Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 4 (FHEQ LEVEL 7)

MEDICAL 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 Biomedical Engineering	Professor Huw Summers
Biomedical Engineering Programme Director	Dr Sanjiv Sharma Sanjiv.Sharma@Swansea.ac.uk
Year 4 Coordinator	Prof Paul Rees P.Rees@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
Medical Engineering
MEng Medical Engineering[HB1V]
MEng Medical Engineering with a Year Abroad
MEng Medical Engineering with a Year in Industry[HB1W]

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EGIM02 **Advanced Computational Methods for Engineers** **10 Credits** **Dr F Zhao** **CORE**	**EG-M332** **Medical Imaging & Informatics** **20 Credits** **Prof P Rees** **CORE**
EGM402 **Fracture and Fatigue** **10 Credits** **Prof RE Johnston** **CORE**	**EG-M83** **Simulation Based Product Design** **10 Credits** **Dr AJ Williams/Dr B Morgan** **CORE**
EGNM07 **Principles of Nanomedicine** **10 Credits** **Dr S Sharma/Prof OJ Guy** **CORE**	**EGM403** **Implant Engineering 2** **10 Credits** **Dr S Sharma/Dr CJ Wright** **CORE**
EGTM79 **Sustainability and Environmental Assessment** **10 Credits** **Prof GTM Bunting/Mr MH Green** **CORE**	
EGDM03 **Individual Research Design Project** **30 Credits** **Dr S Sharma** **CORE**	
Total 120 Credits	

Optional Modules

Choose exactly 10 credits
Please select 10 credits from the options below.

EG-M160	Advanced Microfluidics	Dr F Del Giudice	TB2	10 (CORE)
EGTM89	Polymers: Properties and Design	Dr S Sharma	TB2	10 (CORE)

Year 4 (FHEQ Level 7) 2023/24
Medical Engineering
MEng Medical Engineering with a Year in Industry

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EGIM02 **Advanced Computational Methods for Engineers** **10 Credits** **Dr F Zhao** **CORE**	**EG-M332** **Medical Imaging & Informatics** **20 Credits** **Prof P Rees** **CORE**
EGM402 **Fracture and Fatigue** **10 Credits** **Prof RE Johnston** **CORE**	**EG-M83** **Simulation Based Product Design** **10 Credits** **Dr AJ Williams/Dr B Morgan** **CORE**
EGNM07 **Principles of Nanomedicine** **10 Credits** **Dr S Sharma/Prof OJ Guy** **CORE**	**EGM403** **Implant Engineering 2** **10 Credits** **Dr S Sharma/Dr CJ Wright** **CORE**
EGTM79 **Sustainability and Environmental Assessment** **10 Credits** **Prof GTM Bunting/Mr MH Green** **CORE**	
EGDM03 **Individual Research Design Project** **30 Credits** **Dr S Sharma** **CORE**	
Total 120 Credits	

Optional Modules

Choose exactly 10 credits

Choose exactly 10 credits

EG-M160	Advanced Microfluidics	Dr F Del Giudice	TB2	10 (CORE)
EGTM89	Polymers: Properties and Design	Dr S Sharma	TB2	10 (CORE)

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.

EG-M332 Medical Imaging & Informatics

Credits: 20 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof P Rees

Format: Lectures (2 hours) and interactive workshops/practical classes (2 hours) per week.

Delivery Method: This module will be delivered face-to-face using a mixture of lectures, interactive workshops/practical classes, and independent study across an 11-week teaching block.

Module Aims: The aim of this module is to introduce the science of measurement and explain the potential and the limitations of sensors commonly used in performance sports applications. Throughout the module, foundational principles will be explained using sporting examples of data analysis, with a particular focus on time-series data. A core principle of the module is that the process of measurement must be understood before applied studies are designed and data analysis is undertaken. The limits to measurement and the errors that can exist in a dataset have to be appreciated in the context of performance sport applications. The origin of the data also has to be considered as there are often hidden assumptions influencing its acquisition and pre-processing built into sensors. The aim here is to educate students about where their data comes from and to encourage them to critically assess the conditions under which valid measurements can be obtained in applied performance environments.

