Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 2 (FHEQ LEVEL 5)

MATERIALS ENGINEERING

DEGREE PROGRAMMES

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

DISCLAIMER

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

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

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

The 22-23 academic year begins on 26 September 2022

Full term dates can be found here

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

SEMESTER 1
26 September 2022 – 27 January 2023
SEMESTER 2
30 January 2023 – 09 June 2023
SUMMER
12 June 2023 – 22 September 2023

IMPORTANT

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

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

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

Welcome to the Faculty of Science and Engineering!

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

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

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

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

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

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

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

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
School of Engineering and Applied Sciences **Head of School: Professor Serena Margadonna**	
School Education Lead	Professor Simon Bott
Head of Materials Science and Engineering	Professor Dave Worsley
Materials Science and Engineering Programme Director	Dr Mark Coleman m.p.coleman@swansea.ac.uk
Year 2 Coordinator	Prof. Rob Lancaster R.J.Lancaster@Swansea.ac.uk

STUDENT SUPPORT

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

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

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

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

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

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

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

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

READING LISTS

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

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

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

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

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

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

BEng Materials Science and Engineering[J500,J505]
BEng Materials Science and Engineering with a Year Abroad[J510]
MEng Materials Science and Engineering[J504]
MEng Materials Science and Engineering with a Year Abroad[J506]
MEng Materials Science and Engineering with a Year in Industry[J503]

Coordinator: Prof RJ Lancaster

Semester 1 Modules	Semester 2 Modules
EG-244 Software Engineering 10 Credits Dr JW Jones CORE	EG-218 Materials for Energy 10 Credits Prof MJ Carnie CORE
EG-279 Functional and Smart Materials 10 Credits Prof TM Watson CORE	EG-281 Polymers: Structure and Processing 10 Credits Dr FA Korkees CORE
EG-280 Microstructure Evolution and Control in Metallic Materials 10 Credits Dr A Das/Prof C Pleydell-Pearce CORE	EG-282 Computational Materials 1 10 Credits Dr A Das CORE
EG-285 Statistical Techniques in Engineering 10 Credits Dr M Evans CORE	EG-283 Mechanical Deformation in Structural Materials 10 Credits Dr HL Cockings/Prof MT Whittaker CORE
EG-286 Materials Practicals 2a: Microstructure Development in Alloy Systems 10 Credits Dr A Das/Dr E Sackett CORE	EG-284 Manufacturing Technology II 10 Credits Prof TC Claypole CORE
EG-290 Order and Disorder in Materials 10 Credits Prof S Margadonna/Prof PJ Holliman CORE	EG-287 Materials Practicals 2b: Applied examples in advanced metallic materials 10 Credits Prof RJ Lancaster CORE
EG-277 Research Project Preparation 0 Credits Dr MR Brown/Mrs KM Thomas	
Total 120 Credits	

Year 2 (FHEQ Level 5) 2022/23
Materials Engineering
BEng Materials Science and Engineering with a Year in Industry[J502]
MEng Materials Science and Engineering with a Year in Industry

Coordinator: Prof RJ Lancaster

Semester 1 Modules	Semester 2 Modules
EG-244 Software Engineering 10 Credits Dr JW Jones CORE	EG-218 Materials for Energy 10 Credits Prof MJ Carnie CORE
EG-279 Functional and Smart Materials 10 Credits Prof TM Watson CORE	EG-281 Polymers: Structure and Processing 10 Credits Dr FA Korkees CORE
EG-280 Microstructure Evolution and Control in Metallic Materials 10 Credits Dr A Das/Prof C Pleydell-Pearce CORE	EG-282 Computational Materials 1 10 Credits Dr A Das CORE
EG-285 Statistical Techniques in Engineering 10 Credits Dr M Evans CORE	EG-283 Mechanical Deformation in Structural Materials 10 Credits Dr HL Cockings/Prof MT Whittaker CORE
EG-286 Materials Practicals 2a: Microstructure Development in Alloy Systems 10 Credits Dr A Das/Dr E Sackett CORE	EG-284 Manufacturing Technology II 10 Credits Prof TC Claypole CORE
EG-290 Order and Disorder in Materials 10 Credits Prof S Margadonna/Prof PJ Holliman CORE	EG-287 Materials Practicals 2b: Applied examples in advanced metallic materials 10 Credits Prof RJ Lancaster CORE
EG-233 Placement Preparation: Engineering Industrial Year 0 Credits Prof GTM Bunting/Dr CME Charbonneau/Dr P Esteban/Dr SA Rolland/Dr V Samaras/Dr S Sharma	
EG-277 Research Project Preparation 0 Credits Dr MR Brown/Mrs KM Thomas	
Total 120 Credits	

EG-218 Materials for Energy

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof MJ Carnie

Format:

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

During 20 hours contact time the students will be guided through their group work with a mixture of lectures, information handouts and discussion points. Most of the students' work however is expected to take part in their respective groups outside of the organised lectures.

Module Aims: Materials developed and used for energy generation and storage are critical to all aspects of the Trilema and the large amounts of UKRI funding available reflect the challenges faced by Materials Scientists in their respective fields.

