Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 4 (FHEQ LEVEL 7)

CHEMICAL ENGINEERING

DEGREE PROGRAMMES

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2023-24

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 23-24 academic year begins on 25 September 2023

Full term dates can be found here

DATES OF 23-24 TERMS
25 September 2023 – 15 December 2023
8 January 2024 – 22 March 2024
15 April 2024 – 07 June 2024

SEMESTER 1
25 September 2023 – 29 January 2024
SEMESTER 2
29 January 2024 – 07 June 2024
SUMMER
10 June 2024 – 20 September 2024

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.

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.

At Swansea University and in the Faculty of Science and 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, technical and administrative staff, administrators - I'm sure you will find many friendly helping hands ready to assist you. And make the most of living and working alongside your fellow students.

During your time with us, please learn, create, collaborate, and most of all – enjoy yourself!

Professor David Smith
Pro-Vice-Chancellor and 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 Laura Roberts
School of Engineering and Applied Sciences **Head of School: Professor Serena Margadonna**	
School Education Lead	Professor Simon Bott
Head of Chemical Engineering	Professor Enrico Andreoli
Chemical Engineering Programme Director	Dr Matt Barrow M.S.Barrow@swansea.ac.uk
Year 4 Coordinator	Dr Jesus Ojeda Ledo J.J.Ojedaledo@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 8.30am-4pm.

The **Student Support Team** provides dedicated and professional support to all students in 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 (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 other resources:

https://myuni.swansea.ac.uk/fse/

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 23-24 handbooks to ensure that you have access to the most up-to-date versions. 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 4 (FHEQ Level 7) 2023/24
Chemical Engineering
MEng Chemical Engineering[H801]
MEng Chemical Engineering with a Year Abroad[H802]
MEng Chemical Engineering with a Year in Industry[H890]

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-M01 **Complex Fluids and Flows** **10 Credits** **Dr DJ Curtis** **CORE**	**EG-M07** **Optimisation** **10 Credits** **Prof C Giannetti** **CORE**
EGCM89 **Chemical and Environmental Engineering MEng Design Project** **20 Credits** **Dr JO Titiloye/Dr JJ Ojeda Ledo/Dr PM Williams** **CORE**	**EGDM01** **Colloid and Interface Science** **10 Credits** **Dr S Alexander** **CORE**
EGC401 **Industrial Engineering and Research Practice** **30 Credits** **Dr YK Ju-Nam/Dr JJ Ojeda Ledo/Dr PM Williams** **CORE**	
Total 120 Credits	

Optional Modules
Choose exactly 20 credits
Choose exactly 20 credits from the following modules:

EG-M09	Water and Wastewater Engineering	Prof C Tizaoui	TB1	10 (CORE)
EG-M11	Biochemical Engineering II	Dr JJ Ojeda Ledo	TB1	10 (CORE)
EGCM38	Membrane Technology	Dr P Esteban	TB1	10 (CORE)
EGTM79	Sustainability and Environmental Assessment	Prof GTM Bunting/Mr MH Green	TB1	10 (CORE)

And
Choose exactly 20 credits
Choose exactly 20 credits from the following modules:

EG-M160	Advanced Microfluidics	Dr F Del Giudice	TB2	10 (CORE)
EGCM36	Desalination	Dr W Zhang/Dr SJI Shearan	TB2	10 (CORE)
EGCM40	Pollutant transport by groundwater flows	Dr B Sandnes	TB2	10 (CORE)
EGTM89	Polymers: Properties and Design	Dr S Sharma	TB2	10 (CORE)

EG-M01 Complex Fluids and Flows

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr DJ Curtis

Format: Typically, lectures and office surgeries (20 hours) plus independent and directed study (80 hours). 100 hours total. Contact Hours will be delivered on-campus, and will include lectures practical demonstrations.

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

Lectures, office surgeries and on-line media co-ordinated through Canvas.

Module Aims: This module considers the rheology of complex fluids. Course content provides an introduction to rheology from basic classifications of non-Newtonian materials to how the material properties affect processing operations. Consideration is given to the influence of product rheology and the manufacturing process, quality control and how this influences performance and end-user perception.

Rheological methods for the characterisation of non-Newtonian materials are reviewed and means by which the results of such tests can be used to describe and predict advanced aspects of transport processes involving non-Newtonian fluids are considered. Materials of interest range from simple inelastic time-independent fluids to more complex viscoelastic systems. Measurement techniques considered range from simple shear viscometers to advanced rheometrical techniques for the characterisation of evolving systems (those which are changing with time due to chemical or physical transformation).

Module Content:

- Non-Newtonian fluid mechanics, including aspects of:
- Applications of industrial rheology
- Definition of shear viscosity, shear stress and shear rate.
- Rotational viscometry (non-oscillatory testing)
- Yield Stress, Bingham plastic materials and associated measurement techniques.
- Power law fluids, Bingham plastics, yield pseudoplastics, Herschel Bulkley fluids etc.
- Time-dependent behavior of fluids, thixotropy, rheopexy.
- Rheological models including Power-law, Carreau, Ellis and Casson fluid models.
- Viscoelasticity – Maxwell, Kelvin-Voigt and Burgers models. Relaxation time, Retardation time.
- Time effects in viscoelastic flows- Deborah number
- Small amplitude oscillatory flow, complex shear modulus. Oscillatory flow – Maxwell model. Gel point analysis.
- Measurement of rheological parameters using different viscometer/rheometer systems.

