Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

STUDENT HANDBOOK

MSc MATERIALS ENGINEERING (FHEQ LEVEL 7)

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	
Pro-Vice Chancellor and Executive Dean	Professor David Smith
Director of Faculty 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 Materials Science and Engineering	Professor Trystan Watson
Materials Science and Engineering Programme Director	Professor Geraint Williams geraint.williams@swansea.ac.uk
Materials Science and Engineering Course Coordinator	Dr Amit Das a.das@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/

MSc (FHEQ Level 7) 2023/24
Materials Engineering
MSc Materials Engineering

Coordinator: Dr A Das

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-M106 **Polymer Processing** **10 Credits** **Prof JC Arnold/Mr D Butcher** **CORE**	**EG-M37** **Additive Manufacturing** **10 Credits** **Prof NPN Lavery/Mr D Butcher** **CORE**
EGSM00 **Structural Integrity of Aerospace Metals** **10 Credits** **Prof C Pleydell-Pearce** **CORE**	**EG-M83** **Simulation Based Product Design** **10 Credits** **Dr AJ Williams/Dr B Morgan** **CORE**
EGTM71 **Power Generation Systems** **10 Credits** **Prof I Masters** **CORE**	**EGTM60** **Aerospace Materials Engineering** **10 Credits** **Prof C Pleydell-Pearce** **CORE**
EGTM79 **Sustainability and Environmental Assessment** **10 Credits** **Prof GTM Bunting/Mr MH Green** **CORE**	
Dissertation	
EG-D06 **MSc Dissertation - Materials Engineering** **60 Credits** **Dr A Das** **CORE**	
Total 180 Credits	

Optional Modules

Choose exactly 50 credits

The following modules must be chosen by graduates without Swansea Materials degree

EG-M73	Composite Materials	Dr FA Korkees	TB2	10 (CORE)
EGIM16	Communication Skills for Research Engineers	Dr SA Rolland/Dr T Lake	TB1	10 (CORE)
EGTM88	Ceramics	Prof DA Worsley	TB2	10 (CORE)
EGTM89	Polymers: Properties and Design	Dr S Sharma	TB2	10 (CORE)
EGTM92	Physical Metallurgy of Steels	Dr E Sackett	TB1	10 (CORE)

Or

Choose exactly 50 credits

The following modules must be chosen by Swansea Materials graduates

EG-M122	Group Project (Mechanical & Materials)	Prof DT Gethin	TB1+2	30 (CORE)
EG-M190	Social, environmental and economic context of research	Dr SA Rolland/Prof JC Arnold	TB2	10 (CORE)
EG-M47	Business Leadership for Engineers	<Unknown>	TB2	10 (CORE)

Or
Choose exactly 50 credits
The following modules must be chosen by Swansea Aerospace Engineering graduates

EG-M47	Business Leadership for Engineers	<Unknown>	TB2	10 (CORE)
EGIM16	Communication Skills for Research Engineers	Dr SA Rolland/Dr T Lake	TB1	10 (CORE)
EGTM88	Ceramics	Prof DA Worsley	TB2	10 (CORE)
EGTM89	Polymers: Properties and Design	Dr S Sharma	TB2	10 (CORE)
EGTM92	Physical Metallurgy of Steels	Dr E Sackett	TB1	10 (CORE)

EG-D06 MSc Dissertation - Materials Engineering

Credits: 60 Session: 2023/24 June-September

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr A Das

Format: Typically 1 hour per week i.e 10-15 hrs total contact time. Each student is to be supervised in accordance with the University's Policy on Supervision, with a minimum of three meetings held. A careful record should be kept, agreed between supervisor and student, of all such formal meetings, including dates, action agreed and deadlines set.

Delivery Method: The module is delivered primarily as an individual research project. The student is expected to liaise with the supervisor on a regular basis, with a minimum University requirement of three formal meetings for full-time students. In the case of part-time students it is recommended that a minimum of four meetings are held. Ideally, contact should be more regular, with at least one meeting a week to discuss the development and progress of the project. Depending on the project the student would be expected to carry out this research individually and to complete the necessary risk assessments and training required to work on an industrial site or within laboratory facilities of the University.

Module Aims: The module aims to develop fundamental research skills. It comprises the development of supervised research work leading to a dissertation in the field of the Master's degree programme. The specific research topic will be chosen by the student following consultation with academic staff.

Module Content: Study for the dissertation, which may be based on practical, industrial, or literature work, or any combination of these, is primarily carried out over a period of about 12 weeks, with the dissertation being submitted at the end of September. Preparatory work on the dissertation may take place during Part One of the programme but students will only be permitted to submit their dissertation following successful completion of Part One.

In conducting the research project and dissertation the student will be exposed to all aspects of modern information retrieval processes, the organisation and resourcing of research and the organising and presentation of experimental data. The student must make inferences on conclusions, based on the evidence provided and supported by the research work. Furthermore they must assess the significance of this work in relation to the field and make suggestions about how further work could improve or clarify the research problem. The results of the project will be disseminated in a substantial dissertation demonstrating the student's ability to research a subject in depth.

The student will meet regularly with the supervisor to ensure that the project is well developed and organised.
Progress will be monitored.

Intended Learning Outcomes: Technical Outcomes
On completion of this module, students should have the ability to:
• Investigate a research topic in detail;
• Formulate research aims;
• Devise and plan a research strategy to fulfil the aims;
• Carry out research work - undertake a literature search, a laboratory based or computer based investigation or a combination of these;
• Gather, organize and use evidence, data and information from a variety of primary and secondary sources;
• Critically analyse information;
• Make conclusions supported by the work and identify their relevance to the broader research area;
• Resolve or refine a research problem, with reasoned suggestions about how to improve future research efforts in the field; and
• Produce a report (dissertation), with the findings presented in a well organised and reasoned manner.

Accreditation outcomes (AHEP)
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- 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 (SM9m)
- Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations (EA6m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods (EA7m)
- Knowledge, 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)
- Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate (EL11m)
- 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 (EL13m)
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12m)
- 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)
Plan self-learning and improve performance, as the foundation for lifelong learning/CPD (G2)
Monitor and adjust a personal programme of work on an on-going basis (G3)

Assessment: Report (100%)

Assessment Description: The research project and dissertation forms Part Two of the Masters degree.

Students should refer to:
https://www.swansea.ac.uk/academic-services/academic-guide/postgraduate-taught-awards-regulations/standard-taught-masters/

In particular, section 14 will provide further Information about dissertation preparation and submission.

The word limit is 20,000. This is for the main text and does not include appendices (if any), essential footnotes, introductory parts and statements or the bibliography and index.

Each student is to submit an electronic copy of their dissertation through the Turnitin link on Canvas. The online system will automatically check the similarity of the report.

The dissertation must contain:
• A statement that it is being submitted in partial fulfilment of the requirements for the degree;
• A summary of the dissertation not exceeding 300 words in length;
• A statement, signed by you, showing to what extent the work submitted is the result of your own investigation.
• Acknowledgement of other sources shall be made by footnotes giving explicit references. A full bibliography should be appended to the work;
• A declaration, signed by you, to certify that the work has not already been accepted in substance for any degree, and is not being concurrently submitted in candidature for any degree;
• A signed statement regarding availability of the thesis.

The dissertation is marked by the supervisor and another member of staff and sent to an External Examiner for moderation. An Internal Exam Board is then held to confirm the mark. Finally, all marks are ratified at the University Postgraduate Taught Examination Board.

Deadlines as follows:

MSc Materials Engineering (without resits) - September 30th

MSc Materials Engineering (with resits) - December 15th

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

Assessment Feedback: Informal feedback will be given during regular meetings with supervisors. The supervisor will also provide an assessment of the project drafting skills during the planning of the dissertation. Work will be returned according to specified deadlines and accompanied by constructive comment.