This module starts with some introductory lectures on the importance of Materials for Energy Production, Storage and Usage. The module is student led and students will have an opportunity to choose the energy sector that most interests them. They will then conduct an individual literature search to find a particular filed of materials research that is critically important to their chosen energy sector and more importantly, the Energy Trilema (i.e issues related to energy security, energy equity, and environmental sustainability). In groups the students will then decide which field to base their assessment on. This involves several group-work tasks and self assessment exercises. For example, the students are required to produce a poster, based on a research paper of their choice. Self and peer assessment will be used throughout and guest lecturers will give their perspectives on energy materials research.

After the group work task are complete short practical sessions (5 x 3 hours) where the students will be introduced to lab-scale manufacture of energy materials devices - namely dye-sensitised solar cells and supercapactitors. This will introduce the students to many of the manufacturing methods that are used for a range of lab scale energy technologies.

The module will be 100% continually assessed throughout the semester

Module Content: Materials developed and used for energy generation and storage are critical to all aspects of the Trilema and the large amounts of UKRI funding available reflect the challenges faced by Materials Scientists in their respective fields.

This module starts with some introductory lectures on the importance of Materials for Energy Production, Storage and Usage. The module is student led and students will have an opportunity to choose the energy sector that most interests them. They will then conduct an individual literature search to find a particular filed of materials research that is critically important to their chosen energy sector and more importantly, the Energy Trilema (i.e issues related to energy security, energy equity, and environmental sustainability). In groups the students will then decide which field to base their assessment on. This involves several group-work tasks and self assessment exercises. For example, the students are required to produce a poster, based on a research paper of their choice. Self and peer assessment will be used throughout and guest lecturers will give their perspectives on energy materials research.

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The module will be 100% continually assessed throughout the semester

Intended Learning Outcomes: Technical Outcomes
On successful completion of this module, students should be able, at threshold level, to:
- Search and utilise the research literature and determine if a particular publication is of high quality.
- Identify important areas of Materials research critical to solving the Energy Trilema.
- Appreciate how the funding landscape works with respect to materials research.
- Communicate work to technical and non-technical audiences.
- Exercise initiative and personal responsibility, which may be as a team member or leader.
- Develop the ability to work in different roles within an engineering team.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- 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)
- Plan and manage the design process, including cost drivers, and evaluate outcomes (D5)
- Communicate their work to technical and non-technical audiences (D6)
- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2)
- Ability to apply relevant practical and laboratory skills (P3)
- Understanding of the use of technical literature and other information sources (P4)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)
- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD (G2)
- Plan and carry out a personal programme of work, adjusting where appropriate (G3)
- Exercise initiative and personal responsibility, which may be as a team member or leader (G4)

Assessment:	Laboratory report (35%) Assignment 1 (5%) Group Work - Coursework (15%) Peer Assessment (15%) Group Work - Project (15%) Peer Assessment (15%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: Laboratory Report (35%): A laboratory report based on the fabrication of dye-sensitised solar cells
Assignment 1. (5%): Fill in some details on a research paper you have chosen on Canvas
Group Work - Coursework (15%): Presentation of your chosen research paper as an academic poster
Peer Assessment (15 %): Peer and self assessment based on "Group Work - Coursework" above
Group Work - Project (15%) Create a funding proposal to for a piece of new research.
Peer Assessment (15 %) - Peer and self assessment based on "Group Work" - Project above

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

Assessment Feedback: Lectures will provide feedback on presentations during lecture and laboratory sessions. Tutorial sessions may also be used for general feedback and guidance.

Failure Redemption: A failure would be redeemed by doing a design exercise and submitting a formal report during the normal August Supplementary period. This would form 100% of the mark.

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

Available to visiting and exchange students.

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

Group work sessions are compulsory.

EG-233 Placement Preparation: Engineering Industrial Year

Credits: 0 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

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

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

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

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

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

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

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

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

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

Assessment: Placements (100%)

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

Moderation approach to main assessment: Not applicable

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

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

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

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

EG-244 Software Engineering

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JW Jones

Format: Each week contains 2 one hour lectures and a 2 hour practical session in a computer laboratory
20 hours of live, online drop-in sessions for help with lab assignments.
5 hours of online examples classes bringing together material covered so far.

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

A blended learning approach to class contact will be used in which the key concepts and readings will be introduced and understanding tested weekly via the Canvas platform.

Lab Assignments will be delivered via Canvas and can be solved using the student's own PC or the campus PC Labs. All required software is free and easily installable (a tutorial video is provided on Canvas).

Assistance with Lab Assignments will be provided via a combincation of in-person lab classes, and drop-in sessions on Zoom.

Module Aims: The module develops software engineering practice through practical applications using Python. This is achieved through a number of programming assignments throughout the semester and a series of class tests each week. Each assignment begins with the students being given one or more programs which they are expected to enhance to satisfy the brief.

In order for all of the components marks to count, you must achieve at least 30% in the Coursework 3 component. If you achieve less than this, then the module mark will be just the Coursework 3 mark.

Module Content:
The aspects of the Python language that will be covered include:
• Simple interaction with the user through the keyboard and screen;
• Variables and Types;
• Lists;
• Basic Operators;
• String Formatting and Basic String Operations;
• Conditions;
• Loops;
• Developing and using functions;
• Dictionaries;
• Input and Output to Disk and Serialisation;
• Modules and Packages.