Module Content: • Introduction to sensors and the process of transduction - error, accuracy, precision, resolution, reliability
• Measurement units - scalar and vector quantities, units, absolute and relative measures, calibration
• Limitations to measurement - noise and drift, sensitivity and duration, averaging, noise and SNR
• Basic statistics of measurement - measurement ensembles and value distributions, mean, median, mode, standard deviation and variance
• Graphical analysis - scatter plots and data regression, interpolation and extrapolation, non-linear fitting
• Time-series data - time and frequency domain descriptions, sampling frequency and variance, basic signal manipulation
• Advanced manipulation - correlation, convolution, dynamic time warping
• Frequency analysis – Fourier transforms
• Dealing with multiple variables - dimensional reduction, PCA, stochastic neighbour embedding, cluster analysis
• Machine learning - basic concepts, ground truth, categorisation, model training, demonstration of application using decision trees
• Visualisation techniques for time series data – customisation for specific requirements of different sports
• Data Information Knowledge - understanding the differences and appreciating the wider epistemology, truth/falsehood, measures of statistical certainty, false positive and negative measurements, introduction to Bayesian statistics

Intended Learning Outcomes: On successful completion of the module, students will have the abilty to:
Critically appraise the capabilities and limitations of relevant sensors in delivering accurate and repeatable measurements.
Demonstrate an in-depth knowledge of the fundamental concepts of data analysis techniques relevant to performance science.
Use appropriate analytical approaches in the interpretation of diverse data sets and information.
Research and assess theories, principles, concepts and data, and apply such skills creatively to problem solve.
Accurately analyse and interpret data from real-world performance tests.
Effectively communicate the findings clearly and precisely to a range of audiences.

Assessment: Report (50%)
Report (50%)

Assessment Description: Coursework 1: Timed data analysis and coach report (3 hours) 50%
Coursework 2: Application of analytics to performance science Report (2000 words)

Moderation approach to main assessment: Moderation by sampling of the cohort
Assessment Feedback: Coursework 1 - Students will receive written feedback on their report within 3-weeks. Coursework 2 - Students will receive written feedback on their final submission within 3-weeks
Failure Redemption: Students can redeem a failure via re-assessment on the failed element in a re-sit period.
Additional Notes: The Faculty of Science and Engineering has a ZERO TOLERANCE policy for late submission of coursework, unless extenuating circumstances have been approved.

EG-M83 Simulation Based Product Design

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AJ Williams, Dr B Morgan

Format: Lectures 6, Computer Lab 20, Reading/Private Study 20, Preparation for Assessment 54

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 Computer Laboratory sessions will be delivered on campus.

Module Aims: This module provides an overview of the role that simulation can play in the design process of a product. A series of lectures introduce computational modelling and the computational tools and techniques employed in the design process. The application of simulation in the design of a number of industry based research projects is presented. Computer workshops lead students in using simulation tools and applying the tools in the optimisation of the design of a product.

Module Content:

• Introduction to computational modelling and the use of simulation in the design process: Examples, advantages, disadvantages.
• Information about commercial packages for each stage of the design process.
• Overview of steps involved in the modelling process; Identification of the physics involved, The effect of problem simplifications and assumptions on the solution, Determining an appropriate analysis type, The importance of validation.
• Introduction to steps involved in computational modelling, CAD and meshing: Examples of common problems associated with these stages of the design process and techniques to avoid them; importance of solution mesh independence, Solution procedures, simulation solver software, Post-processing, Interpretation of results, visualisation and optimisation,
• Introduction to software tools used in this module, CAD, meshing, analysis and visualisation packages.
• Analysis techniques: Overview of finite difference, finite volume and finite element methods, their advantages and disadvantages, and common applications for each method type.
• Case studies: application of the knowledge gained during the lectures to a) investigate the importance of solution mesh independence and b) optimise the design of a product using simulation.

Intended Learning Outcomes:
Technical Outcomes
On completion of this module the student will:
- Have the ability to apply computer-based models for solving problems in engineering and recognise the factors that influence model limitations. Assessed using Assignment 1 and 2.
- Demonstrate the ability to develop and apply a test strategy to produce an optimised design. Assessed using Assignment 2.
- Demonstrate an understanding of the modelling process and the role of simulation in design. Assessed using Assignment 2.