A Feedback session will be given to any student who fails their dissertation and is permitted by the Award Board to resubmit their work.

Failure Redemption: Candidates who fail the dissertation are given an opportunity to resubmit the dissertation within 3 months of the result of the examination if a full-time student or 6 months for part-time students. Such students will be given one formal feedback session, including written feedback on the reasons for failure, immediately following confirmation of the result by the University Postgraduate Taught Examination Board. The opportunity to resubmit will only be offered to students who submit a dissertation and are awarded a fail. Those candidates who do not submit a dissertation will not be offered a resubmission opportunity.

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.

If an extension is deemed appropriate a Postgraduate Taught Masters 'Application for Extension to the Submission Deadline/ Period of Candidature' Form will need to be submitted as follows:

- 30 September – deadline for Part Two students (non-resit students).
- 15 December – deadline for Part Two Students (students who had resits).

EG-M106 Polymer Processing

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules: EG-M103

Lecturer(s): Prof JC Arnold, Mr D Butcher

Format: 20 hrs lectures
10 hrs laboratory
70 hrs Directed private study

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/Laboratory demonstrations

Module Aims: The module will provide a deeper understanding of the technology of plastics processing. The material covered will cross cut the engineering disciplines of advanced manufacturing technology and polymer science to broaden the technical and industrial context of polymer processing. Within the content of the module simulation software will be applied to industrial case study examples for critical evaluation. In addition, the application of polymer replication technologies within the emerging field of micro manufacturing will be presented, focusing on the advantage and limitations of size effect and length scale integration. The module will include practical demonstration laboratories and also include industrial visits.

Module Content:

• Injection moulding: processing cycle
• Material selection criteria and processing consideration
• Computational simulation
• Microcellular injection moulding
• Polymer melt rheology
• Mould cooling systems

Intended Learning Outcomes:

Accreditation Outcomes (AHEP)
MEng:
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)
- Understanding of appropriate codes of practice and industry standards (P6)

MSc:
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9m)
- Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate (EL11m)

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

Assessment Description: Two hour examination, choice of three questions out of four.

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

Assessment Feedback: Examination feedback is given using the Faculty of Science and Engineering standard form.

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

MEng finalists are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: McCrum, N. G., Buckley, C. P., Bucknall, C. B., Principles of polymer engineering / N.G. McCrum, C.P. Buckley, C.B. Bucknall., Oxford University Press,, 1988.ISBN: 0198561520
Osswald, Tim A., Polymer processing fundamentals / Tim A. Osswald., Hanser ;, c1998..ISBN: 3446195718
Pearson, J. R. A., Mechanics of polymer processing / J.R.A. Pearson., Elsevier Applied Science,, c1985..ISBN: 085334308X
Birley, Arthur W., Haworth, Barry., Batchelor, Jim., Physics of plastics : processing, properties, and materials engineering / Arthur W. Birley, Barry Haworth, Jim Batchelor., Hanser Publishers,, 1991.ISBN: 9780195209181

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

Available to visiting and exchange students.

The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment. Late assignments will not be marked.

EG-M122 Group Project (Mechanical & Materials)

Credits: 30 Session: 2023/24 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof DT Gethin

Format: At least 6 meetings per session with academic and industrial supervisors.
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. After a team and project allocation there will be an initial discussion with the academic and/or industrial supervisors. Students will be in direct contact with the supervisors as appropriate. Thereafter, regular group meetings will be arranged typically biweekly during the term time. The project progression will be made in accordance with the project requirements and guideline. Details on the project requirements for students (i.e. deliverables with respective submission deadline) will be announced by the module coordinator at the project briefing session and/or via Canvas.

Module Aims: This module enables students to participate in a group activity involving a multi-disciplinary approach to achieve a solution to a specific engineering problem. In most instances it will involve either direct interaction with industry or will be an industrially-related project. Beyond providing a technical solution, the project will also include the development of a business plan proposal

Module Content: Formulating a full design specification that meets all the likely requirements throughout the working life of the 'product' or 'system'. Consideration of aspects such as: material selection, failure and risk, safety and environmental impact, sustainability, health and safety, maintenance and serviceability, also fitness for purpose and cost implications. Production of a construction/manufacturing/assembly/integration/testing strategy. Consideration of Economic Considerations and Business Plan.

Intended Learning Outcomes:
Technical Outcomes
On successful completion of this module students will be expected, at threshold level, to be able to:
- Demonstrate a comprehensive knowledge and understanding of the integral 'total design' process (i.e. understanding and evaluating business, customer and user needs) and project management skills in relation to decision-making and business development in a typical group environment.
- Critically evaluate the design problems and understand how to apply a range of mathematical and statistical methods, tools and notations proficiently and lead to the solution of engineering design problems.
- Demonstrate self-direction and originality in tackling and solving problems, use of computational models relevant to the engineering discipline and an appreciation of their limitations, and act autonomously in planning and implementing tasks at a professional or equivalent level.
- Identify, classify and describe the performance of systems, subsystems and components through the use of engineering principles, analytical methods and modelling techniques.
- Identify any constraints such as environmental and sustainability limitations, health and safety, security and risk issues, legal, intellectual property, codes of practice and standards wherever relevant and applicable.
- Have awareness of developing technologies related to the fields of mechanical/materials engineering in particular and thereby generating an innovative design for products, systems, components or processes to fulfill new needs (i.e. the design to be verified against the specification and validated against the customer requirement, if any).
- Apply advanced problem-solving skills, technical knowledge relevant to the engineering discipline 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.
- Deal with complex issues both systematically and creatively, use fundamental knowledge to investigate new and emerging technologies, make sound engineering judgement in the absence of complete data, and communicate their conclusions clearly.
Plan for effective project implementation. This includes an ability to:
- Plan and manage the design process, including change control (project plan and conceptual phases to preliminary and detail design phases);
- Identify the factors affecting the project implementation (e.g. commercial, economic and social context of engineering processes and their industrial constraints, current practice and its limitations, technical uncertainty, etc.);
- Understand the key drivers for achieving business success (e.g. competitive advantage, innovation, commercial risks and customer satisfaction, etc.).
Plan, organise, delegate, monitor-control tasks, people and resources to deliver a project. This includes an ability to:
- Apply skills in problem solving, communication, working with peers, information gathering and management, and the effective use of computing and laboratory facilities;
- Plan self-learning and make necessary adjustment to improve performance through monitor-control cycle on an on-going basis;
- Organise and lead work teams, coordinating project activities (understanding of different roles within a project team and take initiative and personal responsibility).

Accreditation Outcomes (AHEP)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- 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)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- 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)
- 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 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)
- 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)
- Plan and manage the design process, including cost drivers, and evaluate outcomes (D5)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- 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)
- Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction (EL7m)
- 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)
- Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader (P11m)
- 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)
- Monitor and adjust a personal programme of work on an on-going basis (G3m)
- Exercise initiative and personal responsibility, which may be as a team member or leader (G4)
- Design solutions for complex problems that evidence some originality and meet a combination of societal, user, business and customer needs as appropriate. This will involve consideration of applicable health & safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards (M5)

MSc
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations (EA6m)
- Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods (EA7m)
- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D10m)
- Awareness of the need for a high level of professional and ethical conduct in engineering (EL8m)
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9m)
- Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of the particular specialisation (EL10m)
- 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 (EL13m)
- Ability to apply engineering techniques taking account of a range of commercial and industrial constraints (P10m)
- Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader (P11m)
- 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)
- Monitor and adjust a personal programme of work on an on-going basis (G3m)
- Exercise initiative and personal responsibility, which may be as a team member or leader (G4)

Assessment: Group Work - Project (100%)

Assessment Description: Assessment will be 60% for the group and 40% for the individual's contribution to the group. In assessing the project, considerable importance will be placed on the following aspects:
• Final design specification;
• Technical engineering analysis (hand calculations, numerical and computational analysis, 3D modelling and simulation, prototyping and testing. Also, where relevant it may include Material selection, manufacturing and manufacturing techniques.
• Cost analysis;
• Sociological impact on the environment, sustainability, etc.
• Business plan.