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to:
• Describe the Python language in the context of the application domain (SM1p, EP2p)
• Develop, analyse and test simple Python programs and algorithms to meet specifications (SM1p, SM2p, EA1p, EP2p)
• Implement simple dynamic data structures (SM1p, SM2p, EA1p, EP2p)

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b/SM1p)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b/SM2p)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b/EA1p)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2/EP2p/EP2m)

Assessment:	Coursework 1 (10%) Coursework 2 (20%) Coursework 3 (30%) Examination (40%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: All three pieces of Coursework will be conducted and assessed individually. Each piece of coursework will be assessed within the PC laboratory.

The Class tests will be carried out weekly and will assess the theoretical components of the module as well as the ability to dry-run programs by hand.

In order for the marks from Coursework 1, Coursework 2 and the Class Tests to count, you must achieve at least 30% in Coursework 3. If you achieve less than 30% in Coursework 3 then the module mark will be just the Coursework 3 mark.

Moderation approach to main assessment: Not applicable

Assessment Feedback: All students will receive their marks within two weeks of the assignment deadline.
Answers from the class tests will be given after the deadline.

Failure Redemption: This module can be redeemed via supplementary examination during the August supplementary exam period. This will form 100% of the module mark. Year 2 supplementary exam marks are capped at 40%.

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

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

EG-277 Research Project Preparation

Credits: 0 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr MR Brown, Mrs KM Thomas

Format: Formal Lectures - 2-3 hours

Delivery Method: 2-3 formal lectures throughout the academic year concerning project design and selection.

Module Aims:
This module has been designed to provide you with information needed ahead of undertaking a research project in Year 3 of studies.

The research project in Year 3 is worth 30 credits, and will involve the application of scientific and engineering principles to the solution of a practical problem associated with engineering systems and processes.

In the research project you will gain experience in working independently on a substantial, individually assigned task, using accepted planning procedures. It will require and develop self-organisation and the critical evaluation of options and results, as well as developing technical knowledge in the chosen topic.

The preparation for the research project commences in Year 2 where you are required to engage in project selection. In this preparation module we will confirm the options available to you to either define your own project or to select from a list of project titles and descriptors put forward by academic staff. Communications concerned project selection will be done via the Canvas course page. Additional supplementary resources will also be provided.

Module Content: In conjunction the formal lectures and supplementary resources will cover:

• Key staff members - contact details
• Key dates for Year 2 regarding project selection - defining your own project or selecting from staff titles
• How to design a project concept and what to consider before approaching a possible supervisor
• Where to start in finding a possible supervisor
• What to do if you're hoping to undertake a placement year
• Selecting from staff titles
• Further information around the allocation process
• First steps in EG-353 when you commence Year 3

Intended Learning Outcomes: NA

Assessment: Participation Exercise (100%)

Assessment Description: This module is not assessed but we would strongly suggest participation to ensure that you understand how the project selection system will work.

Moderation approach to main assessment: Not applicable

Assessment Feedback: NA

Failure Redemption: NA

Additional Notes: Only available to students following an Engineering Degree Programme.

EG-279 Functional and Smart Materials

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof TM Watson

Format: Lectures 20 hours
Tutorials / Example classes 5 hours
Directed private study 40 hours
Preparation for Examination 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

On Campus

Module Aims: This module covers the underlying scientific principles behind the physical properties of functional and smart materials. It provides the basis for electrical conductivity, semiconductivity, superconductivity as well as optical, magnetic and thermal properties. The ways in which these properties can be utilised in a wide range of devices is explored.
Module Aims: to introduce the scientific principles behind the physical properties of functional and smart materials and to explore the manufacture of functional devices.

Module Content: Module content: [lecture hours]
• Introductory lecture. Setting the scene for the module. [1]
• A review of the atomic theory of the elements and interatomic bonding. [2]
• The theory of electrical conduction is then introduced, initially from a 'classical' point of view (Drude model) and then progressing (via the necessary concepts) to the modern band theory of semiconduction. The relationship to thermal properties is explored. [5]
• Junctions between different types of semiconductor (p-n junctions) and devices. [2]
• Manufacturing of semiconductor devices [2]
• Photovoltaic materials [1]
• Optical properties of materials. [3]
• Display technologies [1]
• Magnetic properties of materials [2]
• Memory storage materials and devices [1]

Intended Learning Outcomes:
Technical Outcomes
By the end of the module, the student should be able to:
- Demonstrate an understanding of the basic principles of atomic and solid state theory. A key focus of the course is how the material structure (e.g. behaviour of atoms, ions and in particular electrons) controls the macroscopic properties of insulating, semiconducting and metallic solids.
- Appreciate the optical, magnetic and thermal behaviour of materials and how these relate to structure. Material manufacturing and example of applications will be presented.
- Predict the physical behaviour of materials from knowledge of their atomic and microscopic structure. Some numerical analysis of the physical principles is involved.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Communicate their work to technical and non-technical audiences (D6)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (P1)

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

Assessment Description: The module is assessed with a 2-hour exam worth 80%. There are then 2 assignments which make up the remaining 20%.
For assignments 1, 2: The quality of English does not form part of the assessment.