Intended Learning Outcomes:
The student should be able to:

Identify/describe various types of flow behaviour spanning inelastic to viscoelastic responses.

Identify and describe techniques for the measurement of material properties for a range of materials.

Manipulate flow models to evaluate the relationship between stress and rate in flow geometries for assessment of pressure drop from viscometric data or vice versa.

Interpret response to applied stress or imposed strain using mechanical analogues extended to sol-gel transition phenomena in terms of linear viscoelastic theory.

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

Assessment Description: An end of semester examination will form 100% of the module mark

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: The examination feedback summary will be available on-line, for all other matters the lecturer will be available throughout the semester and personalised meetings may be arranged on request.

Failure Redemption: Eligibility for the redemption process is subject to the degree scheme and the associated progression/completion criteria; where permitted, a supplementary examination will be provided.

Additional Notes: Delivery will be on-campus with supporting material provided via Canvas.

All students are required to use the iFind library service to download and retain their own e-copies of all chapters of the essential reading text, "An introduction to rheology" by H.A. Barnes, J.F. Hutton and K. Walters. These book chapters are available for your personal use through the University's Elsevier subscription.

EG-M07 Optimisation

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof C Giannetti

Format: Timetabled lectures and example classes 30 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

Assessment:
Exam: Extended Coursework 80% (LO1, 2 & 3)
Continuous Assessment: 20% - Assignment 1 (LO1 & 2) and Assignment 2 (LO 2 & 3)

Module Aims: This module provides an introduction to some important techniques of optimisation that may be used across a broad range of engineering disciplines. The focus is on understanding the methods through hand calculation rather than the use of particular software packages. Numerical examples are employed to illustrate concepts and potential applications.

Module Content:
Indicative syllabus content:
1. Statement of optimisation and reliability problems.
2. Lagrange multipliers
3. One-Dimensional Minimisation Methods. Direct and indirect methods: unrestricted search; dichotomous search; golden section method; quadratic interpolation; Newton's procedures.
4. Extrema of functions of several variables.
5. Multidimensional Minimisation Problems - direct methods such as: Taxi-cab; conjugate search procedure
6. Multidimensional Minimisation Problems - indirect methods such as: Steepest descent method; Newton's method.
7. Linear Programming - the Simplex Method

Intended Learning Outcomes:
Technical Outcomes
Upon completion of the module the student should:
- Understand and be able to set up and carry out the necessary calculations for univariate unimodal optimisation problems LO1)
- Be able to use search techniques to determine the optima of unconstrained and constrained multivariable systems (LO2)
- Understand and be able to set up and carry out the necessary calculations for Linear Programming problems (LO3)

Accreditation Outcomes (AHEP)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Understanding of concepts from a range of areas, including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects (SM6m)
- Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods (EA7M)
- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D10M)

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

Assessment Description: Exam - 80%
Coursework - 2 separate pieces which involve a selection of problems which utilise the optimisation methods taught. 20%

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback:
Examination - Standard Faculty of Science and Engineering exam 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.

This module assumes good mathematical skills and students will be expected to demonstrate a good understanding of partial differentiation, Taylor series expansion and matrices.

Failure to sit an examination or submit work by the specified date will result in a mark of 0% being recorded.

This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

Additional notes: Office hours, lecture notes and other teaching materials will be posted on Canvas.

EG-M09 Water and Wastewater Engineering

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof C Tizaoui

Format: Lectures and example classes 30 hours Directed private study 70 hours Contact Hours will be delivered on-campus, and will include, lectures, seminars, and tutorial (example class) sessions.

Delivery Method: On-campus lectures and example classes. Module materials are available on Canvas. Assessment: January Assessment (Exam) 80% and one Canvas test 20%.

Module Aims: This module aims to deliver a working knowledge of water and wastewater treatment processes. The module will cover various physical, chemical and biological unit operations commonly used in the treatment of water and wastewater. This module will particularly emphasise the design and operational issues related to these unit operations. Moreover, the module will cover regulatory aspects related to water quality and requirements for treatments of drinking water to be fit for human consumption and of wastewater to be disposed of safely in the aquatic environment.

Module Content: • Introduction. Water resources, quality, pollution, and requirements for treatment [3]
• Drinking water treatment. Selection of typical treatment processes. Preliminary treatment, design of typical treatment units from flotation, coagulation and flocculation, filtration. Chemical oxidation and disinfection. Water treatment works sludge [12]
• Wastewater composition, characterisation, flow rates. Aims of wastewater treatment and standards. Overview of wastewater treatment processes [3]
• Physical wastewater treatment processes, types and design: equalisation basins, screening, grit removal and settling [6]
• Secondary wastewater treatment. Design of the activated sludge process. [3]
• Natural Treatment Systems: Constructed wetlands for wastewater treatment [3]

Intended Learning Outcomes: After completing this module, students should be able to:
• Demonstrate knowledge and apply understanding of: the composition and characterisation of water and wastewater; the terminology used; the role and general principles of the main physical, chemical, and biological treatment processes.
• Analyse and propose design options for water and wastewater treatment unit operations.
• Synthesise and evaluate with reasoned arguments the stages and processes necessary to treat a given water supply or wastewater.
• Assimilate further knowledge relating to drinking water and wastewater treatment and critically appraise sources of information relating to treatment practices.