The group mark will be based on the written report, together with the assessment of a poster display that each group will be required to produce, and will be scaled by using peer review assessment.

The individual mark will be based on the assessment of three aspects:
• The individual project management and progress report;
• The individual contribution to the final report;
• The oral interview.

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

Assessment Feedback: Feedback will be given by supervisors as regular part of meetings with students. Formal verbal/written feedback will be provided on the assessed parts of the project.

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.

Reading List: Childs, Peter R. N., author., Mechanical Design Engineering Handbook, Butterworth-Heinemann, 2019.ISBN: 0081023685
Ashby, M. F., Materials selection in mechanical design, Butterworth-Heinemann, 2011.ISBN: 9781856176637
Automotive Industry Action Group., Verband der Automobilindustrie., The FMEA handbook : failure mode and effects analysis, Automotive Industry Action Group, 2019.ISBN: 9781605343679

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.

NOT AVAILABLE to visiting and exchange students.

EG-M190 Social, environmental and economic context of research

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr SA Rolland, Prof JC Arnold

Format: 30 formal contact hours
10 x 1 hour lectures
10 x 2 hour interactive workshops

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

Lecture and workshops

Module Aims: There is an increasing need for engineers to work towards complex, so called 'wicked problems', for example the secure supply of energy. This necessitates a holistic approach and involves making decisions based on a range of different factors, and consideration for economic, ethical, social, political and environmental, as well as technical limitations.

Obtaining and making sense of such information involves types of knowledge and the use of tools and techniques that have not always been traditionally used within engineering disciplines. For example, ethical issues concerning negative impacts on environment or society may raise questions of value, duty or morality and requires the application of moral reasoning rather than scientific reasoning.

During this module we will make use of a variety of engineering case studies which exemplify the need to consider non-technical aspects of engineering projects. We will use qualitative research approaches and ethical frameworks to help in our engineering decision making. We will also consider the role of the engineer in policy making.

Module Content: Different types of knowledge and research approaches used to obtain different types of knowledge and information
The use of moral reasoning and ethical frameworks
Policy process and the role of the engineer in informing policy

Intended Learning Outcomes: Technical Outcomes
By the end of this module students should be able to:
Knowledge of the stages of a research project and how to select appropriate research methods.

Accreditation Outcomes (AHEP)
Awareness of the need for a high level of professional and ethical conduct in engineering (EL8M / ET1fl)
Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9M/ ET2fl)
Awareness that engineering activities should promote sustainable development (EL11M / ET4fl)

Assessment: Coursework 1 (60%)
Coursework 2 (40%)
Participation Exercise (0%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Assessment One: Selection of a contemporary engineering topic/project. Outline of the role of different types of knowledge and information needed to inform project. Ethical, economic, social and environmental evaluations of the engineering issues involved.
Assessment Two: A policy brief (choice of contemporary engineering topic)

PASS/FAIL COMPONENT Minimum attendance and contribution to workshop sessions
Note, that this module cannot be passed if this pass/fail element is not passed. If you do not meet the requirements of the Pass/Fail component, 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: Formative and peer feedback will be given in group/workshop sessions Feedback during Q&As in lecture and example classes. Lecturer available for ad-hoc feedback during office hours. Written feedback on all coursework submitted
Failure Redemption: Students will be provided with the opportunity to resubmit failed components. If engagement in group project activities is below required level, no supplementary will be possible and module will have to be resat in the following year.
Reading List: Singh, Pooja ; Singh, Lalit Kumar, Instrumentation and control systems design for nuclear power plant: An interview study with industry practitioners, Elsevier B.V, 2021-11.ISBN: 17385733 Szopiska-Mularz, Monika, Adaptive reuse of modern movement car parking structures for controlled environment agriculture: Results from an interview study for the innovative design process in cities, 2021.ISBN: 18779166 Zhu, Runhe ; Lucas, Gale M ; Becerik-Gerber, Burcin ; Southers, Erroll G, Building preparedness in response to active shooter incidents: Results of focus group interviews, Elsevier Ltd, 2020-09.ISBN: 22124209 Kim, Ji-Eun ; Kessler, Larry ; McCauley, Zach ; Niiyama, Itsumi ; Boyle, Linda Ng, Human factors considerations in designing a personalized mobile dialysis device: An interview study, Elsevier Ltd, 2020-05.ISBN: 00036870
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. .

EG-M37 Additive Manufacturing

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules: EG-M103

Lecturer(s): Prof NPN Lavery, Mr D Butcher

Format: 10x2hr lectures/seminars/example classes
10x2hr practical demonstrations
8x1hr office 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 - There will be 10 x 1hr lectures over the full semester, 5 x 1hr seminars, which will include 2-3 revision classes. - There will be 2 x 1hr invited guest lectures with speakers from industry working in additive manufacturing and the production of metal powders. - A group project (40%) - Each week there will be a 2hr practical laboratory where which students will undertake studies on AM components as set per their projects. At the end of the assignment, students will give a short presentation (5%), and upload their CAD files (5%). A short report (30%) will be required on their practical assignment which will be due at the end of the term. - There will be 5 Canvas tests (10%) based on online video learning, which will be done every other week throughout term. - The remaining 50% weighting will be assessed by examination. - There will be 10x1hr office hours.

Module Aims: 1.1 Introduction to Additive Manufacturing
1.3 Additive Manufacturing Processes
1.3 Applications of Additive Manufacturing
1.4 Mechanics of the Powder Bed System
1.5 Physics of Additive Manufacturing
1.6 AM Defects and Process Control
1.7 Measurement and analysis of AM properties
1.8 Computer Aided Engineering of AM Parts
1.9 Powder Metals
1.10 Design for AM and part preparation

Module Content: Chapter 1 – Module overview (1 lecture)

Chapter 2 – Additive Manufacturing Processes (1 lecture)
This chapter gives a refresher of manufacturing processes, and places additive manufacturing processes in the general context of manufacturing. In this chapter you will also revise how to perform techno-economic calculations on manufacturing processes which later on will help you decide which production route is most suitable for a given component. The second part of this chapter gives a bit of recent history, describing the evolution of additive manufacturing from its origins in rapid prototyping. The final section of this chapter gives a top-down approach to the classification of different additive manufacturing technologies, and a machine-by-machine description of commercially available systems. It will be reiterated that due to the rapidly changing nature of AM, only a small number of case-studies are included in these notes, and that more complete and up-to-date case-studies will be given in the lecture presentations.

Chapter 3 – Additive Manufacturing Applications (1 lecture)
This chapter describes applications via a series of case studies. Only a number of case studies are included in these notes, and that more complete and up-to-date case studies will be given in the lectures. We introduce the concept of a TRL level to be able to differentiate between the readiness of additive manufacturing technologies with respect to more mainstream (traditional) processes. Finally, some case studies will be shown for various sectors.