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

Assessment Feedback: Standard examination feedback form available for all students after the examination.

Feedback sheets are completed for each assignment. General feedback for the class test will be uploaded to Canvas.

Failure Redemption: Resit examination in August - 100% weighting.

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

Available for Visiting and Exchange Students

EG-280 Microstructure Evolution and Control in Metallic Materials

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules: EG-286

Lecturer(s): Dr A Das, Prof C Pleydell-Pearce

Format: Lectures 28 hours
Tutorials / Example classes 5 hours
Directed private study 40 hours
Preparation for assessment 30 hours

Delivery Method: Blended delivery with online recorded lectures and live online lectures as needed.
Face to face teaching will depend on Covid-19 situation but online delivery of entire modules will be available for off-campus students.
Assessment: 2 hr examination at the end of semester.

Module Aims: This module considers the most important solidification and solid-state phase transformations that can occur in metallic materials and how these transformations determine microstructural evolution. The kinetics of phase transformations are discussed and procedures for controlling microstructures, and hence mechanical properties, detailed by reference to the processing of commercially significant alloys.

Module Content: Module content: [lecture hours]
• The different structural aspects that control the behaviour of materials. The 'equilibrium state' of a metallic material, the concept of metastable states. The types of phase found in microstructures. [2]
• The mechanisms of phase transformations; heterogeneous and homogeneous transformations. The growth stage in heterogeneous transformations. [2]
• Liquid-solid phase transformations; Classical thermodynamic models of homogeneous and heterogeneous nucleation, the influence of undercooling on nucleation. [3]
• Solidification and grain structure evolution. Microstructures of solid solution alloys. [3]
• Phase diagram for isomorphous alloy system. The Lever Rule and Gibbs Phase Rule. [2]
• Equilibrium and non-equilibrium solidification of alloys in a simple eutectic phase diagram. Peritectic reactions. [2]
• Diffusion and diffusional transformations. [2]
• Diffusionless transformations. [2]
• Solid-state phase transformations and microstructures. Types of interface. [2]
• Growth laws for transformations; TTT curves. [2]
• Deformation. Restoration processes including recrystallisation. [2]
• Phase transformations in plain carbon steels; the iron-cementite phase diagram; the influence of cooling rate. [2]
• Precipitation strengthening [2]

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to:
• Understand rigorously the interpretation of binary equilibrium phase diagrams.
• Be familiar with the most important phase transformations, the evolution of the associated microstructures and the importance of the nucleation and / or growth stages of phase transformations.
• Understand how phase transformations can be controlled to influence microstructures and properties in a range of materials.
• Demonstrate a proficiency at employing phase diagrams to explain / predict alloy microstructures.
• Relate process conditions to microstructure and hence properties.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- 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 materials, equipment, processes, or products (P2)

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

Assessment Description: Assessment: 2 hr examination at the end of semester. Supplementary examination to redeem failure will be standard 2 hr resit examination
Moderation approach to main assessment: Universal second marking as check or audit
Assessment Feedback: Verbal feedback provided through model answers during examples classes. Examination feedback provided through college of engineering feedback system.
Failure Redemption: Supplementary examination to redeem failure will be standard 2 hr resit examination - 100% weighting.
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

EG-281 Polymers: Structure and Processing

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr FA Korkees

Format: Lectures 22 hours
Practicals 9 hours
Blended Learning activity 10 hours
Directed private study 36 hours
Preparation for assessment 30
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

All lectures will be delivered on-campus
Practicals will be delivered on-campus

The module is assessed with 2 hours examination (75%) and class test (10%) and lab report (15%)

For the class test and lab report: The quality of English does not form part of the assessment.

Online class test (10%) – A short test, based on multiple-choice questions covering all practicals. This is worth 10% of the module and is really a check to make sure you have understood the basics of each practical.

Assignment (15%) – Detailed report on one of the polymer-based practical sessions, as detailed below:
Practical 1: Environmental Stress Cracking of Amorphous Polymers
Practical 2: Injection Moulded Glass Fibre Reinforced Nylon
Practical 3: Carbon Fibre Composites - Effects of curing temperature on the tensile properties.

This assignment is worth 15% of the module.

Important - Attendance at all practical sessions is expected. Students will not gain any marks for a practical session that they did not attend, even if a report is submitted for the assignment.
Only students who attend all 3 practical sessions will be permitted to take the class test.

Module Aims: The module will explore the link between the processing methods, structure and mechanical properties of polymers and polymer-based composites. This will give the students a good understanding and knowledge about the effects of structure and properties on the behaviour of these materials.

