Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

STUDENT HANDBOOK

MSc MECHANICAL ENGINEERING (FHEQ LEVEL 7)

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

DISCLAIMER

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

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

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

The 22-23 academic year begins on 26 September 2022

Full term dates can be found here

DATES OF 22-23 TERMS

26 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

SEMESTER 1

26 September 2022 – 27 January 2023

SEMESTER 2

30 January 2023 – 09 June 2023

SUMMER

12 June 2023 – 22 September 2023

IMPORTANT

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

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

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

Welcome to the Faculty of Science and Engineering!

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

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

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

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

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

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

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

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
School of Aerospace, Civil, Electrical, General and Mechanical Engineering **Head of School: Professor Antonio Gil**	
School Education Lead	Professor Cris Arnold
Head of Mechanical Engineering	Dr Andrew Rees
Mechanical Engineering Programme Director	Dr Eifion Jewell e.jewell@swansea.ac.uk
Mechanical Engineering Course Coordinator	Dr Alison Williams Alison.j.williams@swansea.ac.uk

STUDENT SUPPORT

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

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

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

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

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

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

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

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

READING LISTS

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

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

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

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

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

MSc (FHEQ Level 7) 2022/23
Mechanical Engineering MSc - January start
MSc Mechanical Engineering

Semester 1 Modules	Semester 2 Modules
EG-M103 Advanced Thermo Fluid Mechanics 10 Credits Prof D Deganello CORE	EG-M190 Social, environmental and economic context of research 10 Credits Prof JC Arnold/Dr N Wint CORE
EG-M106 Polymer Processing 10 Credits Dr A Rees CORE	EG-M36 Systems Monitoring, Control, Reliability, Survivability, Integrity and Maintenance 10 Credits Dr K Wada CORE
EG-M97 Advanced Solid Mechanics 10 Credits Dr C Wang CORE	EG-M37 Additive Manufacturing 10 Credits Prof NPN Lavery CORE
EGIM16 Communication Skills for Research Engineers 10 Credits Dr SA Rolland/Dr T Lake CORE	EG-M73 Composite Materials 10 Credits Dr FA Korkees CORE
EGTM71 Power Generation Systems 10 Credits Dr M Togneri CORE	EG-M83 Simulation Based Product Design 10 Credits Dr AJ Williams/Dr B Morgan CORE
EGTM79 Environmental Analysis and Legislation 10 Credits Prof GTM Bunting CORE	EG-M93 Metallurgy and Alloy Design 10 Credits Dr RS Ransing CORE
Dissertation	
EG-D03 MSc Dissertation - Mechanical Engineering 60 Credits Dr AJ Williams CORE	
Total 180 Credits	

EG-D03 MSc Dissertation - Mechanical Engineering

Credits: 60 Session: 2022/23 June-September

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AJ Williams

Format: Directed private study (including meetings with supervisors): 600 hours.

Each student is supervised in accordance with the University's Policy on Supervision, with a minimum of three meetings held. Typically a student will meet with their supervisor weekly (i.e. 10-15 hours total contact time). 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;
- 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 (SM9M)
- 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)
- Ability to generate an innovative design for products, systems, components or processes to fulfil new needs (D11M)
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12M)
- 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)
- Exercise initiative and personal responsibility, which may be as a team member or leader (G4)

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 Mechanical Engineering (without resits) - September 30th MSc Mechanical 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. The marking process for dissertation resubmissions is the same as for first submissions. The dissertation will be marked by the supervisor and the member of staff who marked the first submission, and sent to the External Examiner for moderation. The mark will be confirmed at an Internal Exam Board and ratified at the University Postgraduate Taught Examination Board. The resubmission will be capped at 50%.

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.

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:

- 31 August – deadline for Part Two students (non-resit students).
- 8 November – deadline for Part Two Students (students who had resits).