Chapter 4 – Mechanics of Additive manufacturing (1-2 lectures)
This chapter comes in two parts. In the first part you will get a practical overview of a specific powder bed system, with a breakdown of each of the different parts of the machine much the same way as you would in an operator training course. Hopefully this will be accompanied by a visit to the ALM laboratory as seeing the machine in action is a much better way to learn about it. In the second part of this chapter we will go into more details about the specific interaction of the laser and the powder, and the consolidation process leading to process maps for specific process control parameters such as exposure time, point distance and hatch spacing.

Chapter 5 – Physics of Additive Manufacturing (1-2 lectures)
In this chapter we will go into more depth into the physics of additive manufacturing processes, specifically processes which use a laser as a heating source. Some aspects are specific to metal powder-bed based systems, but others could equally be applicable to extrusion plastic systems, wire extrusion or electron beam systems, basically anything that requires a thermal heat source for the material consolidation. The chapter builds a fundamental knowledge which will lead to a better understanding of some of the root causes of defects and best material properties available from AM.

Chapter 6 – AM Defects and Process Control (1-2 lectures)
In this chapter we introduce some of the common defects which are associated with parts made by Additive Manufacturing. We will go into more details about the specific interaction of the laser and the powder, and the consolidation process leading to process maps for specific process control parameters such as exposure time, point distance and hatch spacing. These are related to AM defects. Additionally, we introduce Taguchi or ANOVA (Analysis of variances) in the context of AM process parameters, as a means of optimising the machine settings.

Chapter 7 – Measurement and analysis of AM material properties (2 lectures)
This chapter gives an overview of material properties and measurement techniques used for parts/materials made by AM. The content is mainly used to emphasise some of the sections in previous chapters where the material properties have already been introduced. There will be no worked examples for this chapter as the content is embedded within examples introduced in the other sections.

Chapter 8 – Computer Aided Engineering of AM parts (1 lecture)
This chapter gives an overview of the many ways in which Computer Aided Engineering can be applied to Additive Manufacturing. Modelling is playing an increasingly important role in AM. Currently most efforts continue to go towards the understanding of the process, at multiple different length scales. However, the digital nature of AM will mean that at some point in the future there will be a convergence of the modelling to enable a full virtual design of the component prior to the build.

Chapter 9 – Powder Metals (1-2 lectures)

In this chapter, you will learn how powders are characterised using Powder Size Distributions, Morphology and Physical properties (tap density, apparent density …). You will learn about the various metal powder production routes from both a primary and secondary feedstock, including Physical/gas atomisation processes which are the main route for AM powder production. Of these, gas or plasma atomisation can produce powders which are ideal for AM processes, due to tight powder size distributions, low impurities and a good (rounded) morphology which can be repeated from batch to batch, leading to more reliable mechanical properties in AM parts.

Chapter 10 – Design for AM and component preparation (1-2 lectures)
This chapter will cover some of the design and part preparation procedures associated with powder bed fusion systems. General design rules arise due to the digital fabrication nature of AM, and these have consequences on the mechanical properties of the build. These are discussed and put in the more general context of efforts to standardise AM processes and materials. The combination of design constraints and material properties have to be considered when selecting the appropriate AM process, but this is by no means straight forward or definitive at the current time. This work will link directly into the practical project.

Practical Project (C1 Group project worth 40% of module)
The learning objectives of the practical on this module is to maximise your knowledge of AM by exposing you to the practical nature of 3D metal printing. Specifically developing your knowledge of products designed specifically for AM looks to bring out the creative side of your engineering skills guided by knowledge of the process limitations of 3D printing.

The assignment, worth 40% (C1-1 30% report + C1-2 5% presentation + C1-3 5%CAD) of this 10-credit module, is comprised of a report which should not be more than 10 pages (excluding appendices but including 4-5 references). The report can be written together as a group, but there needs to be a clear indication of the contribution of each individual student, and this is weighted at 30%.

To maintain the creative nature of the assignment the overall structure of the report is left free to be determined by the group, except for two sections and the appendices. Namely, the "Executive Summary" and the "Individual Contribution" which should be written in the individual student’s own words.

In the first week after the Easter Recess, on the Monday, each group must present a short 5 minute/3 slide presentation on their project and component. This will be judged but not marked and will provide feedback for the assignment report.
The assignment should be uploaded by each student to Turnitin on Canvas in PDF format by the deadline.

Intended Learning Outcomes:
Technical Outcomes
Upon completion of the module the students will:
LO1 learn the basic terminology and principles of AM technologies
LO2 learn general capabilities and limitations of AM with respect to other manufacturing technologies
LO3 learn classifications of metal-based AM technologies
LO4 be able to compare AM technologies and select for specific design/manufacturing applications
LO5 develop an in-depth understanding of specific metal-based laser powder-bed system
LO6 learn about design constraints, and the practicalities of setting-up builds and running AM machines
LO7 learn about the underlying physics of lasers, and thermal transfer of laser-powder interaction
LO8 learn how process maps are developed for specific materials and AM machines
LO9 learn how to select optimal machine parameters from process maps
LO10 understand the causes of errors and failures in AM parts, how to identify and avoid them
LO11 learn to identify features of part design and material which will be problematic for AM, and suggest alternatives
LO12 learn how scientific methodologies such as Design of Experiments are used to optimise machine parameters
LO13 learn about important research challenges in AM such CAE of melt pool/residual stress modelling
LO14 learn how to evaluate and select best build orientations and prepare a build report
LO15 plan, produce and evaluate a novel 3D metal printed component specifically designed for AM

Accreditation Outcomes (AHEP)

MEng:
- 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)
- Awareness of developing technologies related to own specialisation (SM4m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Ability to apply relevant practical and laboratory skills (P3)

MSc:
A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Monitor and adjust a personal programme of work on an on-going basis (G3)

Assessment:	Examination 1 (50%) Coursework 1 (40%) Coursework 2 (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: 2 hr examination where students attempt 3 out of 4 questions (50%).

A practical done in a group worth 40% of the module, but which is graded individually per student.

5 Canvas tests each worth 2% throughout term (10%).

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

Assessment Feedback: Coursework 1 (C1) - A practical done in a group worth 40% of the module, but which is graded individually per student. The learning objectives of the practical on this module is to maximise your knowledge of AM by exposing you to the practical nature of 3D metal printing. Specifically developing your knowledge of products designed specifically for AM looks to bring out the creative side of your engineering skills guided by knowledge of the process limitations of 3D printing. The assignment is comprised of a report which should not be more than 10 pages (excluding appendices but including 4-5 references). The report can be written together as a group, but there needs to be a clear indication of the contribution of each individual student, and this is weighted at 30%. To maintain the creative nature of the assignment the overall structure of the report is left free to be determined by the group, except for two sections and the appendices. Namely, the "Executive Summary" and the "Individual Contribution" which should be written in the individual students own words. In the first week after the Easter Recess on the Monday each group must present a short 5 minute/3 slide presentations on their project (5%) and the actual CAD of the component (5%). This will be judged and provide feedback for the assignment report. The assignment should be uploaded by each student to Turnitin on Canvas in PDF format by the deadline.

During lectures the students will go through example questions. Standard examination feedback form is available for students after the exam.

Coursework 2 (C2) - worth a total of 10% will be made up of 5 Canvas tests (2% each) done at intervals throughout term. The tests will be a combination of multiple choice and calculated questions with automated feedback on Canvas. Students will have up to 5 attempts to get the highest scores.

