Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 4 (FHEQ LEVEL 7)

MECHANICAL ENGINEERING

DEGREE PROGRAMMES

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

DISCLAIMER

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

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

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

The 22-23 academic year begins on 26 September 2022

Full term dates can be found here

DATES OF 22-23 TERMS

26 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

SEMESTER 1

26 September 2022 – 27 January 2023

SEMESTER 2

30 January 2023 – 09 June 2023

SUMMER

12 June 2023 – 22 September 2023

IMPORTANT

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

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

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

Welcome to the Faculty of Science and Engineering!

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

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

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

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

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

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

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

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
School of 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
Year 4 Coordinator	Prof. David Gethin D.T.Gethin@Swansea.ac.uk

STUDENT SUPPORT

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

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

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

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

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

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

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

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

READING LISTS

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

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

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

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

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

Year 4 (FHEQ Level 7) 2022/23
Mechanical Engineering

MEng Mechanical Engineering[H304]
MEng Mechanical Engineering with a Year Abroad[H309]
MEng Mechanical Engineering with a Year in Industry[H306]

Coordinator: Prof DT Gethin

Semester 1 Modules	Semester 2 Modules
EG-M103 **Advanced Thermo Fluid Mechanics** **10 Credits** **Prof D Deganello** **CORE**	**EG-M36** **Systems Monitoring, Control, Reliability, Survivability, Integrity and Maintenance** **10 Credits** **Dr K Wada** **CORE**
EG-M106 **Polymer Processing** **10 Credits** **Dr A Rees** **CORE**	**EG-M37** **Additive Manufacturing** **10 Credits** **Prof NPN Lavery** **CORE**
EG-M85 **Strategic Project Planning** **10 Credits** **Dr K Wada** **CORE**	**EG-M47** **Business Leadership for Engineers** **10 Credits** **Dr A Munnangi/Dr AS Walters** **CORE**
EG-M97 **Advanced Solid Mechanics** **10 Credits** **Dr C Wang** **CORE**	**EG-M83** **Simulation Based Product Design** **10 Credits** **Dr AJ Williams/Mr B Morgan** **CORE**
	EG-M93 **Metallurgy and Alloy Design** **10 Credits** **Dr RS Ransing** **CORE**
EG-M122 **Group Project (Mechanical & Materials)** **30 Credits** **Prof DT Gethin** **CORE**	
Total 120 Credits	

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: Universal second marking 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: Universal second marking 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-M122 Group Project (Mechanical & Materials)

Credits: 30 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof DT Gethin

Format: Group allocation and team building at start of the project followed by practical sessions group and individual work, meetings with Industrialists as arranged. 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 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

Project briefing (module coordinator/academic supervisor(s)), group meetings, preparation of initial and final design (supervision and group work), report writing, poster and viva presentations and/or interview sessions.

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. Issues other than providing a purely technical solution to the problem will have to be considered in order to achieve a satisfactory outcome to the project.

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 wherever relevant to the project);
• Material selection;
• Cost analysis;
• Manufacturing techniques;
• 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

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.

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-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: Universal second marking 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: Universal second marking 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-M47 Business Leadership for Engineers

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr A Munnangi, Dr AS Walters

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 second marking

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.

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-M83 Simulation Based Product Design

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AJ Williams, Mr 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

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-M85 Strategic Project Planning

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr K Wada

Format: Lectures and Case Studies 13-15 hours; Project Monitoring 7 hours (project briefing, project update and presentations); Private Study 78-80 hours (reading, group work, 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 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

Series of lectures and combination of case study, project briefing/update and group work sessions.
Practical group work sessions (50%) will be arranged in order to grasp the project management techniques and effectively apply them to form a 'High Performance Team'. This coursework assessment (CA) is comprised of a group project and group presentation.
Examination - Closed Book (50%) at the end of the semester.

Module Aims: This module has been accredited by the professional body - the Association for Project Management (APM). At the end of this course students will be able to recognise and define the key characteristics and components of a project, understand the advantages/disadvantages associated with the management of both small and large projects, and have an appreciation of the strategic tools and techniques available to enable effective or efficient project management leading to a 'High Performance Team'. The acquired skills will be reinforced by the completion of a group project to produce an initial feasibility report (e.g. a business case/project management plan document) for a major regional project.