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

Assessment Description: January Assessment 80% (Exam) and one Canvas test 20%
Resit: Assessment (100%) (Exam)

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Assessment results and general feedback forms common across Faculty. Assignment feedback will be given by individual written comments, one-to-one comments and assignment mark.

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

Additional Notes: We will make every effort to engage with students where changes are necessary and any changes will be communicated to students, as soon as possible. Delivery of both teaching and assessment will be on-campus.

Available to visiting and exchange students.

This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

EG-M11 Biochemical Engineering II

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JJ Ojeda Ledo

Format: Lectures 20 hours
Example classes 5 hours
Private study 75 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% examination in January.

Module Aims: This module builds up from EG-203 (Biochemical Engineering I) and describes more advanced topics in the production and optimisation of biological materials and processes. Optimisation methods of bioprocesses are described, and how these are exploited in the commercial situation. Topics such as mixed cultures, allosteric enzymes, genetically modified micro-organisms, biofouling and biocorrosion, specialised biological separation processes (e.g. chromatography), biosafety, quality control, and Hazard Analysis and Critical Control Points (HACCP) are discussed in detail. The principal products of such processes are investigated to illustrate the current and future technology of these systems with an emphasis on modern biotechnology methods. The impact of the use of such techniques on quality management, safety assessment and regulatory environment are reviewed.

Module Content:
- Biocatalysts inhibition and immobilisation:
Models of more complex enzyme kinetics, Allosteric enzymes, Hill equation, Effects of pH, temperature and insoluble substrates, Diffusional limitations in immobilised systems, Electrostatic and steric effects.

- Production systems:
Deviations from ideality in cell growth and bioreactors, The logistic equation, Strategies to recover, purify and characterise products in the food and pharmaceutical industry: ultrafiltration, microfiltration, chromatography, spectroscopic tools.

- Biocatalyst Optimisation:
Molecular biology and biological information, Structure and function of nucleic acids and proteins, Protein synthesis, Mutation and genetic recombination, Genetic manipulation and genetic engineering, Screening and organism selection, Guidelines for using host-vector systems, Considerations in plasmid design.

- Mixed cultures:
Major classes of interactions in mixed cultures, Mixed cultures in nature, Mathematical models describing mixed-culture interactions, Industrial utilisation of mixed cultures.

- Biofilms, biofouling and biocorrosion:
Steps in biofilm formation, biofilms in industrial environments, Anti-fouling approaches, Monitoring, Control strategies, Surface modification.

- Safety in biotechnology:
Bio-hazards; Risk assessment; Containment; Quality management and process validation. Hazard Analysis and Critical Control Points (HACCP) in the food industry.

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

• Identify the different types of biocatalysts and evaluate their application in diverse scenarios: justify when to use different genetically engineered microorganisms; explain how biological information can be utilised, manipulated and stored; be aware of and overcome deviations from ideality and diffusional limitations.
• Assess, calculate and predict product formation and optimal conditions when using mixed cultures in batch and continuous reactors, and compare the major interactions between different populations of microorganisms.
• Describe the principles of biofilm formation and biofouling, and evaluate different routes to monitor and control them.
• Compare and assess different optimisation, advanced separation processes and quality control tools, and their applications.
• Evaluate and categorise the potential hazards when working with bioprocesses and microorganisms, and describe the precautions required to reduce the risks associated with them.
• Summarise, explain, defend and discuss scientific findings and express ideas in a logical and coherent manner.

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

Assessment Description: Examination in January, 100%

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Questions from students will be answered during class, and office hours allocated for this module. Worked-examples during classes are participative, and written solutions to every problem are provided after discussion.

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.

Lecture notes are available on Canvas

EG-M160 Advanced Microfluidics

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr F Del Giudice

Format: Lectures: 22 hours. Office Hours: 11 hours. Private study: 100 hours

Delivery Method: The lecture will first present the theoretical foundation for each topic. Students will be guided by the lecturer in the critical analysis of existing microfluidic platforms in order to identify potential limitations. Students will also be guided towards the design of alternative platforms with better performances. Sometimes, students will be asked to complete preliminary readings in preparation to the lecture. Two final lectures will be delivered in the laboratory to further strengthen and visualise the concepts learned during the module.

Module Aims: Microfluidics is the set of science and technology at the micrometer scale. In the last 30 years, microfluidic devices have been widely employed for a variety of engineering applications, including cell and particle separation, fabrication of fiber, production of droplets and microparticles and characterization of complex fluids. In all these applications, chemical engineers have employed their skills to work across scientific fields in order to promote significant improvement in many areas including diagnostic, molecule detection and advanced manufacturing. Microfluidics has enormous advantages compared to conventional techniques such as small volume of samples required (less than 1 ml), easy and accurate control of flow parameters, larger sensitivity, compact size.