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

Reading List: Horne, Richard, author., Hausman, Kalani Kirk, author., 3d printing for Dummies, John Wiley & Sons, Inc., 2017 - 2017.ISBN: 1119386322
Linkan Bian editor.; Nima Shamsaei editor.; John M. Usher editor., Laser-based additive manufacturing of metal parts : modeling, optimization, and control of mechanical properties / edited by Linkan Bian, Nima Shamsaei, John M. Usher., Boca Raton, Florida : CRC Press is an imprint of the Taylor & Francis Group, an Informa business, 2018.ISBN: 1498739997
Gibson, I. (Ian) author., Rosen, D. W. (David W.), author.; Stucker, B. (Brent), author.; Khorasani, Mahyar, author., Additive manufacturing technologies., Springer, 2021.ISBN: 9783030561277
Gibson, Ian.; Rosen, David; Stucker, B. (Brent), Additive manufacturing technologies : 3D printing, rapid prototyping, and direct digital manufacturing, Springer Verlag, 2016.ISBN: 9781493944552
Lipson, HodKurman, Melba, ebrary, Inc, Fabricated the new world of 3D printing, John Wiley and Sons, 2013.ISBN: 1118350634
Bhaskar Dutta author., Sudarsanam Babu author.; Bradley Jared author., Science, technology and applications of metals in additive manufacturing / Bhaskar Dutta, Sudarsanam Babu, Bradley Jared., Amsterdam : Elsevier, 2019.ISBN: 9780128166437
Bourell, David Lee, Campbell, R. I. (R. Ian), ebrary, Inc, Selected papers from the 14th Annual Solid Freeform Fabrication Symposium, University of Texas, Austin, Texas, 4-6 August 2003, Emerald Group Pub., 2004.ISBN: 0861769171
Smit, Lotte J, Dijk, Julia H. Van, ebrary, Inc, Powder metallurgy research trends, Nova Science Publishers, 2009.ISBN: 1604568526
Hilton, Peter D., editor.; Jacobs, Paul F. (Paul Francis), editor., Rapid tooling : technologies and industrial applications, Marcel Dekker, Inc., 2000.ISBN: 0824787889
Lombard, Mattebrary, Inc, SolidWorks 2013 bible, Wiley, 2013.ISBN: 1118508408

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-M47 Business Leadership for Engineers

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s):

Format: Lectures/Workshops - 22 hours
Open door tutorials/workshops - 8 hours
Directed private study 70 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

Combination of interactive lectures/workshops/case studies and self-study.

Module Aims: At the end of this course students will be able to recognise and understand key characteristics of leadership as well as a wide range of strategic business skills, ideas and theories with emphasis on innovation and “entrepreneurial thinking” which is essential for the current multidisciplinary engineering environment. The course delivery integrates practical project work and academic rigour.

Module Content: Workshop 1 – Introduction & Leadership Part 1
Workshop 2 – Leadership Part 2
Workshop 3 – Team Formation, Development and Communication
Workshop 4 - Entrepreneurial Thinking
Workshop 5 – Change Management
Workshop 6 – Strategic Management
Workshop 7 – Innovation and Business Thinking, Group Assignment Part 1
Workshop 8 – Innovation and Business Thinking, Group Assignment Part 2
Workshop 9 – Group Assignment Workshop
Workshop 10 – Group Assignment Workshop

Intended Learning Outcomes:
Technical Outcomes
On successful completion of this module students will be expected, at threshold level, to be:
- Demonstrate an understanding of current leadership issues. Critically appraise theories and approaches to leadership and at the same time reflect on personal leadership aspects.
- Knowledge to assess the basic factors that must be considered for a business formation. Use of basic level strategy and innovation methods in order for an organisation to gain competitive advantage. Critically evaluate the rationale for utilising methods for idea generation/innovation.
- Have awareness of theoretical perspectives and approaches to change management in organisational environments. Synthesise the relationship between the external context of an organisation and its internal context and their impact on its strategic direction.
- Demonstrate and appraise, entrepreneurial way of working, team development and communication skills

Accreditation Outcomes (AHEP)

- 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)
- Demonstrate the ability to generate an innovative design for products, systems, components or processes to fulfil new needs (D8m)
- Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of the particular specialisation, (ET3fl)
- Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate, (ET4fl)
- 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)
- Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction. (ET7m)

Assessment:	Group Work - Coursework (80%) Online Class Test (10%) Online Class Test (10%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: Online Test 1 Assessment level marking - PGTM March 10%
Online Test 2 Assessment level marking - PGTM March 10%
Group Work Coursework Assessment level marking - PGTM April 80%

The group (5/6) assignment will require application of the "key skills" and innovation development tools to generate solutions for real-world scenarios – report (40 pages) and development of Business Canvas.

This module is assessed by a combination of group-based and individual assignments (quiz-1 and quiz-2). In the main exam, the marks students get in quiz -1 and quiz-2 will add to the marks the individual gets in the group assignment project. For the resit exam, the quiz-1 and quiz-2 marks will not add to the project.

Moderation approach to main assessment: Partial moderation

Assessment Feedback:
Continuous group feedback on "out-comes" of workshops, after submission of coursework 1 at request during open-tutorials.

Failure Redemption:
Exam resits according to University regulations.
100% coursework.

Reading List: Birley, Sue., Muzyka, Daniel F., Mastering enterprise : your single-source guide to becoming an entrepreneur / edited by Sue Birley, Daniel F. Muzyka., FT/Pitman,, 1997.ISBN: 0273630318
Simon. Bridge, Ken O'Neill (Producer), Understanding enterprise : entrepreneurship and small business / Simon Bridge and Ken O'Neill., Palgrave Macmillan, 2013.ISBN: 9780230308091

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

Related assignments are used to assess this module.

This module is assessed by a combination of group-based and individual assignments. In order for the individual assessment marks to count, you must achieve at least 40% in the group-based assignment. If you achieve less than 40% in the group-based assignment, then the module mark will be just the group-based assignment mark.

EG-M73 Composite Materials

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr FA Korkees

Format: 20 hrs Lectures
6 hrs Example classes/Tutorials
46 hrs Directed private study
30 hrs Preparation for assessment
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 will be delivered on-campus.
Assessment is via an in-person (on campus) Examination (75%), and Assignment (25%).

Module Aims: A detailed coverage of current polymer, metal and ceramic matrix composite systems for engineering applications focusing on their performance envelope, advantages and limitations.

The units will cover the following:
- The components and their attributes - an overview (reinforcements, matrices and interfaces),
- Properties of the matrix materials (Thermosets/thermoplastics, metals, ceramics, structure and mechanical behaviour),
- Properties of fibres and particles (Glass fibres, organic fibres, carbon fibres, ceramic particles and fibres; processing, structure, mechanical response),
- Composite manufacture (Piles, weaves, preforms, moulding pultrusion, filament winding, powder metallurgy, casting spraying),
- Mechanics of reinforcement (Rule of mixtures, anisotropy, laminate structures, stress- strain response),
- Basic stress analysis and failure mechanisms (Stress transfer and partitioning, multiple failure events, progression of fracture, toughness),
- Fatigue design considerations (Damage progression, reinforcement effects); Calculations.
- Environmental effect on / of composites and joining techniques

Module Content: A detailed coverage of current polymer, metal and ceramic matrix composite systems, focusing on their performance envelope, advantages and limitations.

The units will cover the following:
• The components and their attributes - an overview (reinforcements, matrices and interfaces), (3 hrs)
• Properties of the matrix materials (Thermosets/thermoplastics, metals, ceramics, structure & mechanical behaviour), (2 hrs)
• Properties of fibres and particles (Glass fibres, organic fibres, carbon fibres, ceramic particles and fibres; processing, structure, mechanical response), (2 hrs)
• Composite manufacture (Plies, weaves, preforms, moulding, pultrusion, filament winding, powder metallurgy, casting spraying), (2 hrs)
• Mechanics of reinforcement (Rule of mixtures, anisotropy, laminate structures, stress- strain response), (3 hrs)
• Basic stress analysis and failure mechanisms (Stress transfer and partitioning, multiple failure events, progression of fracture, toughness), (3 hrs)
• Fatigue design considerations (Damage progression, reinforcement effects); (3 hrs)
• Environmental effect on / of composites and joining techniques ; (2hrs)

Intended Learning Outcomes:
Technical Outcomes
Upon completion of the module the student will have:
- A detailed understanding and wide-ranging knowledge of the engineering usage of composite materials.
- Appreciation of the important inter-relationship between structure, processing and properties for advanced materials.
- The ability to undertake structural design calculations for composite materials.