Module Content: Module content: [lectures and practicals hours]

• Introduction to polymeric materials: polymers structures and properties. [2]
• Thermoplastic and thermoset polymers: properties, applications and issues related [2]
• Practical: Environmental Stress Cracking of Amorphous Polymers [2]
• Rheology; the flow behaviour of polymer melts and solutions. [2]
• Manufacturing methods with thermoplastics; Extrusion and Injection moulding; including a brief review of computer modelling packages. [3]
• Practical: Injection Moulded Glass Fibre Reinforced Nylon. [2]
• Manufacturing methods with thermosets and rubbers. [3]
• Polymer based composites: an overview. [2]
• Practical: Carbon Fibre Composites - Effects of curing temperature on the tensile properties. [2]
• Polymer joining and finishing methods. [2]

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to:
• Understand the structure of different polymers and polymer composites and appreciate its importance in determining properties and suitable processing methods
• Demonstrate a thorough knowledge of the range of processing methods available for polymers and polymer composites and an appreciation of the underlying aspects of additive technology and rheology.
• Discuss the advantages, disadvantages and limitations of different polymer-based materials and process methods.
• Critically evaluate processing options for engineering applications and select the most appropriate.
• Appreciate processing / property relationships.
• Conduct standard mechanical testing procedures with polymer composites.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Communicate their work to technical and non-technical audiences (D6)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2)
- Ability to apply relevant practical and laboratory skills (P3)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

Assessment:	Class Test 1 - Coursework (10%)
	Assignment 2 (15%)
	Examination 1 (75%)
Resit Assessment:	Examination 2 (100%)

Assessment Description: The module is assessed with 2 hours examination (75%) and class test (10%) and lab report (15%)

For the class test and lab report: The quality of English does not form part of the assessment.

Online class test (10%) – A short test, based on multiple-choice questions covering all practicals. This is worth 10% of the module and is really a check to make sure you have understood the basics of each practical.

Assignment (15%) – Detailed report on one of the polymer-based practical sessions, as detailed below:
Practical 1: Environmental Stress Cracking of Amorphous Polymers
Practical 2: Injection Moulded Glass Fibre Reinforced Nylon
Practical 3: Carbon Fibre Composites - Effects of curing temperature on the tensile properties.

This assignment is worth 15% of the module.

Important - Attendance at all practical sessions is expected. Students will not gain any marks for a practical session that they did not attend, even if a report is submitted for the assignment.
Only students who attend all 3 practical sessions will be permitted to take the class test.
Valid extenuating circumstances will be considered.

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

Assessment Feedback: Standard examination feedback form available for all students after the examination.

Formative marking on submitted assignments. Feedback sheets are completed for each assignment. Students will receive individual feedback comments for the assignment via the Canvas site.

Failure Redemption: Resit examination in August - 100% weighting

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

Available for visiting and exchange students.

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION

Important - Attendance at all practical sessions is expected. Students will not gain any marks for a practical session that they did not attend, even if a report is submitted for assignment 2. Only students who attend all 3 practical sessions will be permitted to take the class test. Valid extenuating circumstances will be considered.

EG-282 Computational Materials 1

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr A Das

Format: Online Practical classes 44 hours
Directed private study 54 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: Will employ a blended approach to delivery using the Canvas Digital Learning Platform and Zoom sessions for live and self-directed online activity, with live and self-directed on-campus activities if and when possible.

Assessment: 2 hour examination at the end of the semester (50%) plus three computer-based assignments (50%) weighted for assignments I, II and III at 10%, 20% and 20% respectively. Each assignment is assessed via evaluation of the programming code submitted by the student. These assignment marks are provided using a standard feedback form which is returned to each student through Canvas. In terms of deadlines zero tolerance principle applies.

Module Aims: The course builds on knowledge gained in Year 2 Modelling and Simulation module. The course will provide students with the opportunity to construct programmes that solve more advanced numerical problems and also simulate some real physical phenomena that are important in engineering. The course finishes when students synthesize mathematical, numerical and fundamental metallurgical principles into a fully operational diffusion simulation.

Module Content: Module content: [lecture hours]
• Matrices: Simple matrix algebra and solution of simple linear systems using Gaussian Elimination and Gauss-Siedel Iteration, Matrix conditioning, pivoting techniques. [2]
• Finite Difference Method: Boundary value and initial value problems. [1]
• Coupling of matrix formulation to finite difference system. [1]
• Steady-State problems. Discretization of Laplace equation [1]
• Applications to thermal and electrical potential fields (welding and corrosion). [1]
• Limitations of the continuum approach in materials systems, especially at micro/meso length scale in relation to microstructural effects and metallurgical theory. [1]
• Transient problems. Discretisation of the diffusion equation. [1]
• Application to transient heat flow and diffusion problems. [1]
• Introduction of source terms for solidification, laser heating and Joule heating. [1]

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to:
- Understand the application of continuum field based modelling to several problems commonly encountered in computational materials.
- Have a working knowledge of FORTRAN95 programming and understand the main steps in implementing numerical algorithms to solve scientific problems including 1D, 2D and 3D Laplace and 1D, 2D and 3D transient diffusion cases (Fick's 2nd Law and/or Fourier Heat Transfer equation).

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 mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2p)
- 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 in order to solve engineering problems and to implement appropriate action (EA3b)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

Assessment:	Examination 1 (50%) Assignment 1 (10%) Assignment 2 (20%) Assignment 3 (20%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description:
Examination 1 - Standard 2 hours examination, students to answer 3 questions out of 4.
Coursework 1 (10%)
Coursework 2 (20%)
Coursework 3 (20%)
These are programming assignments which are carried out by students during the timetabled PC laboratory sessions.
All of these assignments are individual pieces of work, students are not to work with other students or as part of a group.
Postgraduate demonstrators are present during all practical sessions, as well as the module lecturer, in order to provide assistance to students completing the assignments.