In this course, we will introduce the advanced phenomena occurring at the micrometer scales. We will see how complex flows can be used to drive a variety of further phenomena including alignment and spacing of particles, droplet formation, particle fabrication, and cell separation. We will also see manufacturing of materials using Microfluidics devices together with recent applications in machine learning and AI. We will employ a critical approach to identify limitations of existing microfluidic technologies and we will develop a mindset oriented towards problem solving (i.e., positive attitude) and design of alternative devices for targeted applications.

Module Content: Introduction to the course. Bounded and unbounded flow. Navier-Stokes Equations. Particle migration in Newtonian and non-Newtonian liquids. [2]

Particle focusing and separation in Stokes flow. [2]

Inertial flows applied to Microfluidic applications [4]

Complex viscoelastic fluids applied to Microfluidic applications [4]

Formation of droplets in Microfluidic flows with application single-cell encapsulation and material synthesis [4]

PC Lab 1: Implementing ChatGPT algorithms to review the state-of-the-art on microfluidic topics. [2]

Pc Lab 2: Implementing ChatGPT algorithms to design microfluidic devices. [2]

Pc Lab 3: Implementing ChatGPT algorithms to prepare a critical analysis of a microfluidic design. [2]

Intended Learning Outcomes: By the end of the module the student will be able to:

1. Critically analyze a research paper featuring microfluidic applications: identify strength, limitations and future directions

2. Design microfluidic devices for targeted applications.

Assessment: Coursework 1 (100%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Coursework (100%): Extended coursework through producing a report (100%). Students will be asked to employ ChatGPT to present an overview of the state-of-the-art related to specific microfluidic topics (30%), design a microfluidic device for a specific application (35%), and prepare a critical analysis of a microfluidic device taken from a published paper (35%). This component will be carried out at home and students will have a pre-defined amount of time to complete and submit the report. Redemption of failed coursework: Same rules as for the Coursework.
Moderation approach to main assessment: Not applicable
Assessment Feedback: Students will receive feedback during lectures, laboratory activities, workshop and office hours.
Failure Redemption: Coursework (100%): Same rules as Coursework 1
Additional Notes: Available to visiting and exchange students. A scheme of direct private study supports relevant reading material provided. Notes prepared by the lecturer are also available. The lectures will not be recorded and the students are expected to engage in the class activities. The lectures will be highly interactive and the students will be asked to contribute to discussions in order to receive direct feedback from the lecturer: this approach has been widely appreciated by previous cohorts of students in terms of receiving relevant and specific feedback in preparation for the exam. Therefore, this type of lecture is not appropriate for lecture recording. Students that cannot attend one or more lectures are warmly invited to visit the lecturer during office hours to receive feedback. All the activities will be sign-posted on Canvas and the material available will be sufficient to complete successfully the final assessment. Lecture attendance is the opportunity to engage directly with the lecturer and work with peers to solve microfluidic problems.

EGC401 Industrial Engineering and Research Practice

Credits: 30 Session: 2023/24 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr YK Ju-Nam, Dr JJ Ojeda Ledo, Dr PM Williams

Format: Research - Tutorial sessions and lab instruction; Industrial - Tutorial sessions and site visits

Delivery Method:
Industrial Placement - On and off site placement at a company.
Research Placement - On and off campus placement within a research group in the FSE.

General module information will be available in Canvas.

Module Aims: This module aims to give students practical experience in either the industrial setting or the research environment.. Either two day placements in industry or two day research placements within the School are conducted.
The industrial placements are determined by interview with the companies involved or departmental staff. A range of research projects will be offered by the staff.

Module Content:
Industrial Placements:
Placements are assigned in consultation with the technical staff at the firms participating in the scheme. This may involve an interview before the student attains a placement. Industrial placements are not guaranteed. Each student/group will be involved in a variety of projects/jobs depending on the placement. While on site, students are encouraged to take part in any training sessions made available by the firm. The academic supervisor will endeavour to visit the students in their place of work at least once each teaching block in order to monitor progress.

Research Placements:
A variety of projects will be offered to the students and they may select an area of research dependent upon their interests (students may also put forward research projects of their own). The work can involve experimental, theoretical and/or computational work. The placements will provide experience in developing and critically assessing new work in an existing field of research. The student will be expected to be involved in health and safety assessment of the project including a comprehensive risk assessment.

Student commitment:
For the industrial placements, students are representing the University when they go out into industry and are expected to conduct themselves in a professional manner. Any student who is dismissed from their place of work will automatically fail the module. In general, the student must provide evidence during the module assessment that they have invested extensive time and endeavour to attain a professional standard.

Intended Learning Outcomes:
After completion of this module, students are expected to:

Research Placement:

Design and carry out an independent research project in the chosen field of work.
Analyse experimental observations and data using appropriate methods.
Assess and present experimental results and findings in a detailed written report.
Communicate research aims, hypothesis and outcomes through an oral presentation to their peers.

Industrial Placement:

Plan and conduct independent day-to-day work, projects and tasks within an industrial setting.
Identify and evaluate appropriate methods available to solve complex problems.
Demonstrate effective time management and professional conduct.
Communicate overview, problem solving strategies and outcomes of projects orally to members of the host organisation and/or an audience of their peers.
Evaluate and present project outcomes in a detailed written report.