Accreditation Outcomes (AHEP):

MEng:
- Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and implement appropriate action (EA3m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D3m)
- Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D7m)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1)

MSc:
- Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations (EA6m)
- Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D9m)
- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D10m)

Assessment:	Assignment 1 (20%)
	Assignment 2 (80%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description:
• Assignment 1: Mesh Sensitivity Study.This is an individual piece of coursework.This coursework will involve the investigation of the influence of mesh dependence, convergence criteria and physical phenomena on a simulation solution. The results of the investigation will be presented in a written report (maximum of 15 pages).
• Assignment 2: Design Optimisation. This is an individual piece of coursework.This coursework will require the student to use simulation tools to optimise the design of a component subject to given criteria.The student will also be required to show their understanding of the role that simulation plays in the design process using examples presented within the module.This coursework will be presented in a written report (maximum of 20 pages).
• Supplementary Coursework.This is an individual piece of coursework. This coursework will require the student to use simulation tools to investigate and optimise the design of a given device. This coursework will be presented in a written report (maximum of 20 pages).

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

Assessment Feedback: Individual written feedback will be given using Canvas. An overall assessment of the cohort's performance for the coursework will also be published on Canvas.

Failure Redemption: A supplementary piece of coursework will be set which will form 100% of the mark. This assessment will cover the learning outcomes of both coursework 1 & 2.

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

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

EGDM03 Individual Research Design Project

Credits: 30 Session: 2023/24 September-June

Pre-requisite Modules: EG-353

Co-requisite Modules:

Lecturer(s): Dr S Sharma

Format: One to one meetings between student and supervisor every week

Delivery Method: One-on-one meetings with an academic supervisor will provide guidance and feedback on an ongoing basis.

Module Aims: This module involves the application of advanced scientific and engineering principles to the solution of a practical problem coming from outside engineering. It mainly involves project to design solutions for complex biomedical engineering problems and evidences some originality and meets a combination of societal, user, business and customer needs as appropriate. This project will involve consideration of applicable health and safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards.

The student will be working independently on a substantial, individually assigned research design, using accepted planning procedures. It will require and develop self-organisation and a critical evaluation of options and results, as well as developing technical knowledge in the topic of research design. The student will develop a clear view on the integration of biomedical engineering in a professional environment.

Module Content: Module content: Students will carry out a laboratory-based research project in association with the medical school/local NHS.

Laboratory-based research projects

• These will be technically-based individual projects, carried out within a research group either within engineering or the medical school. Students will spend a significant amount of time working in the laboratory and have to demonstrate the ability to integrate into existing teams within these research groups.

• The project will be multi-disciplinary, with a need to communicate across technical boundaries.

• The project will build on the research skills developed at level 3. However the students will need to demonstrate a greater degree of autonomy, as they will be spending a considerable amount of time in the laboratory. The project will give the students a genuine experience of work within a medical engineering research environment.

Intended Learning Outcomes: Technical Outcomes
Students will demonstrate an ability to carry out an extensive individual research project including
• Setting clear & realistic objectives
• Integrating effectively into an existing team
• Carry out independent research
• Communicate the research effectively to both medics and engineers
• Problem solving and critical analysis skills. Practical laboratory skills. Report writing.

Accreditation Outcomes
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively (SM3m)
- Awareness of developing technologies related to own specialisation (SM4m)
- 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)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and to implement appropriate action (EA3m)
- Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems (EA4m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Ability to extract and evaluate pertinent data and to apply engineering analysis techniques in the solution of unfamiliar problems (EA6m)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1)
-Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards (D2)
- Work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D3m)
- Apply advanced problem-solving skills, technical knowledge and understanding to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal (D4)
- Communicate their work to technical and non-technical audiences (D6)
- Demonstrate the ability to generate an innovative design for products, systems, components or processes to fulfil new needs (D8m)
- Understanding of the need for a high level of professional and ethical conduct in engineering, a knowledge of professional codes of conduct and how ethical dilemmas can arise (EL1m)
- Knowledge and understanding of management techniques, including project and change management that may be used to achieve engineering objectives, their limitations and how they may be applied appropriately (EL3m)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk (EL6m)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (P1)
- Ability to apply relevant practical and laboratory skills (P3)
- Understanding of the use of technical literature and other information sources (P4m)

Assessment:	Report (0%) Report (10%) Report (60%) Presentation (30%)

Assessment Description: Project Deliverables
The project has 5 deliverables.

• Inception Report 0% Defines scope of project, literature survey and background, and initial management plan . Deadline November end. Submission via Canvas

• Interim Report 10% Presents initial background research and/or early implementation results, and detailed project plan.Deadline January end, Submission via Canvas

• Final Report 60%
Documents overall project results (includes background)
Deadline First week of June, Submission via Canvas

• Presentation 30% Presents project achievements and provides an opportunity for you to answer questions from your project markers. This will be arranged in the first week of May . Submission of electronic copy via Canvas.

The submission dates can be extended if approved by the Research supervisor

Moderation approach to main assessment: Partial moderation

Assessment Feedback: Feedback will be given verbally or via email during one-on-one meetings by your 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.

Only available to students following an Engineering Degree Programme and not available to visiting or overseas students.

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

EGIM02 Advanced Computational Methods for Engineers

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-228; EG-399

Co-requisite Modules:

Lecturer(s): Dr F Zhao

Format: Synchronous / Lectures 20h
Asynchronous & Directed Private Study 80h

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

Online based lectures and example classes, the course material will be available for download from Canvas.
Assessment: 30% continuous assessment assignments, 70% closed book examination.
Practical Work: Exercises/project will involve coding some of the methods presented in MATLAB.

Module Aims: Introduction to advanced computational (numerical) methods including ordinary and partial differential equations at masters level. The course provides an understanding of fundamental methods that form the basis of common solution techniques used in many simulators and commercial packages with wide application in science and engineering.

Module Content:

- Review of Basic Numerical Methods.
- Newton’s method
- Numerical Integration
- Discretization of Ordinary Differential Equations
- Discretization of Partial Differential Equations
- (All Types Elliptic, Hyperbolic and Parabolic)
- Finite difference and Finite volume methods
- Consistency, stability and convergence
- An Introduction to the Solution of Linear Systems
- Gaussian elimination
- Relaxation methods

Practical Work: Exercises/project will involve coding some of the methods presented in MATLAB
NOTE: Knowledge of some MATLAB or scientific programming is assumed.

Intended Learning Outcomes: Technical Outcomes
Demonstrate a knowledge and understanding of:
• The basic principles of: numerical integration, numerical solution of ordinary and partial differential equations. Truncation error and solution error. Consistency, stability and convergence. Direct and iterative solution of Linear systems of equations.
• Demonstrate the ability to (thinking skills): Understand and formulate basic numerical procedures and solve fundamental problems.
• Demonstrate the ability to (practical skills): Understand practical implications and behaviour of numerical methods and their solutions. Logically formulate numerical methods for solution by computer with MATLAB.
• Demonstrate the ability to (key skills): Study independently, use library resources. Effectively take notes and manage working time.

Accreditation Outcomes (AHEP)
- 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)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively (SM3m)
- 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)

Assessment:	Examination (70%) Assignment 1 (30%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Assessment is comprised of a closed book examination (70%) and 1 assignment (30%) involving analysis and computation.

Assignment. Questions on key components and concepts of the course material covered during the semester.

The examination and assessments tests knowledge and understanding of all the material presented.

Formative exercises are also set each week which also involve questions on key components and concepts of the course material to aid and reinforce learning and understanding.

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

Assessment Feedback: Feedback on assessed work is given in example classes and via canvas.
Feedback on formative exercises is also given in example classes.
Specific issues and questions are answered throughout the module including example classes.
Feedback on formal examinations is given via a web feedback template.

Failure Redemption: The supplementary closed book exam paper is sat during the month of August following the first exam sat in January.
A supplementary examination will normally form 100% of the module mark and is capped at 50%.

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

Lecture notes provided.

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

Students must have completed Year 1 maths modules and EG-228 matlab or equivalent in order to take this module.

EGM402 Fracture and Fatigue

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof RE Johnston

Format: Lectures: 20 hours
Directed private study: 50 hours
Preparation for assessment: 30 hours

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. The module will be taught mainly through the medium of lectures and tutorials delivered on campus, supplemented by case studies.

Module Aims: To provide a detailed understanding of fracture mechanics and fatigue modelling of materials; relating to real-world case studies and current cutting-edge research. Failure of biological and engineered materials.