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

Assessment Feedback: Standard examination feedback form available for all students after the examination.
Feedback sheets are provided through Canvas for each student after each of the coursework assignments.

Failure Redemption: Through supplementary examination in August.

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

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION

Available to visiting and exchange students.

Practical classes are compulsory. Students must have sufficient attendance at practical classes in order to be allowed to be assessed for the module.

EG-283 Mechanical Deformation in Structural Materials

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: EG-184

Lecturer(s): Dr HL Cockings, Prof MT Whittaker

Format: Lectures 20 hours
Tutorials / Example classes 10 hours
Directed private study 40 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

Assessment: 2 hour examination at the end of the semester (80% of total mark) plus one assignment (10%) and one class test (10%) during the semester.

Module Aims: Following on from the first year module "Mechanical Properties" this module provides further detail about the deformation characteristics of a wide range of engineering materials.
The course aims to develop the understanding of topics taught in the first year module by application to high performance materials such as titanium and nickel. Further understanding of deformation and damage mechanisms is gained through targeted units on elasticity, plasticity, alloy strengthening, mechanics of materials, fatigue and creep. The knowledge provided then allows for topics such as methods of mechanical testing and additive layer manufacturing. The module then seeks to draw these topics together by considering application to three main material classes, metals, ceramics and composites.

Module Content: Module content:
• Properties of high performance alloys
• Elasticity and plasticity
• Alloy strengthening
• Effects of strain rate and temperature
• Creep behaviour in engineering materials
• Fatigue behaviour in engineering materials
• Mechanics of materials
• Methods of mechanical testing
• Fracture behaviour
• Ceramics
• Composites

Intended Learning Outcomes:
Technical Outcomes
After completing this module, the students should be able to (assessed by):
• Understand clearly the main factors governing the stress-strain response of engineering materials and how the mechanical performance can be improved through alloy strengthening or the fabrication of composite materials. (Examination, Coursework 1) - (Learning outcomes SM1b US1, D1 D2)
• Appreciate materials selection for engineering components (Examination) - (Learning outcome Ea1b E1)
• Distinguish between the response of single crystal and polycrystalline variants of metals, ceramics and polymers (Examination) - (Learning outcome P2b P1)
• Associate typical forms of fracture mechanism with specific case studies of industrial failure (Examination) - (Learning outcome Ea1b E1)
• Describe the testing requirements to evaluate mechanical properties for a range of engineering materials (Examination, Coursework 2) - (Learning outcome P2b P1)
• Understand the equations of static equilibrium to calculate reactions, axial forces, bending moments, shear forces (Examination, Coursework 2) - (Learning outcome Ea1b E1)

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- 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)
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 materials, equipment, processes, or products (P2)

Assessment:	Examination 1 (80%)
	Coursework 1 (10%)
	Class Test 1 - Coursework (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Examination 1 - 2 hour examination (80%).

Assignment 1 - Summative assessment - Fatigue (10%). This is an individual piece of coursework. It looks to demonstrate methods of fatigue life calculation which are widely utilised within industry.

Class test 1 (10%) - Class test on Canvas. This assessment includes Mohr's circle, thermal expansion and mechanical testing/properties.

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

Assessment Feedback: Written feedback provided to students individually on assignments indicating areas of strength/areas for improvement.
Verbal feedback provided through model answers on assignments during examples classes.

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

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

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

Additional notes: Detailed course notes provided. Course notes, past papers and supporting material available on Canvas site.

EG-284 Manufacturing Technology II

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof TC Claypole

Format: Lectures 24 hours
Tutorials / Example classes 12 hours
Directed private study 36 hours
Preparation for assessment 28 hours

Delivery Method: Assessment:
Examination – 70%
Assignments – 30%
- State of the art notes for each the 3 topics (10% per topic)
- Annotate the provided notes and slides
 -With personal notes/comments
 -Literature review of journal papers correctly referenced
 -Bibliography

Module Aims: The course builds on information presented in Manufacturing Technology I (EG-182) by describing advanced processes for special machining and surface modification and by examining available joining techniques for assembly of components. The advantages and limitations of specific processes are outlined and procedure for optimum design and manufacture provided.
Module Aims: to provide awareness and understanding of advanced manufacturing methods used for engineering materials and components.