Assessment: Project (100%)

Assessment Description: Conduct of project [10%] This is assessed by the project supervisor. Project Report [60%] The project report will be an 15 to 20 pages document. It takes the form of a research paper for Research Projects and an industrial report for Industrial Placements. Competence and Commitment Report [5%] Part of the assessment of this module will involve a competence and commitment report. Progress [5%] Performance of student will be assessed during site/lab visits or Zoom meetings (students must give an overview of their projects and show evidence of the work) Oral Presentation [20%] This will take the form of a power point presentation to an audience.
Moderation approach to main assessment: Universal Non-Blind Double Marking of the whole cohort
Assessment Feedback: Students will receive feedback continuously throughout the module from their project or industrial supervisor.
Failure Redemption: There is no failure redemption for this module. Failure in this module would normally result in an exit qualification due to insufficient credits having been attained.
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.

EGCM36 Desalination

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr W Zhang, Dr SJI Shearan

Format: Lectures 20 hours
Design 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

On campus lectures and example classes.

Module Aims: Desalination is an important process in the management of water resources and it has a large societal, economic and environmental impact. This module will give engineering students a solid grounding in desalination and related separation processes. This will prove invaluable for a future career in many areas of engineering.

Module Content: 1. Introduction including Resources and Need for Water Desalination; Composition of Seawater; Definition and Classification of Industrial Desalination Processes.
2. Basics of desalination systems including Pre-treatment and Post-treatment Systems; Energy Recovery Devices;
3. Thermal Desalination Systems including Evaporators; Single Effect Evaporation; Multiple Effect Evaporators; Multiple Effect Distillation (MED): Forward Feed Multiple Effect Evaporation; Parallel Feed Multiple Effect Evaporation; Multi Stage Flash Distillation (MSF); Freeze Desalination Systems.
4. Reverse Osmosis: Elements of Membrane Separation; Performance Parameters; RO Membranes; Membrane Modules; Design of RO Systems; RO Feed Treatment, Biofouling and Membrane Cleaning.
5. Novel Desalination Systems including Forward Osmosis (FO), Pressure Retarded Osmosis (PRO), Solar Greenhouses; Membrane distillation etc.

Intended Learning Outcomes: After completing this module students should be able to:
• Demonstrate a systematic understanding of different desalination systems (Exam, Coursework 3)
• Apply theory critically to analyse the mechanisms of desalination technologies (Exam, Coursework 2).
• Make critical evaluation and appreciation of the different thermal and RO membrane modules used in desalination industry (Exam).
• Formulate mathematical models for mass and heat transfer in thermal desalination (Exam, Coursework 1).
• Develop flowsheeting and detailed design of either thermal/RO membrane systems (Exam).

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

Assessment Description: Examination (85%)
Coursework 1 (15%)

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Exam feedback will be given via exam results and the exam feedback forms available on the Swansea University intranet.

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 with chemical engineering background.

This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

EGCM38 Membrane Technology

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-100; EG-200

Co-requisite Modules: EGCM36; EGDM01

Lecturer(s): Dr P Esteban

Format: Formal Contact hours 32: • Lectures – 22 hours • Example Classes – 10 hours • Directed private study 68 hours Notional Hours 100 Contact Hours will be delivered line in lecture theatre

Delivery Method: Lectures supported by worked examples. Assessment: Course Work 20%. In person examination 80%.

Module Aims: A Masters Level course to deliver a working knowledge of liquid phase membrane separation processes. This will include a detailed understanding of current membrane fabrication techniques to produce polymeric hollow fibres and flat sheet membranes and the subsequent production of tubular and spiral wound modules along with a review of current Ceramic membrane production. The design, construction and optimisation of membrane plants will be considered with specific emphasis placed on configuration. An appreciation of membrane characterisation techniques will be developed, including SEM, AFM, particle sizing, zeta potential measurement, rejection and flux experimentation. The specific operations of membrane microfiltration, ultrafiltration, nanofiltration and reverse osmosis will be investigated and mathematical descriptions will be developed. The course will conclude with a series of practical case studies detailing current applications of membrane processes and scope for future development.

Module Content:

• Introduction: introduction to membrane processes, classification of membrane processes, the filtration spectrum, the nature of synthetic membranes, fabrication processes, molecular weight cut off, module design and plant configuration.

• Microfiltration: introduction to frontal and cross flow filtration, development of knowledge and understanding of solid liquid separations and cake filtration, general membrane equations and adaptation to cake filtration, calculation of cake properties, time of filtration, bed depth and process optimisation, case studies

• Ultrafiltration: introduction to ultrafiltration processes, mass transfer and concentration polarisation effects, simple gel theory, osmotic pressure effects, effects of membrane charge, diafiltration, optimisation of separations, case studies.

• Nanofiltration: introduction to nanofiltration processes, equilibrium partitioning, pore models for neutral solute rejection, effects of membrane charge and effects on physical properties, pore size distributions, case studies

• Reverse Osmosis: what is osmosis, introduction to reverse osmosis, the solution diffusion mechanism of transport, case studies.

• Optimisation: membrane characterisation - methods and equipment.

• Process stream characterisation - methods and equipment, trial methods and data collection for design parameters, experimental requirements, process improvements, pre-treatments, case studies.