Accreditation Outcomes (AHEP)
MEng
- A comprehensive knowledge and understanding of the 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)
- Awareness of developing technologies related to own specialisation (SM4m)
- Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems (EA4m)

MSc
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- 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 (SM9m)
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12m)
- 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%) Assignment 1 (25%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Assessment is via an Examination, worth 75% and Assignment 1 (25%) which is a 1500-word report. The quality of English does not form part of the assessment.

Important - To pass the module you must i. achieve a minimum of 40% for each component and ii. obtain 50% 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%. It is therefore important that you complete and submit each component.

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

Assessment Feedback: Standard examination feedback form available for all students after the examination.
Students will receive individual feedback comments for the assignment via Canvas.

Failure Redemption: Resit examination worth 100% in August.

Reading List: F. L. Matthews author., R. D Rawlings (Rees D.), author., Composite materials : engineering and science / F.L. Matthews and R.D. Rawlings., Cambridge, England : Woodhead Pub., 1999.ISBN: 0849306213
Scott, Murray L ; Baker, Alan A, Composite Materials for Aircraft Structures, Third Edition, American Institute of Aeronautics and Astronautics, Inc, 2016.ISBN: 162410326X
A. A Baker (Alan A.); Stuart Dutton; Donald Kelly (Donald W.), Composite materials for aircraft structures / [edited by] Alan Baker, Stuart Dutton, Donald Kelly., American Institute of Aeronautics and Astronautics, 2004.ISBN: 1563475405
Grove, Stephen, author., Composite materials and structures for engineering students, Stephen Grove, 2018 - 2018.ISBN: 9781983344800
Bafekrpour, Ehsan, author., Figueiredo, Ana R. P., contributor.; Silvestre, Armando J. D., contributor.; Vilela, Carla, contributor.; Santulli, Carlo, contributor.; Neto, Carlos Pascoal, contributor.; Freire, Carmen S. R., contributor.; Puglia, Debora, contributor.; Bafekrpour, Ehsan, contributor.; Sarasini, Fabrizio, contributor.; Jiang, Gaoming, contributor.; Xian, Guijun, contributor.; Böhrk, Hannah, contributor.; El-Dessouky, Hassan M., contributor.; Li, Hui, contributor.; Mei, Hui, contributor.; Jose, Josmin P., contributor.; Kenny, José M., contributor.; Zhao, Li, contributor.; Guan, Li-Zhi, contributor.; Zhen, Liang, contributor.; Tang, Long-Cheng, contributor.; Xie, Ning, contributor.; Ma, Pibo, contributor.; Fangueiro, Raul, contributor.; Pinto, Ricardo J. B., contributor.; Thomas, Sabu, contributor.; Park, Sang Yoon, contributor.; Heimbs, Sebastian, contributor.; Parveen, Shama, contributor.; Rana, Sohel, contributor.; Bergmann, Tim, contributor.; Shao, Wenzhu, contributor.; Choi, Won Jong, contributor.; Gao, Zhe, contributor., Advanced Composite Materials: Properties and Applications, De Gruyter Open Poland,, 2017.ISBN: 9783110574432

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

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.

EGIM16 Communication Skills for Research Engineers

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr SA Rolland, Dr T Lake

Format: Lectures (15h), Exercises (15h), Reading / Private Study (30h), Preparation for Assessment (40h)

Delivery Method: The module will be delivered on campus and partially online.

Module Aims: Communication at a research level differs from that at the undergraduate level in that it is usually driven by an output or result rather than the requirement to show knowledge or understanding. The skill of a good communicator at research level lies in efficiently and rigorously conveying the ideas behind the theory and proof of the research output. Verbal, written and visual communication will be explored through a series of lectures and formative exercises.

Module Content: Background to Communication:
• Academic misconduct and research publication ethics.
• Fundamentals of communication.
• Critical thinking in research.

Written Communication:
• The usual layout of reports, theses, journal & conference papers.
• How to write a good abstract for a research output.
• What should be in the introduction?
• Contents of the main body of a research output.
• Effective conclusions
• Writing style
• Cross-referencing, captions, references
• Critical review of self and others
• Design concepts for research posters

Oral Communication:
• The usual layout of a research presentation
• Slide design for a research presentation
• Delivery of a presentation
• Audience engagement.

Intended Learning Outcomes: Technical Outcomes:
By the end of this module the student will be able to:
• Write a paper or equivalent employing the structure and rigour required at research level (assessed by assignments 1 and 4)
• Efficiently communicate the concepts associated with complex ideas (assessed by the first written assignment and the oral presentation)
• Critically evaluate a written output (assessed within the second assessment component)
• Verbally present a complex idea using the presentation structure, slide content and delivery techniques expected of a research engineer (assessed through the oral presentation)

Accreditation Outcomes (AHEP)
- Awareness of the need for a high level of professional and ethical conduct in engineering (EL8M / ET1fl)
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9M / ET2fl)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9M / EP2fl)

Assessment: Assignment 1 (30%)
Oral Examination (50%)
Writing (20%)

Assessment Description: The first sit assessment will consist of 3 assignments.

The first assessment component will be a written piece, which will test the students' understanding of the literature-based research process, test their ability to articulate the findings, and draw relevant, well-supported conclusions. This is an individual piece of coursework. This assignment is a precursor to assignment 3 (article).

The oral examination will involve the students presenting the outcome of their chosen research topic (literature-based only, no original research requirement in the module), through an oral presentation. The target duration of the oral presentation will usually be between 8 to 10 minutes. The exact duration will be specified in the assignment descriptor. This is an individual piece of coursework.

The final, third, component will require the student to write a technical article or equivalent. This paper will be between four to five pages in length and will be written to a format described in the assignment descriptor. This is an individual piece of coursework.

The pass mark for a module at Level 4/M is 50%. In addition to this Students must achieve at least 40% in the Oral Examination AND 40% in the Writing assessment to pass the module.

The reassessment will consist of 2 assignments, detailed in a further section.

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

Assessment Feedback: CANVAS will be used to provide individual feedback to the students on all the components that contribute to the final mark. For the first assessment component a class feedback document is also generally included on CANVAS.

As part of the practical sessions the students will receive verbal feedback on their performance. These sessions do not contribute to the final mark.

Failure Redemption: Candidates shall be given one opportunity to redeem a failure in the module during the summer supplementary period.

In addition, the 40 % oral and written assignments of the first must be passed individually to pass the module, and will have to be redeemed even if a pass mark is achieved for the module overall on first sit. A pass mark on both main assessment components will be required to pass the module.

All components are redeemable individually in the event of failure across the module. Students may be required to take supplementary examination of examined components they have already passed if the combination of marks is such that the module may be failed.

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

All lectures and course material will be provided on CANVAS.

The pass mark for a module at Level 4/M is 50%. In addition to this Students must achieve at least 40% in the Oral Examination AND 40% in the Writing assessment to pass the module.

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

EGSM00 Structural Integrity of Aerospace Metals

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules: EGTM60

Lecturer(s): Prof C Pleydell-Pearce

Format: Lectures 20 hours
Examples classes 8 hours
Directed private study 36 hours
Preparation for examination 36 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

Lecture based.

Module Aims: This module aims to instill a detailed understanding of the mechanism of failure that can occur in service with aerospace metals, how they can be predicted through lifetime modelling, how they can be monitored and how they can be prevented by changes to material structure and processing. The module covers a wide range of content from fundamental deformation mechanisms at the atomic scale to the design and maintenance of large engineering structures.

Module Content:

Unit 1: The Application – Gas Turbine Technology – Thrust or Bust?
Unit 2: Material Deformation and Dislocation Theory
Unit 3: Failure modes in materials
Unit 4: Cracks and Fracture Mechanics
Unit 5: Fatigue
Unit 6: Fatigue lifing methods
Unit 7: Creep
Unit 8: Creep lifing methods
Unit 9: Mixed mode regimes – TMF – Creep-Fatigue interaction.
Unit 10: Forensic Characterisation of Failure

Intended Learning Outcomes: Technical Outcomes:
• To develop an in-depth understanding of the potential in-service failure modes with aerospace metals, including creep fatigue, stress-corrosion cracking, thermal oxidation and impact.
• To instill a good understanding of how the material structure can affect the occurence of failure.
• To instill a good understanding of how the processing of the material can affect the occurence of failure.
• To provide a working knowledge of how failure can be predicted through lifetime modelling, and how performance can be assessed with in-service monitoring.

Learning 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)
- Awareness of developing technologies related to own specialisation (SM4m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
-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)
- 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)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- 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 (EL6)
- Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction (EL7m)
- 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 appropriate codes of practice and industry standards (P6)
- Ability to work with technical uncertainty (P8)
- 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)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

MSc
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- 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 (D9)
- Awareness of the need for a high level of professional and ethical conduct in engineering (EL8m)
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9m)
- Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of the particular specialisation (EL10m)
- Awareness of relevant regulatory requirements governing engineering activities in the context of the particular specialisation (EL12m)
- 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 (EL13m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12m)
- Ability to apply engineering techniques taking account of a range of commercial and industrial constraints (P10m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

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

Assessment Description: A two-hour examination.

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

Assessment Feedback: There is no assessed work in this module, but during example classes students will be able to attempt and discuss past exam questions to prepare them for the final examination. Standard examination feedback form available for all students after the examination.

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

Reading List: Dieter, George Ellwood., Bacon, David., Mechanical metallurgy / George E. Dieter., McGraw-Hill,, c1988..ISBN: 0071004068

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.

EGTM60 Aerospace Materials Engineering

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof C Pleydell-Pearce

Format: Combination of interactive lectures and self study
18 hours formal contact
15 hours pre module preparation
37 hours post module directed study
30 hours preparation for assessment

Delivery Method: 2 hour examination and an assignment.

Module Aims: This module will relate the sources of stress and mechanical design requirements in aerospace power plant and structures to the development, optimisation and selection of high performance materials.
Principles of materials development: Material types and structure: metals, alloys, composites.
Mechanical behaviour of materials: Stress-strain response, deformation mechanisms, single and poly-crystals, failure modes.
Sources of stress in power plant: CF loading, direct stress, bend, pressure, thermal, complex, stress concentrations.
Optimising microstructure and properties: Solidification processing, heat-treatment: alloy strengthening.
Performance of specific material systems: Titanium alloys, nickel alloys, steels, metal matrix/ceramic matrix composites.
Materials selection: codes, specification, design requirements for creep, fatigue, static fracture and environmental resistance.
Advanced material developments: New materials and processes for the next millenium.

Module Content: The course focuses on key materials used in the aerospace industry including titanium alloys, nickel alloys and composites highlighting how their properties and processing relate to structural integrity requirements in engines and airframes. Specific themes include:
• Basic structural integrity requirements: sources of stress, material strength and ductility, toughness, fatigue, creep and environmental degradation.
• Principles of materials development and selection.
• Alloy types for each class of material (titanium, nickel).
• Optimising properties through processing methods, heat treatment schedules and microstructural evolution.
• Casting, forging and thermo mechanical processing.
• Solid solution strengthening, precipitation hardening, Tempering and texture (directional) strengthening.
• Advanced composite systems for airframes and engines: metal matrix, ceramic, mechanisms of reinforcement; specific design requirements and applications.
• New materials and processes for the next decade - their advantages and disadvantages.
• Case studies and in-service issues

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to demonstrate a knowledge and understanding of:
• Aerospace material types and their applications.
• Optimisation of materials for particular applications through composition, processing and heat treatment.
• Structural integrity requirements for selected components in engines and airframes.
• Strengthening mechanisms in materials.

Learning 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)
- Awareness of developing technologies related to own specialisation (SM4m)
- 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)
- Communicate their work to technical and non-technical audiences (D6)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction (EL7m)
- 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)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)

MSc
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- 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)
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9m)
- Awareness of relevant regulatory requirements governing engineering activities in the context of the particular specialisation (EL12m)
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader (P11m)

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

Assessment Description: Examination worth 80%
Assignment worth 20%. This is an individual piece of coursework.

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

Assessment Feedback: Written feedback on assignment. Examples classes.

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

Reading List: Roger C. Reed, The superalloys fundamentals and applications / Roger C. Reed., Cambridge University Press, 2006.ISBN: 1107167256
Meherwan P. Boyce, Gas turbine engineering handbook Meherwan P. Boyce., Elsevier, 2012.ISBN: 1283347814
I. J. Polmear, Light alloys : metallurgy of the light metals / I.J. Polmear., Edward Arnold, 1997.ISBN: 0340700297
F. C. Campbell (Flake C.), Manufacturing technology for aerospace structural materials / F.C. Campbell., Elsevier, 2006.ISBN: 9781856174954
G. Lütjering, J. Williams, Titanium.
Callister, William D., Jr., 1940- author., Rethwisch, David G., author., Materials science and engineering, Wiley, 2014.ISBN: 9781118319222

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

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

EGTM71 Power Generation Systems

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof I Masters

Format: Lectures and directed private study

Delivery Method: Seminar style lectures which include Q&A, informal discussion and class debate sessions. Assessment 100% Exam.

Module Aims: This module will provide a detailed introduction to the technology, politics and economics of power generation and its distribution, with an emphasis on the UK network. The main topics include power for transport applications and electricity generation. Case studies of traditional power plant (including coal, oil, gas, nuclear) will be followed by an assessment of current and future low carbon and sustainable technologies (wind, wave, tidal, solar, biomass).

Module Content: Definitions of energy, work and power; energy conversion.
Steam engines, internal combustion and diesel engines; aeroengine variants, low emissions vehicles.
Conventional power generation: Fundamentals and nuclear reactor types.
Hydroelectric, geothermal, wind, solar, biomass, wave, tidal and other energy sources.
UK energy policy.
Changing patterns of energy requirements in the UK and the world; climate change.

Intended Learning Outcomes:
Technical Outcomes
Upon completion of the module the student should be able to demonstrate:
- Comprehensive knowledge of existing power generation systems.
- Awareness of future energy requirements, constraints and emerging generation systems.
- Power generation systems for transport and electricity supply.
- An ability to (thinking skills): Evaluate alternative power systems in light of social, economical and environmental concerns.
- An ability to (key skills): Present a coherent (even personal) view of energy requirements, supply and use on regional, national and international scales.

Accreditation Outcomes (AHEP)
MEng:
- LO1 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)
- LO2 Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- LO3 Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)
- LO4 Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction (EL7m)

MSc:
- LO5 Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9M)
- LO6 Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate (EL11M)

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

Assessment Description: Formal Exam. 100%. All learning Outcomes. Questions based on course notes and the "Energy Plans" given in the textbook "Sustainable energy without the hot air".