Module Content:

• Static Fracture; theoretical strengths, ductile failure, brittle failure mechanisms, ductile to brittle transitions, recognising microstructures features of damage and artificial intelligence ways of classifying.
• Biological material failure and toughening mechanisms.
• Stress intensity factors; plane strain and plane stress, crack opening modes, stress concentrations, local yielding.
• Measurement of fracture toughness, KQ and K1C.
• Fatigue; mechanisms, initiation and growth, mechanisms of initiation, fatigue fracture surfaces.
• Stress and strain dependence of fatigue; S-N curves, low & high cycle fatigue, cycle softening & hardening, hysteresis loops.
• Damage tolerance approach to fatigue; stress intensity range, the Paris relationship, measurement of crack propagation.
• Fatigue crack thresholds.
• Crack closure mechanisms; R values, stress reversals.

Intended Learning Outcomes: Technical Outcomes:
On successful completion of the module, students should be able to demonstrate knowledge and understanding of:
• The behaviour of cracks in materials and the associated theoretical modelling of them.
• Fracture mechanics and how it can be used to prevent static and fatigue failure.
• How the structure of materials can be used to control the crack-growth behaviour.
• How to apply mathematical concepts to predicting crack behaviour and use this to design to avoid failure.
• The use of modern fracture mechanics methods to undertake materials design, predict lifetimes, and undertake failure analysis.
• How to relate underlying microstructural details to engineering applications.
•The application of mathematical techniques to solve engineering design issues.

Accreditation Outcomes (AHEP)
- 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 (SM1b/SM1m)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b/SM3m)
- Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components (P2m)

Assessment: Coursework 1 (35%)
Coursework 3 (30%)
Coursework 4 (15%)
Coursework 5 (20%)

Assessment Description: C1: Fracture and microstructures
C3: K1C
C4: Miner's Rule
C5: Course wrap up

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

Assessment Feedback:
Feedback will be provided via a document that highlights potential areas for improvement, based on the examination. This will highlight common areas where mistakes were made, where improvements could be included, and also good practice. During the coursework, discussion classes will be held after coursework is complete to discuss the students' approaches and to give the opportunity for questions and discussion. Also, standard Feedback Forms will be completed and made available to students

Failure Redemption: Students are only permitted to redeem a failure as per University regulations. If you are eligible for a resit assessment this will take the form of resitting all failed coursework components.

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

Available for visiting students
Detailed course notes provided as slides, with accompanying background notes.

EGM403 Implant Engineering 2

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules: EGA308

Co-requisite Modules:

Lecturer(s): Dr S Sharma, Dr CJ Wright

Format: 20 Hours Lectures
5 Hours Tutorial
Site Visit
75 Hours directed learning

Delivery Method: On campus

Module Aims: This module is an advanced look at the design, fabrication and optimisation of medical implants and prosthetics. Case studies will be used to bring together engineering concepts and apply them to key devices that are used to treat disease and assist patients.

Module Content: This module will examine in depth the following areas before looking in detail at several specific case studies;

Lectures

• The material properties that are important to optimise function of the implant.
• The mechanical relationship between the implant and the system it is integrated into Biomechanics of the tissues associated with implants.
• The response of the body to different materials implanted or associated with the human body.
• Modification and coating of implant surfaces for optimisation.
• Characterisation and monitoring of the medical device performance.
• Regulation of implant device fabrication and application.
• The business of implant and prosthetics.
• Advanced function and control of the medical device.
• Ethics and human augmentation.

Detailed case studies

• Rehabilitation engineering and assistive technology.
• Skin

Practical
• Solid works and other software will be used to design an implant device, which will be 3D printed as a prototype.
• Materials testing of key implant substrates.

Intended Learning Outcomes: Technical Outcomes
• Knowledge and understanding of the application of engineering principles to the design fabrication and optimisation of medical implants and prosthetics.(Assessed in Project and Exam)
• Knowledge and understanding of biocompatibility and impact of implants and prosthetics on the human body (Assessed in Project and Exam).
• Practical skills; Mechanical testing methods and how to handle specific materials used in manufacturing of medical implants and prosthetics. Experience of the medical design process from inception to prototype fabrication through 3D printing and other fabrication methods. (Assessed in Project)
• Knowledge and understanding of regulation of implant device fabrication and application and how to decipher the jargon and language style of regulatory documentation. (Assessed in Project)
• An appreciation of the future direction of implants and prosthetics and the demands this will have on a future career within medical engineering.

Accreditation Outcomes
- 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)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively (SM3m)
- Awareness of developing technologies related to own specialisation (SM4m)
- 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)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1)
- Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards (D2)
- Apply advanced problem-solving skills, technical knowledge and understanding to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal (D4)
- Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D7)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)
- Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues, and an awareness that these may differ internationally (EL5m)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk (EL6m)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (P1)
- Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components (P2m)
- Understanding of the use of technical literature and other information sources (P4m)
- Understanding of appropriate codes of practice and industry standards (P6)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Ability to apply engineering techniques taking account of a range of commercial and industrial constraints (P10m)

Assessment:	Examination (75%) Project (25%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: 75% written exam

25% Project and presentation. Working in pairs the team will be allocated an implant device to research and appraise as if they are consultants advising a medical institution on the purchase and future of the relevant technology.
This coursework is conducted and assessed in groups.

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

Assessment Feedback: The students will have the standard Faculty of Science & Engineering feedback from the exam with a diagnostic description of each answer provided by the student cohort. This will include identification of common errors and shortfalls in the answering of the question, description of good and poor answers and recommendations as to how answers could have been improved.

The marks of the continual assessments will be given to the students with a written description of their performance and how it could have been improved.

An office surgery will be held to discuss progress on the course and the delivery of the project assignment.

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.

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

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

EGNM07 Principles of Nanomedicine

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr S Sharma, Prof OJ Guy

Format: 20 hours of formal lecturing. 40 hours private study/reading and 40 hours preparation for assessment

Delivery Method: 100% course work

Module Aims: This module will cover the broad range of subjects which encompass the discipline nanomedicine. Building on the foundation of a knowledge of nanotechnology this module will focus on medical applications including biological markers, diagnostics, therapeutics and drug delivery vehicles.

Module Content:

- Interactions on the nanoscale: biological, physical, chemical and optical interactions.
- Nanoparticles: optical markers, magnetic markers - dots, tubes, wires etc.
- Drug delivery strategies: drug delivery systems, pharmacology of nanovectors.
- Imaging techniques: Microscopy, Flow cytometry.
- Therapeutics: thermal, optical, microwave.

Intended Learning Outcomes: Technical Outcomes
• An understanding of the physics at the nanoscale together with an appreciation of the relevant biology of the system studied.
• How to design and fabricate a nanoparticle marker.
• An understanding of nanoscale imaging techniques and their limitations.
• An appreciation of how a nanoparticle can be used as a drug delivery vehicle.
• A knowledge of medical practices, diagnosis and treatment
• Study independently; use library resources; note taking; time management

Accreditation Outcomes (AHEP)

MEng
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively (SM3m)
- Awareness of developing technologies related to own specialisation (SM4m)
- 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)
- Work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D3m)
- Understanding of the need for a high level of professional and ethical conduct in engineering, a knowledge of professional codes of conduct and how ethical dilemmas can arise (EL1m)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk (EL6m)
- Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components (P2m)
- Understanding of the use of technical literature and other information sources (P4m)
- Ability to work with technical uncertainty (P8m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

MSc
- 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 (SM3fl)
- Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D1fl)
- Awareness of the need for a high level of professional and ethical conduct in engineering (ET1fl)
- Awareness of and ability to make general evaluations of risk issues in the context of the particular specialisation, including health & safety, environmental and commercial risk (ET6fl)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (EP2fl)

Assessment:	Coursework 1 (25%) Coursework 2 (25%) Coursework 3 (25%) Coursework 4 (25%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: The continuous assessment will be based on a literature survey and a series of problem sheets relating to scientific journal papers and class room lectures.

Courseworks C1, C2 and C3 will be done individually. C4 will involve group presentations.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Individual feedback on each piece of assessed work via Canvas or can be discussed via Zoom, Skype or in person.
Failure Redemption: If rules allow - standard University provisions with marks capped. Any re-examination of this module will be by 100% coursework submission.
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 module has no pre-requisites.

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