Intended Learning Outcomes: On successful completion of the module program students will be able to:

1. Choose and apply the appropriate membrane transport model for calculation of fluxes and determine the extent of separation of various membrane systems.
2. Interpret the various mechanisms of fouling and formulate proposals for prevention or removal from a membrane system.
3. Justify the selection of appropriate membrane material, module design and manufacturing process for a specific separation/purification by examination of the material to be processed.
4. Propose procedures to determine how to collect appropriate experimental data needed for the calculation of membrane design parameters.
5. Select and design a suitable membrane system or systems for a proposed separation process.

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

Assessment Description:
Standard format Faculty of Science & Engineering examination.
Coursework 1 - Case study review of a specific membrane separation system (individual work).

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Course Work: Formal feedback will be provided on completion of the course work via Canvas. Additionally, informal feedback will be provided during lectures and examples classes. Formal feedback will be provided following completion of the final exam in line with standard Faculty of Science & Engineering protocols.
Failure Redemption: A supplementary examination will form 100% of the module mark.
Additional Notes: Delivery of both teaching and assessment will be live and on-campus. This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

EGCM40 Pollutant transport by groundwater flows

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr B Sandnes

Format: Onsite Lectures and office hours provided.

Delivery Method: Lectures, lecture recordings, examples embedded in lectures.

Module Aims: This module focuses on groundwater flow in aquifers, the transport of pollutants by groundwater flows, and the chemical and biological transformation of pollutants in the subsurface.

Module Content:
• Introduction: Ground water resources.
• Characteristics of the porous medium and fluid.
• Darcy flow in saturated porous media.
• Role of advection, diffusion and dispersion in environmental flows.
• Geochemical interactions, reactive transport.
• Carbonates and carbon dioxide.
• Pollutant transport.
• Transport models.
• Multiphase flows.

Intended Learning Outcomes:
After completing this module students should be able to:
1. Demonstrate an understanding of how flows in porous media play a fundamental role in a range of environmental and engineered processes.
2. Demonstrate detailed knowledge of how the properties of the fluid and the porous media govern the flow behaviour.
3. Evaluate the transport and fate of environmental pollutants subjected to groundwater flows.
4. Assess common geochemical reactions involving solutes carried by environmental flows.
5. Independently implement models to quantify hydrological transport of pollutants.
6. Critically assess model results and how they relate to real world problems.

(1 - 6 assessed in exam and coursework)

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

Assessment Description: Exam, 90% of mark.
Coursework 1: Tutorial sheet, 10% of total mark. Individual piece of coursework.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Informal feedback will be provided during lectures and examples classes.
Feedback on coursework will be given as written notes and informal feedback.

Failure Redemption: Eligibility for the redemption process is subject to the degree scheme and the associated
progression/completion criteria; where permitted, a supplementary examination will form 100% of the mark.

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

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

As this is a masters level module, it is expected that students demonstrate independent study, and seek out and extract relevant information from a range of available sources.

EGCM89 Chemical and Environmental Engineering MEng Design Project

Credits: 20 Session: 2023/24 September-January

Pre-requisite Modules: EGA319; EGA326

Co-requisite Modules:

Lecturer(s): Dr JO Titiloye, Dr JJ Ojeda Ledo, Dr PM Williams

Format: 2 hours lecture
18 hours tutorials; (An initial project brief in two lectures, then a series of tutorial sessions with supervisor to give guidance on further progress).

Delivery Method: Initial project brief in one/two lectures, then a series of tutorial sessions designed to answer questions and give guidance on further progress. Delivery will be on-line using ZOOM platform and limited on-site face to face delivery when required.

Module Aims: This module aims to advance and broaden the design practices learnt at Level 3. This project will necessitate the students to adapt the design methodologies learnt previously to an unfamiliar molecule in order to generate a novel manufacturing process. The project itself requires the students to develop an innovative design for a plant to make a molecule for which no large scale production facility exists. The molecules to be produced need to be selected on the following characteristics: they should not be manufactured on a large capacity production facility (there may however be small scale production) and an outline of a manufacturing process including basic chemistry exists somewhere. The project will require the students to make choices and judgments on: the production capacity, time of operation, raw materials to use, production process, and benefit of the molecule to the company (ie economic, extending the knowledge base etc). Design is a team exercise throughout and working well as a team is critical to successfully completing this project.

Module Content: The project will involve:
A literature search of alternative and innovative technologies;
Critical selection of a process route and explanation of rationale;
Preparation of process scope, PFD and development of a detailed equipment P&ID;
Possible sizing and design of equipment;
Detailed analysis of capital and operating costs;
Detailed discussion on health, safety and environmental issues of the selected process;
A review of process operability and viability assessment.

Intended Learning Outcomes: After completing this module a student should be able to demonstrate a knowledge and understanding of:

The preparation of a detailed Process and Instrumentation Diagram (P&ID);
National standards and codes for equipment design;
An in-depth process design for major items of equipment;
The estimation of process capital and operating costs;
Process safety and environmental assessment for a complex process;
The use of computer packages for simulating complex process systems (ASPEN, UniSim, Excel etc.);
The preparation of an advanced technical design report and oral exposition of a process design to an audience.

Develop an ability to:
Define a problem and identify constraints
Define solutions according to the brief
Adapt designs to meet their new purposes or applications
Generate an innovative design for processes, systems and products to fulfill new needs.