Module Content:
Module content:

Topic 1 – Non-traditional machining
• Fabrication – machining of flat stock
o Laser
o Plasma
o Waterjet
• Micro machining
o Applications
o Advanced Manufacture by Printing
 Flexography
o Screen printing
o Ink jet
o Aerosol jet deposition
o Vacuum Metallising
o Laser micromachining
Topic 2 – Additive manufacture
• Measurement of surface profile
o Stylus system
o Infinite focus microscopy
o White light interferometry
• Coating
o Anodising
o Plasma Carburising and Nitriding
o Electroplating
• 3D Printing
o Fused Deposition
o Stereolithography/Resin 3D printing
o Ink jet resin injection
o Laser sintering
Topic 3 – Joining
• Welding
o Fusion welding
o Solid state welding
• Brazing
• Soldering
• Adhesive Bonding
o Joint design
o Adhesive types
• Mechanical Assembly
o Threaded fasteners
o Rivets
o Assembly methods based on interference fits
o Other mechanical fastening methods
o Moulding inserts and integral fasteners
o Design for assembly

Intended Learning Outcomes:
Technical Outcomes
Upon completion of the module the student should be able to:
- Understand the principles, advantages and limitations of the main non-traditional machining processes.
- Discuss coating technology, joining techniques and their advantages and limitations.
- Select appropriate machining, coating and joining techniques.
- Relate the effects of large scale processes on the microscopic structure of materials.
- Compare information from several sources to select optimum processing.

Accreditation Outcomes (AHEP)
- 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)
- Knowledge of characteristics of particular materials, equipment, processes or products (P2)

Assessment:	Assignment 1 (10%) Examination (70%) Assignment 2 (10%) Assignment 3 (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Examination – 70%
Assignments – 30%
- State of the art notes for each of the 3 topics (10% per topic)
 -Annotate the provided notes and slides
 -With personal notes/comments
 -Literature review of journal papers correctly referenced
 -Bibliography

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

Assessment Feedback: Through Faculty of Science and Engineering feedback procedure

Failure Redemption: Supplementary Examination 100% in August

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

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION

EG-285 Statistical Techniques in Engineering

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr M Evans

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

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

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

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

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

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

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

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

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

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

EG-286 Materials Practicals 2a: Microstructure Development in Alloy Systems

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules: EG-280; EG-283

Lecturer(s): Dr A Das, Dr E Sackett

Format: Laboratory Work 30 hours
Directed private study 30 hours
Preparation for assessment 40 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

Laboratory sessions.

Module Aims: This module is concerned with the microscopic examination, measurement and interpretation of the microstructures of metals. This involves the development skills in the microstructural characterisation of metals and the development of sound microstructural measurement methodologies. This is then reinforced by logical reasoning based on an understanding of binary phase diagrams of the nature of the phase transformations occurring in metals and of the influence of processing on microstructure. This module also details the mathematical descriptions necessary for the solution of a variety of critical engineering problems, with an emphasis on materials processing.

Module Content:
Practical work:
Nine 2 hour practical sessions involving metallographic examination, microscopic measurement and hardness testing of a range of metallic materials.

Specific materials to be covered include:
- Wrought Iron - Determination of Grain Size.
- Advanced High Strength Steel (AHSS)
- Eutectics.
- Peritectics.
- Grey and white cast irons.
- Brasses.
- Hardness and its relation to yield strength.

Intended Learning Outcomes: Technical Outcomes
After completing this module, the students should be able to:
• Understand fundamentally how the microstructure relates to different types of solidification and solid-state phase transformation and to processing parameters.
• Understand most types of phase transformation.
• Interpret binary alloy equilibrium phase diagrams and use them for the analysis and explanation of metallurgical microstructures.
• Interpret the microstructures of metals in terms of alloy chemistry and processing history.
• Apply practical metallographic measurement and standard mechanical testing procedures.
• Apply skills in writing of scientific reports and in logical reasoning based on microscopic observations.

Accreditation Outcomes (AHEP)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2)
- Ability to apply relevant practical and laboratory skills (P3)
- Understanding of the use of technical literature and other information sources (P4)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

Assessment: Coursework 1 (10%)
Coursework 2 (20%)
Coursework 3 (20%)
Coursework 4 (10%)
Coursework 5 (20%)
Coursework 6 (20%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Assessment comprises marking of lab reports and class tests submitted by the students through the Canvas system.

Attendance at labs or on-line equivalents is compulsory. Each coursework is linked with a lab session and zero marks will be awarded in this component for unauthorised absence from the lab session.Valid extenuating circumstances will be considered.

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

Assessment Feedback: Feedback on each lab report is provided to students through the Canvas system.

Failure Redemption: Through submission of additional coursework during resit period.

Additional Notes: PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION

Attendance at labs or on-line equivalents is compulsory. Each coursework is linked with a lab session and zero marks will be awarded in this component for unauthorised absence from the lab session. Valid extenuating circumstances will be considered.

Available to visiting and exchange students (note that this course runs in conjunction with EG-280 Microstructure Evolution and control, so attendance of both courses is advised).

EG-287 Materials Practicals 2b: Applied examples in advanced metallic materials

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: EG-281; EG-283; EG-284

Lecturer(s): Prof RJ Lancaster

Format: Laboratory Work: 27 hours
Directed private study: 45 hours
Preparation for assessment: 25 hours

Delivery Method: Assessment: 5 x assessments including:

4 x written assignments

1 x in-class test

Module Aims: Materials Practicals 2b: Applied examples in advanced metallic materials - identification and assessment of microstructures and mechanical properties of a variety of ferrous and non-ferrous alloys. The module will explore the link between microstructure and mechanical properties and show how processing treatments can radically alter the microstructure and behaviour of materials.

Module Content: Practical work: 9 x 3-hour practical sessions involving metallographic examination and mechanical testing of a range of metallic materials.

Specific materials to be covered include:
1-2 Titanium alloys (microstructure, mechanical testing, failure analysis);
3-4 Aluminium alloys (microstructure, mechanical testing, failure analysis);
5-6 Creep (failure analysis, microstructural damage, data analysis);
7-8 Additive Materials (microstructure, porosity calculations, data analysis, failure analysis);
9 Class Test.

Intended Learning Outcomes: Technical Outcomes
After completing this module, the students should be able to:
- Demonstrate knowledge of characteristics of particular materials, equipment, processes or products.
- Apply relevant practical and laboratory skill.
- Understanding of the use of technical literature and other information source.
- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD.
- Plan and carry out a personal programme of work, adjusting where appropriate.

Accreditation Outcomes (AHEP)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2)
- Ability to apply relevant practical and laboratory skills (P3)
- Understanding of the use of technical literature and other information sources (P4)
- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD (G2)
- Plan and carry out a personal programme of work, adjusting where appropriate (G3)

Assessment: Coursework 1 (22%)
Coursework 2 (22%)
Coursework 3 (20%)
Coursework 4 (20%)
Coursework 5 (16%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Assessment 1 (22%) - Titanium Alloys - Effects of thermal and mechanical processing on the microstructure / mechanical properties of the Titanium alloy Ti-6Al-4V.
Assessment 2 (22%) - Aluminium Alloys - The effect of age hardening on the mechanical properties of Aluminium 2000 series alloys.
Assessment 3 (20%) - Creep Damage - The effect of creep damage on the structural integrity of an engineering material.
Assessment 4 (20%) - Additive Manufactured Steels - The effect of build orientation on the fatigue performance of Additive Manufactured Steels for Nuclear Submarine Components.
Assessment 5 (16%) - Class test based on the four previous assignments.

Attendance at laboratory sessions is compulsory. Each coursework is linked with a laboratory session and zero marks will be awarded in this component for unauthorised absence from the laboratory session.

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

Assessment Feedback: Formative marking on submitted assignments.

Failure Redemption: Extra assignments will be set to redeem failures.

Additional Notes: PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION

Attendance at laboratory sessions is compulsory. Each coursework is linked with a laboratory session and zero marks will be awarded in this component for unauthorised absence from the laboratory session.

The module can be re-examined through a supplementary coursework. The failure redemption is only available to students who had at least 80% attendance at laboratory sessions during the teaching semester. Students who fail the module and have attended less than 80% of the laboratory sessions will normally be required to take the module again in the next academic session.

EG-290 Order and Disorder in Materials

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof S Margadonna, Prof PJ Holliman

Format: 20 hours of synchronous/face-to-face sessions and 10 hours of asynchronous sessions
Directed private study 50 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, online video demonstrations, 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

20 hours of synchronous on line or face-to-face lectures/example classes on campus
10 hours of asynchronous teaching with worked examples, short recorded materials and quizzes.

Module Aims: Introduction to order in materials-single crystals and polycrystalline powders. Understanding of the basic principles of crystallography and the factors governing atomic arrangements through defined examples of crystal structures of elements, ionic compounds, interstitial and substitutional solid solutions. The importance of powder diffraction for the characterisation of materials and examples of its application. Introduction to imperfections in crystals and the concept of disorder rather than defects (i.e. positive and negative effects of disorder). Disorder will be considered around 0-dimensional point defects (impurities and vacancies), 1-dimensional line defects (dislocations), 2-dimensional planar defects (interfaces and grain boundaries) and 3-dimensional defects (particulate) . The positive and negative effects of defects on different types of crystalline materials; and how understanding can lead to control. Case studies of real-life examples of disorder will be used to illustrate the concepts through the module.

Module Content: Module content:
Order:
1) Crystallographic concepts- lattice, unit cells, crystal systems, Bravais lattices, lattice directions and Miller indices.
2) Powder diffraction
3) Close-packed structures of metals
4) Ionic structures and Pauling’s Rules
5) Interstitial and substitutional solid solutions

Disorder
1) Introduction to imperfections in crystals; point defects (impurities and vacancies), line defects (dislocations) and planar defects (interfaces and grain boundaries).
2) The interplay between crystal growth and defects.
3) Case studies of positive and negative effects of defects on different types of crystalline materials

Intended Learning Outcomes: Technical Outcomes
Upon completion of the module the student should be able to demonstrate a knowledge and understanding of:
- Basic crystallographic concepts to describe specific crystal structures
- The factors and rules that govern atomic arrangement in crystal structures particularly in metals and ionic compounds
- Powder diffraction for the characterisation of cubic crystal structures
- Different types of disorder in crystals; from point defects to linear defects to planar defects to particle defects
- To correlate between crystalline structure and disorder
- To understand how crystal defects interact and influence the properties of crystalline materials
- The relationships between unit cell phenomena and macroscopic behaviour

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Communicate their work to technical and non-technical audiences (D6)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

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

Assessment Description: Assessment by Examination (100%).

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

Assessment Feedback: Standard Feedback Forms will be completed and made available to students.

Failure Redemption: Supplementary examination in August

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

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION.
Available to visiting and exchange students.