Module Content: 1) Lectures: series of lectures will be conducted and/or recorded to cover the fundamentals of strategy and project management. Various tools and techniques used by a project manager at large in the industry will be demonstrated with figures/diagrams/tables/videos and further elaborated through relevant examples.
Intended coverage of syllabus (as recommended by APM):
1. Structure of organisations and projects
2. Project life cycle
3. Project contexts and environments
4. Governance and structured methodologies
5. Communication
6. Leadership and teamwork
7. Planning for success
8. Scope management
9. Schedule and resource management
10. Procurement
11. Project risk management and issue management
12. Project quality management

2) Case study/Webinar: internal/external guest speaker(s) will be invited to give talks on some of the topics on project management, an hour session each.

3) Project briefing and update: information on CA (including but not limited to project titles, group allocation, project manager/assistant manager nominations, marking scheme, report format, and presentation arrangement) will be announced during these sessions. Frequently asked questions (FAQs) will be answered in the meantime.

4) Group work and Presentation: dedicated hours will be provided for the group work (i.e. dealing with CA task). No lectures during these sessions. With regard to CA, dedicated time slots will be arranged for the final presentation.

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 project management - the nature of both small and large projects, the issues and constraints such as environmental and sustainability limitations; ethical, legal, health, safety, security and risk issues; the tools available to manage the project - and critically evaluate them and apply the tools effectively in projects to communicate the outputs to technical and non-technical audiences. (Assessed by Coursework report, Presentation and Exam; or Resit Exam)
- Use fundamental knowledge to investigate new and emerging technologies via application of strategy such as PESTLE analysis, SWOT analysis and Porter's generic strategies as a means not only to understand the key drivers for business success pertaining to the commercial, economic and social context of engineering processes, but also to identify, compare and evaluate competitive advantage, cost leadership, differentiated product/services, or niche markets. (Assessed by Coursework report, Presentation and Exam; or Resit Exam)
- Have awareness of relevant legal and contractual issues, as well as quality issues and their application to continuous improvement (i.e. quality planning, quality assurance, quality control and continuous improvement). This requires the demonstration of knowledge, interpretation and application of project management theory and practice. (Assessed by Coursework report, Presentation and Exam; or Resit Exam)
- Demonstrate a comprehensive knowledge and understanding of the role of a project manager - an ability to exercise initiative and personal responsibility: i) understand the team members' characteristic and their needs; ii) delegate project activities and find ways to resolve conflicts through effective communication to build a 'High Performance Team'; and iii) understand and evaluate business, customer and user needs. (Assessed by Coursework report, Presentation and/or Resit Exam)

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)
- Communicate their work to technical and non-technical audiences (D6)
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (ET2fl)
- 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)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (EP2fl)
- Ability to apply engineering techniques, taking account of a range of commercial and industrial constraints (EP3fl)
- 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 (EP4fl)

Assessment: Examination 1 (50%)
Coursework 1 (50%)

Assessment Description: Coursework 1 is a group project allocated during the lecture series. Examination 1 is a standard closed book examination.

The pass mark for a module at Year 4/M is 50%. In addition to this, students must also achieve at least 40% in both components to pass this 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 repeat the failed component(s), even if your module mark is above 50%.

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

Assessment Feedback: Informal feedback is given during lectures, project briefing/update sessions, group presentations, and at group work meetings. Formal feedback is given via standard College of Engineering feedback protocols.

Failure Redemption: Failure Redemption of this module will be by repeating an equivalent coursework and/or exam to any component in which a pass mark was not achieved.

Marks achieved in assessment component passed during the first attempt will automatically be transferred to the equivalent component in the resit.

No opportunity to resit the passed component.

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

Penalty for late submission of work: ZERO TOLERANCE.
Available to visiting and exchange students wishing to enhance project management skills.

The pass mark for a module at Year 4/M is 50%. In addition to this, students must also achieve at least 40% in both components to pass this module.

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

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: Second marking as sampling or moderation

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: Universal second marking 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.