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

Assessment Feedback: Standard Faculty exam feedback form.

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

Reading List: MacKay, David J. C., Sustainable energy--without the hot air / David J.C. MacKay., UIT,, 2009.ISBN: 9780954452933
Johnson, Kate; Dalton, Gordon; Masters, Ian, Building industries at sea : 'blue growth' and the new maritime economy / editors: Kate Johnson, Gordon Dalton, Ian Masters, 2017.ISBN: 8793609264

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.

AVAILABLE TO visiting and exchange students.

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%).

Reading List: Braungart, Michael, McDonough, William, Cradle to cradle : remaking the way we make things, Vintage, 2009.ISBN: 0099535475
Henrikke. Baumann, Anne-Marie Tillman, The hitch hiker's guide to LCA : an orientation in life cycle assessment methodology and application / Henrikke Baumann & Anne-Marie Tillman., Studentlitteratur, 2004.ISBN: 9789144023649
Ciambrone, David F., Environmental life cycle analysis / David F. Ciambrone., Lewis Publishers,, 1997.ISBN: 9781566702140
Frankl, Paolo., Rubik, Frieder., Life cycle assessment in industry and business : adoption patterns, applications and implications / Paolo Frankl, Frieder Rubik ; with contributions by Matteo Bartolomeo ... [et al.]., Springer,, c2000..ISBN: 3540664696
Webster, Ken, author., The circular economy : a wealth of flows, Ellen MacArthur Foundation Publishing, 2017.ISBN: 9780992778460

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.

EGTM88 Ceramics

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof DA Worsley

Format:
Lectures 20 hours
Tutorials / Example classes 10 hours
Directed private study 36 hours
Preparation for assessment 34 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. There will be face to face lectures which are recorded for online reference which will be supported by weekly release of both course notes and slides. Additional video material online will be accessible through hyperlinks on the slide packs. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Module Aims: This module provides a detailed coverage of the structure, properties and engineering use of advanced structural ceramics. It focusses on how control of the microstructure can lead to material improvements, especially in regard to toughness.

Module Content: • Basic ceramic types; typical properties, mechanical properties and dislocations.
• Preparation routes for ceramics; single crystals, polycrystalline ceramics, sintering methods.
• Toughness of ceramics; Griffith flaws, high-strength sintered ceramics.
• Silicate glasses; structure, properties, processing routes.
• Refractory materials; properties required, test methods, thermal shock and spalling.
• Glass ceramic materials; composite microstructure development by partial devitrification, control of microstructure by nucleation and growth, properties.
• Transformation toughened ceramics; Zirconia - Yttria ceramics, PSZ, toughening mechanisms and engineering applications
• Fibre and whisker reinforced ceramics; fabrication routes, toughening mechanisms and properties.
• High temperature ceramics; silicon nitride, silicon carbide, boron nitride, sialons, oxidation resistance.
• Comparison of ceramic materials and materials selection issues.
• Electroceramics; solid electrolytes, fuel cells, sensors, oxygen pumps.

Intended Learning Outcomes: After completing this module you should be able to demonstrate:
• A knowledge of the structure, properties, and engineering applications of a wide range of ceramic materials.
• A knowledge of the processing routes available for ceramic materials.
• How the microstructure of ceramics can be used to tailor the properties.
• How to relate the structure / property relationships seen with metals and polymers to ceramic materials.
• How to undertake materials selection and engineering design with ceramic materials.
• The application of fundamental materials science concepts to the engineering use of ceramic materials.

Accreditation Outcomes (AHEP)

MEng:
- 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. (SM1m)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes. (EA1m)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- Knowledge of characteristics of particular materials, equipment, processes or products (P2m)
- Understanding of the use of technical literature and other information source (P4m)

MSc:
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)

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

Assessment Description: There will be two class tests in an online format that will each be made up of short answer questions and a single examination in the summer period which will comprise of a choice of three from four questions which will have multiple sections to test specific areas of the course.

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

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

Failure Redemption: Resit - 100% supplementary examination.

Reading List: Anderson, J. C., Anderson, J. C., Leaver, K. D., Leevers, P., Rawlings, R. D., Materials science for engineers [print and electronic book] / J.C. Anderson ... [et al.]., Nelson Thornes,, 2003.ISBN: 9780748763658

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

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.

Reading List: Crawford, R. J., Plastics engineering [print and electronic book] / R.J. Crawford., Butterworth-Heinemann,, 1998.ISBN: 9780750637640
Birley, Arthur W., Haworth, Barry., Batchelor, Jim., Physics of plastics : processing, properties, and materials engineering / Arthur W. Birley, Barry Haworth, Jim Batchelor., Hanser Publishers,, 1991.ISBN: 0195207823
Powell, Peter C., Ingen Housz, A. J., Engineering with polymers / P. C. Powell, A. J. Ingen Housz., Chapman & Hall,, 1998.ISBN: 0412791706
Ward, I. M., Hadley, D. W., An introduction to the mechanical properties of solid polymers / I.M. Ward and D.W. Hadley., Wiley,, 1993.ISBN: 0471938742
McCrum, N. G., Buckley, C. P., Bucknall, C. B., Principles of polymer engineering / N.G. McCrum, C.P. Buckley and C.B. Bucknall., Oxford University Press,, 1997.ISBN: 9780198565260

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

EGTM92 Physical Metallurgy of Steels

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr E Sackett

Format: Lectures 2 hours per week
Example classes 1 hour per week
Office hours: 1 hour per week
Directed private study and preparation for assessment: 6 hours per week

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

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Module Aims: This module will provide you with comprehensive theoretical understanding of the uses of ferrous alloys which will be of critical value in the design and implementation of your research project and in the appreciation of value added products. It is also the case that you will have a greater awareness of the potential for multi-material design solutions.

Module Content: • Revision on Phase Transformations: The Iron-carbon phase diagram, Steels and Cast Irons, TTT and CCT diagrams.
• Study of equilibrium and non equilibrium Ferrous transformations: Pearlitic, Bainitic and Martensitic Transformations.
• Effect of alloy additions on steel properties: Martensitic quench, Hardenability issues.
• High Strength Low Alloy Steels, Interstitial Free Steels: Properties with particular emphasis on automotive applications.
• Tool Steels , creep resistant steels, High temperature oxidation resistant steels.
• Cast Irons
• Surface treatment and coating technology for steel products.
• Microstuctural characterisation Techniques for Steel Products.
• Applications of Cast Irons and Steels.

Intended Learning Outcomes: Technical Outcomes:
After completing this module you should be able to demonstrate:
• Advanced understanding of the metallurgical principles of ferrous alloys, their development and applications.
• Advanced knowledge of the design and development of novel ferrous alloys.
• Establish relationships between processing routes and microstructure to properties, facilitating prediction of engineering properties.
• Advanced materials selections with steels and cast irons.
• Promoting the ability of carrying out self-directed study, including communication skills and computing skills.

Accreditation Outcomes (AHEP)
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D10m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader (P11m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

Assessment:	Examination 1 (60%) Assignment 1 (10%) Group Work - Coursework (20%) Assignment 2 (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Coursework (MCQ) - 10%
Laboratory Report - 10%
Group Assessment - 20%
Examination - 60%

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

Assessment Feedback: Feedback will be provided via tutorial sessions (results released via personal tutors).
Data on Class exam performance and breakdown of marks will be provided through the Faculty of Science and Engineering Canvas Community page.

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

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.
Available to visiting and exchange students.
The Faculty of Science and Engineering has a ZERO TOLERANCE PENALTY policy for late submission of all coursework and continuous assessment.

Full course notes based on the Powerpoint presentation provided.