EG-M103 Advanced Thermo Fluid Mechanics

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof D Deganello

Format: 20 hours lectures, 10 hours tutorial/office hours

Delivery Method: • 20 hours of lectures
• 10 hours of tutorials/ office hours
• 70 hours of directed private study

Module Aims: This module advances thermal-fluid flow modelling from that studied at a previous level. Students are assumed to have an understanding of the flow of air and water, but this module advances knowledge into multiphase materials that may be Non-Newtonian and have temperature dependent properties. It also includes study of heat transfer, solidification and melting processes. The aim is to equip the student with the theoretical understanding to solve thermal and fluid flows problems and their application to real life situations. Examples will be drawn from oil and gas applications and processes such as casting of metals, moulding of polymers, printing of inks and melting of powders.

Module Content: This module advances thermal-fluid flow analysis and modelling. Students are assumed to have an understanding of the flow of air and water, but this module advances knowledge into multiphase materials that may be Non-Newtonian and have temperature dependent properties. It also includes study of heat transfer, solidification and melting processes. The module covers derivation of Navier Stokes for Newtonian, and Non Newtonian fluids; Viscous Non Newtonian models and Viscoelastic fluids; Pouissille flows for Newtonian & Non Newtonian; Flow in pipes: modelling of turbulence; Design of piping system for different fluids, pumps; Dispersions: flow of solid-liquid mixtures; Flow of multi-phase mixtures in pipes (oil,water, gas); Surface tension and its induced flows: Marangoni, thermo-capillary convection, dynamic and static contact angle. Heat Transfer: conduction/convection/radiation and vaporisation; Melting, solidification, latent heat, phase change; Natural convection, buoyancy and other temperature driven flows; Heat transfer in pipes and their design; thermal properties of fluids/mixtures; heat exchangers. Examples will be drawn from oil, gas and polymer flow applications and from processes such as casting of metals, moulding of polymers, printing of inks and melting of powders.

Intended Learning Outcomes:
Accreditation Outcomes (AHEP)
- 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)
- 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)
- Ability to extract and evaluate pertinent data and to apply engineering analysis techniques in the solution of unfamiliar problems (EA6m)
- 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)

MSc:
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- 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)

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

Assessment Description: Formal Exam. 100%. 2 hours. Examination questions will be open ended questions to assess the breadth and depth of understanding of the subject. Students will be asked to show the application of knowledge gained in the module.
Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit
Assessment Feedback: The College of Engineering uses a standard college exam feedback form posted on an intranet site.
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

EG-M106 Polymer Processing

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules: EG-M103

Lecturer(s): Dr A Rees

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.
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-M190 Social, environmental and economic context of research

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof JC Arnold, Dr N Wint

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

EG-M36 Systems Monitoring, Control, Reliability, Survivability, Integrity and Maintenance

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr K Wada

Format: 15 hours lecture;
10 hours group work;
2 hours revision session;
73 hours private study (reading, coursework, exam preparation)
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 be delivered using the Canvas Digital Learning Platform for live and self-directed online activity each week.

Series of lectures. Practical group work sessions (20%) will be arranged in order to promote and enhance problem-based learning within a group. Question & Answer, feedback and revision sessions will be arranged toward the end of the semester. Open book examination (80%) at the end of the semester.

Module Aims: The module will provide overview of the systems engineering aspects of monitoring, control, reliability, survivability, integrity and maintenance. Areas of interest to be studied will encompass an engineering application from mechanical, marine and aerospace. The important underlying systems engineering concepts on plan-do-check-act cycle, reliability in relation to quality engineering, design considerations on system survivability, integrity and maintenance will be highlighted and demonstrated with relevant examples. Of particular example will be looked at, including but not limited to, plant operation (hazard analysis, on-condition monitoring, majority voting system and high integrity protective system), marine and aerospace applications such as pump, propulsion subsystem and commercial satellite solar array subsystem (combination of series and parallel systems). Failure Modes and Effects Analysis and Load (stress) - Strength analysis will be introduced and the important links between type of failure, failure rate and safety margin will be quantified.