Assessment: Project (100%)

Assessment Description: Individual Project Report (80%), Presentation (5%), Conduct of Project (15%).

Moderation approach to main assessment: Universal Non-Blind Double Marking of the whole cohort

Assessment Feedback: Final result and general feedback forms via the internet. Constant advice and feedback throughout the course.
Each student receives feedback at the end of his/her presentation.

Failure Redemption: There is no mechanism to redeem a failure in this module.

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.

This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

EGDM01 Colloid and Interface Science

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr S Alexander

Format: Lectures: 20 hours
Example classes: 5 hours
Directed Private Study: 75 hours
Contact Hours will be delivered on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All lectures will be delivered onsite. But students are still required to use Canvas for self-directed online activities.

Module materials available at CANVAS.

Module Aims: Students will gain an in-depth understanding of the properties of colloids and their importance in industry.

Module Content: Introduction to the nature of the colloidal state
Particle size and its determination; theory and practice
Determination of zeta potential
Charge and potential distribution: the structure of the electrical double layer;
Interactions between particles: repulsive and attractive forces, DLVO theory; Van der Waals theory and Steric stabilisation
Determination of important properties for colloidal systems, e.g. Osmotic pressure, viscosity, diffusion coefficients;
Coagulation and Flocculation
Small-angle neutron and X-ray scattering
Solid-gas, liquid-gas and liquid-liquid interfaces
Surface tension and wetting
Emulsions, foams and aerosols

Intended Learning Outcomes: You should be able to demonstrate a knowledge and understanding of:

• What colloids are; their characteristics and properties;
• Techniques used to characterize colloid size and colloidal systems;
• Colloidal stability and charged particles;
• The importance and examples of colloidal science in industry;
• The relationship between properties at the nano, micro and bulk scales;

You should be able to demonstrate an ability to:

• Use scientific literature to evaluate information on colloidal systems;
• Analyse and present scientific findings and express ideas in a logical and coherent manner;
• Apply knowledge and understanding to calculate relevant parameters, e.g. different measures of size, zeta potential, molecular weight etc.

Accreditation Outcomes (AHEP)
• A comprehensive understanding of the relevant scientific principles of the specialisation
• A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation
• Understanding of concepts relevant to the discipline, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects
• Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations

Assessment: Examination 1 (70%)
Coursework 1 (30%)

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

Assessment Description: This module is assessed by examination and coursework.

Examination - Answer 3 Questions from 4 (70%).
Coursework 1- Case study: this is a teamwork assignment/presentation (30%)

This module is assessed by a combination of examination and continual assessment. In order to pass the module students must achieve a minimum of 40% in the examination component, and a minimum of 50% overall for the module. If students do not meet the exam and module requirements they will receive a QF outcome and will be required to take a supplementary assessment in this module, even if their module mark is above 50%.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Exam past papers will be available for students and general feedback on student performance in the exam is given via the University feedback system.
Coursework 1 will be marked and oral/written feedback will be given to students.

Failure Redemption: Eligibility for the redemption process is subject to the degree scheme and the associated
progression/completion criteria; where permitted, a supplementary examination will form 100% of the mark.

Additional Notes: All lectures will be delivered on site. But students are still required to use Canvas for self-directed online activities.

This module will be supported with CANVAS.

This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

This module is 70% assessed by examination and 30% by coursework.

EGTM79 Sustainability and Environmental Assessment

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof GTM Bunting, Mr MH Green

Format: Lectures 25; Directed private study35; Preparation of assignments 40;
Contact Hours will be delivered through a blend of on-site lectures and workshops, supported by online learning resources on the Canvas site.

Delivery Method: Delivery of teaching will be via on-campus lectures, supported by tutorials and on-line learning resources using the Canvas Digital Learning Platform.

Module Aims: This module covers the principles and practice of the assessment of sustainability of engineering activities, including life cycle analysis and the benefits of a Circular Economy. It covers the assessment of resource conservation by optimal use of resources, including consideration of primary extraction processes, design/manufacturing/fabrication, improving product life and end of life usage. It includes training and practice in how to undertake a quantitative environmental impact assessment.

Module Content: •The concepts of lifecycle analysis and Circular Economy.
•Principle of energy and resource conservation from 'cradle to grave' and ‘cradle to cradle.’
•Sustainability and the understanding of how societal, economic and environmental concerns interact. A review of the methods of assessing societal impacts.
•A review of the methodology of LCA, including inventory analysis, data sources and environmental impact assessment.
•Case studies from various sectors of engineering and waste management will be covered.
•The effects of economic, social and political pressures on sustainable business activities.

Intended Learning Outcomes: Accreditation Learning Outcomes
On successful completion of this module students will be expected, at least at threshold level, to have met the following AHEP4 Learning Outcomes:

• M2 Formulate and analyse complex problems to reach substantiated conclusions (L7/EQF).
• M4 Select and critically evaluate technical literature and other sources of information to solve complex problems (L7/EQF).
• M7 Evaluate the environmental and societal impact of solutions to complex problems (to include the entire life-cycle of a product or process) and minimise adverse impacts (L7/EQF).
• M15 Apply knowledge of engineering management principles (L6/EQF).
• M17 Communicate effectively on complex engineering matters with technical and nontechnical audiences, evaluating the effectiveness of the methods used (L7/EQF).

