a resit (provided university resit criteria are meet) where by students will be offered a new and separate 100% resit component (capped at 40%).
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online. PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION The module is only for students within the College of Engineering. Notes, worked examples and assignments can be found on Canvas.