Module Content: • Systems Engineering
• Quality and Reliability Engineering
• Design, Durability and Integrity of Engineering Structures and Systems
• Design Considerations on Survivability (i.e. series, parallel, full active redundancy, standby, diversity systems)
• Load-Strength analysis, BDA, FTA, FMEA, FMECA, QFD, HAZOPS, Programme risk assessment
• Maintenance Management and Engineering, Availability, MDT, MTBF, MTTT, MTTR, MMT, MTBMA, MPMT, RCA, RCM
• Control of production variability
• Hazard analysis
• Condition Monitoring and Protective Systems
• Quality Management, PDCA, FRACAS, TQM

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 system engineering principles in the areas of Systems Monitoring, Control, Reliability, Survivability, Integrity and Maintenance. (Assessed by Coursework report and Exam; or Resit Exam)
- Critically evaluate the design problems and understand how to apply a range of mathematical and statistical methods, tools and notations related to quality and reliability engineering. (Assessed by Coursework report and Exam; or Resit Exam)
- Solve complex engineering problems in a form of individual and/or group tasks by an integrated or system engineering approach by means of quantitative, qualitative and computational methods, using alternative approaches to extract and evaluate pertinent given data and to apply quality and reliability engineering analysis techniques in the solution of familiar or unfamiliar problems, and appreciation of their limitations. (Assessed by Coursework report and/or Resit Exam)
- Demonstrate a comprehensive knowledge and understanding of engineering principles and the ability to apply them to undertake risk issues, including hazard, environmental and commercial risk, industry standards, and an ability to evaluate programme risk. (Assessed by Coursework report and Exam; or Resit Exam)

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)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems (EA4m)
- Ability to extract and evaluate pertinent data and to apply engineering analysis techniques in the solution of unfamiliar problems (EA6m)
- 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)
- 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)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- Knowledge and understanding of risk issues, including health and safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk (EL6m)

MSc:
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- 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)
- 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)

- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)
- Monitor and adjust a personal programme of work on an on-going basis (G3)

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

Assessment Description: Coursework 1 is a group workshop (design for reliability task sheet and total quality management related) allocated during the lecture series. Examination 1 is a standard Faculty of Science and Engineering examination.

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

Assessment Feedback: The Faculty of Science and Engineering uses a standard college exam feedback form posted on the Faculty of Science and Engineering Community page on Canvas.

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

Additional Notes: Delivery of both teaching and assessment will include live and self-directed activities online.

Available to visiting and exchange students wishing to learn quality and reliability engineering.
The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

Office hours, lectures notes and other teaching materials will be provided on Canvas.

EG-M37 Additive Manufacturing

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: EG-M103

Lecturer(s): Prof NPN Lavery

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 (30%) - 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 (20%) will be required on their practical assignment which will be due at the end of the term.
- There will be 5 Canvas tests (20%) 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 (Group project worth 20% 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 20% 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 20%.
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 (30%)
	Coursework 2 (20%)
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 30% of the module, but which is graded individually per student.

5 Canvas tests each worth 4% throughout term (20%).

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 30% 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 20%. 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 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 20% will be made up of 5 Cavas tests (4% 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.
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-M73 Composite Materials

Credits: 10 Session: 2022/23 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.

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.

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: 2022/23 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).
• Assignment 3: 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.

EG-M93 Metallurgy and Alloy Design

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr RS Ransing

Format: Lectures: 20 hours
Office Hour: 11 hours
Reading/private study 50 hours
Preparation for assessments 20 hours

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

Module Aims: The module will be presented with real life scenario of improving mechanical properties of a cast component by providing suggestions for optimising its alloy composition. The module will cover the necessary knowledge required to understand the metallurgical concepts and terminology used in peer-reviewed scientific papers so that students can not only review them but evaluate results and use the information to make informed decisions in the context of alloy design.

Module Content: Week 19: Introduction and Aims and Objectives
Week 20: The Hume-Rothery rules for Solid Solutions – Identical composition in lattice structures everywhere.
Week 21: The constitutional undercooling – Compositional changes in neighbouring lattice structures within one crystal structure or a grain.
Week 22: Microscopic and Macroscopic Segregation – Compositional changes in neighbouring lattice structures within and across crystal structures or grains.
Week 23: Defective lattice structures, dislocation motion and its relevance to mechanical properties.
Week 24: Composition and phase estimation from equilibrium binary and ternary phase diagrams
Week 25: Revision and 25% Continuous assessment: Submit a 1000-word essay on Canvas.
Week 26: Role of various chemical elements in the design of Ni based superalloys.
Week 27: How to review papers followed by a peer feedback session on an exam style question on alloy design.
Week 28: Individual feedback on the1000-word essay, exam preparation and continuation of the peer feedback session.

Intended Learning Outcomes:
Technical Outcomes –
An ability to explain metallurgical knowledge related to casting processes for ferrous/non-ferrous metals (assessed in 25% essay and 75% final examination).
An ability to interpret, review, rephrase and apply metallurgical knowledge spread in various external sources with a given objective and compile information to support arguments (assessed in 25% essay and 75% final examination).

Accreditation Outcomes and how they are achieved (AHEP4)

M1. Apply a comprehensive knowledge of engineering principles to the solution of complex problems. Much of the knowledge will be at the forefront of the particular subject of study and informed by a critical awareness of new developments and the wider context of engineering.
How it is achieved: Study comprehensive metallurgical knowledge and apply it to address a particular objective. With the knowledge gained the students are able to review and understand information reported in latest journal papers in the wider context of engineering.

M2. Formulate and analyse complex problems to reach substantiated conclusions. This will involve evaluating available data using first principles of mathematics, statistics, natural science and engineering principles, and using engineering judgment to work with information that may be uncertain or incomplete, discussing the limitations of the techniques employed
How it is achieved: Students use only one source of information – background literature to understand the role and compositional range of elements in a new alloy design. They extrapolate information from first principles but become aware that the information is uncertain or incomplete and recognise its limitations and learn opportunities for further work.

M4. Select and critically evaluate technical literature and other sources of information to solve complex problems
How it is achieved: Students learn how to critically evaluate new developments reported in the literature and are given individual feedback on their 1000-word review essay.

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

Assessment Description: Component 1: The 25% report is a 1000 word essay submitted on Canvas on a given topic.
Component 2: The final exam is a closed book written exam.

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

Assessment Feedback: Individual feedback will be given for the 1000 word essay on Canvas. Peer feedback is given on sample exam style questions in week 27 and 28.

Failure Redemption: An opportunity to redeem failures will be available within the rules of the University, if permitted the resit will be via 100% supplementary examination.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.
• PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION.
• AVAILABLE TO: visiting and exchange students.

EG-M97 Advanced Solid Mechanics

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-262

Co-requisite Modules:

Lecturer(s): Dr C Wang

Format: 20 hours lectures/practical FEA, 10 hours tutorial/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

20 hours of lectures/practical FEA
10 hours of tutorials/ office hours
70 hours of directed private study

Module Aims: This module covers material that is important to Engineers when working in an advanced design environment where non-linear effects such as large displacement, plasticity, creep, fatigue and bolted joint mechanics are to be considered.

Module Content: • Plasticity - post-yield stress-strain constitutive relations, development of the plastic zone, plastic bending and torsion, plastic buckling and collapse, residual stresses, spring back, low cycle fatigue
• Creep - stress-strain constitutive relations, Norton-Bailey and other creep laws, analysis of creep problems, stress redistribution, plasticity-creep interaction
• Large displacement analysis - curved beams, gross deformation
• Analysis of bolted and welded joints - bolt pre-tension, load distributions, strength and analysis of welded joints
• Codes of Practice - pressure vessels, corrosion and thermal effects, linearisation of point load stresses
• Non-linear finite element analysis - material behaviour models, incremental analysis, examples

Intended Learning Outcomes:
Technical Outcomes
- A knowledge and understanding of advanced theories associated with non-linear material and component behaviour; plasticity, creep and large displacements and how such behaviours are numerically modelled within a finite element code.
- An ability to apply these advanced theories to practical problems such as plastic bending and torsion, residual stresses and spring back, plastic buckling and low cycle fatigue.
- An ability to use finite element analysis for predicting the non-linear behaviour of components and structures and to interpret the predictions in a meaningful way.
- A knowledge and understanding of design codes of practice applied to such components as pressure vessels and piping structures.

Accreditation Outcomes (AHEP)
Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems (EA4m)
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)

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

Assessment Description: Written Exam 80%
Individual assignment based on a study of non-linear FEA 20%.

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

Assessment Feedback: Written feedback on the individual report.
The Faculty of Science and Engineering uses a standard College exam feedback form posted on an intranet site.

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

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

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

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

Not available to visiting and exchange students.

EGIM16 Communication Skills for Research Engineers

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

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

Format: Lectures (10h), Exercises (20h), 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, visual and group communication will be explored through a series of lectures and formative exercises.

Module Content:

Written Communication: [6 hours]
• 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: [6 hours]
• The usual layout of a research presentation
• Slide design for a research presentation
• Delivery of a presentation, do's and don'ts
• Maintaining the audience's interest.

Other topics: [3 hours]
• Attending & chairing meetings
• Conferences – submissions and attendance
• Submission of papers and peer review.

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)
• Demonstrate an awareness of the other modes of communication of ideas at a research level such as posters and group discussions (assessed in the second assessment component)

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 and ability to apply quantitative techniques where appropriate (EL11M / ET4fl)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9M / EP2fl)

Assessment:	Assignment 1 (10%) Assignment 2 (10%) Oral Examination (40%) Writing (40%)

Assessment Description:
The first sit assessment will consist of 4 assignments.

The first assessment component will be a short written piece, up to two pages long, which will test the students understanding of the concepts with respect to the written work and to allow feedback to the participants in the module prior to the final assessment. This is an individual piece of coursework.

The second component will feature a small number of tasks which are aimed to evaluate the students understanding of the other ideas, beyond the written word and oral presentations, which are covered in the module. This will include the critical review of a written output. Other possible tasks include group meetings and the creation of a poster. The coursework may be done individually or in groups, this will be confirmed at the time of setting the work.

The oral examination will involve the students presenting an example of the work they have undertaken in the past, typically a project, 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, fourth, component will require the student to write a paper 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, details of which are provided in a later 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.
All components are redeemable individually in the event of failure across the module.

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.

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.

EGTM71 Power Generation Systems

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr M Togneri

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 college exam feedback form.

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

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

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 Environmental Analysis and Legislation

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof GTM Bunting

Format: Lectures 25
Directed private study 35
Preparation of assignments 40

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

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

On Campus

Module Aims: This module presents the principles of life cycle analysis and 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 also reviews the current and planned European legislation that is of relevance to materials and energy and considers its implementation in the UK.

Module Content:
• The concepts of lifecycle analysis and Circular Economy.
• Principle of energy and resource conservation from 'cradle to grave' and ‘cradle to cradle.’
• 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 current environmental legislative framework, especially as it relates to energy and waste, including UN, EU and UK legislation.
• The effects of economic, social and political pressures on sustainable business activities.

Intended Learning Outcomes:
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 significant legislation relevant to circular economy/ sustainability and an understanding of legislation 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.

Accreditation Outcomes (AHEP)
MEng:
- Understanding of the need for a high level of professional and ethical conduct in engineering, a knowledge of professional codes of conduct and how ethical dilemmas can arise (EL1m)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2m)
- 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 requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)
- Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues, and an awareness that these may differ internationally (EL5m)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk (EL6m)
- Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction (EL7m)

MSc:
- 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 that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate (EL11M)
- 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)

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

Assessment Description:
Assignment 1 - a 2500 word report based around information gathering, review and collation.
Assignment 2 - a numerical analysis of an LCA Case Study, coupled with a written report on interpretation of the
findings.

Important information: The pass mark for a module at Level 4/M is 50%. In addition, in order to pass the module, students must achieve a minimum of 40% in both components.

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%.

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.