Technical Outcomes
- An understanding of the principles of life cycle analysis and the different approaches that have been used.
- An appreciation of the application of LCA to industry.
- Familiarity of the approach of circular economy to address sustainability concerns and an understanding of engineering as a key driver for sustainable business activities.
- An understanding of the circular economy and how it relates to new opportunities for industry.
- An appreciation of the complexity of legislative, social and political pressures on technological development.

Assessment: Assignment 1 (10%)
Assignment 2 (90%)
Coursework reassessment instrument (100%)

Assessment Description: Both assignments will involve working in groups. Assignment 1 – completion and analysis of results from an Excel based model evaluating circular economy design opportunities. Assignment 2 – evaluation of opportunities for circularity and reduction in environmental impact of a particular product. This will build on the work performed for assignment 1 and will involve a numerical analysis using circularity indicators and LCA, coupled with a written report on interpretation of the findings and proposed methods to reduce environmental impacts. This will robustly assess Learning Outcomes M2, M7 and will include aspects of M17. Important information: The pass mark for a module at Level 4/M is 50%. In addition, in order to pass the module, students must pass both assessment components with a minimum of 50%. 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 repeat the failed component(s), even if your module mark is above 50%.
Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit
Assessment Feedback: Each student will receive the mark and individual feedback comments on each piece of submitted coursework, via Canvas.
Failure Redemption: Submission of additional assignment worth 100% (capped at 50%).
Additional Notes: Delivery of both teaching will be primarily via on-site lectures, supported with on-line learning resources. Assessments will be via coursework submitted to the Canvas system. Available to visiting and exchange students. The pass mark for a module at Level 4/M is 50%, and students must achieve this pass mark in both assessment components to pass this module.

EGTM89 Polymers: Properties and Design

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr S Sharma

Format: Lectures 22 hours
Blended Learning activity 12 hours
Directed private study 34 hours
Preparation for assessment 30 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

Lectures and examples classes delivered on campus and on-line

Assessment will be by a combination of an on-line test (50%) and a design assignment (50%). A minimum mark of at least 40% is needed in both assessments in order to pass the module.

Module Aims: To instil an understanding of design methods with polymeric materials, dealing especially with viscoelastic behaviour.
• Mechanical properties and design with rubber.
• General mechanical properties of polymers; viscoelasticity, time and temperature dependence, creep, recovery and stress relaxation.
• Design using deformation data; creep curves, pseudo-elastic design methodology, time and temperature dependant modulus, limiting strain.
• Mathematical modelling of viscoelasticity; equations for creep, recovery, relaxation, Maxwell and Voigt models, 4-element model, standard linear solid model.
• Boltzmann superposition principle and its use with complex stress histories.
• Strength and fracture of polymers; energy approach, toughness, ductile / brittle transitions, yield strength, ductility factor.
• Creep failure of plastics; fracture mechanics approach, fatigue failure, effects of cycle frequency, waveform, fracture mechanics approach to fatigue.

Module Content:
• Mechanical properties and design with rubber
• General properties of polymers; viscoelasticity, time and temperature dependence, creep, recovery and stress relaxation.
• Design using deformation data; creep curves, pseudo-elastic design methodology, time and temperature dependant modulus, limiting strain.
• Mathematical modelling of viscoelasticity; equations for creep, recovery, relaxation, Maxwell and Voigt models, 4-element model, standard linear model.
• Boltzmann superposition principle and its use with complex stress histories.
• Strength and fracture of polymers; energy approach, toughness, ductile / brittle transitions, yield strength, ductility factor.
• Creep failure of plastics; fracture mechanics approach, fatigue failure, effects of cycle frequency, waveform, fracture mechanics approach to fatigue

Intended Learning Outcomes: Technical Outcomes:
After completing this module students should be able to demonstrate:
• A thorough knowledge of mechanical design considerations with polymer-based materials. (EA1)
• A knowledge of mathematical models for viscoelasticity and complex stress histories. (SM2)
• A knowledge of failure modes in polymers. (SM1 / P2b)
• The application of mathematical models to mechanical behaviour of materials. (G1 / SM2)
• How to interpret and use design data for polymer-based materials (EA1)
• The application of mathematical skills in real engineering applications. (SM2)
• The application of fundamental materials knowledge across different materials classes. (P2b)

All LO's are assessed in the end of module exam

Accreditation Outcomes (AHEP):
MEng:
- A comprehensive knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1m)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components (P2m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

MSc:
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)

Assessment: Online Class Test (50%)
Assignment 1 (50%)

Assessment Description: Assessment will be by a combination of an on-line test (50%) and a design assignment (50%). A minimum mark of at least 40% is needed in both assessments in order to pass the module.
On-line Canvas test to be completed by April, but with more than one opportunity to complete before then.
Individual Design Study Assignment

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback:
Standard will receive written feedback on the assignment and immediate marks on the on-line test.

Failure Redemption: If a student is eligible for a resit, they will have an opportunity to redeem either assessment component failed. Capping of marks will apply at the component level.

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.
Detailed course material provided on Canvas which students should engage with in their own time.

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION