Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

MSc AEROSPACE ENGINEERING (JANUARY)

(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.

Please note that module descriptors for September-January modules might change later in the academic year.

The 22-23 academic year begins on 19 September 2022

Full term dates can be found here

DATES OF 22-23 TERMS

19 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

SEMESTER 1

19 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 have 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)	Dr Laura Roberts
School of Aerospace, Civil, Electrical, General and Mechanical Engineering **Head of School: Professor Antonio Gil**	
School Education Lead	Professor Cris Arnold
Head of Aerospace Engineering	Dr Ben Evans
Aerospace Engineering Programme Director	Dr Alexander Shaw A.D.Shaw@swansea.ac.uk
MSc Coordinator	Dr Yuying Xia yuying.xia@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
Aerospace Engineering MSc - January start
MSc Engineering (Aerospace)

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-M193 **Aerospace Group Project (MSc Jan Intake)** **10 Credits** **Dr H Madinei** **CORE**	**EG-M190** **Social, environmental and economic context of research** **10 Credits** **Prof JC Arnold/Dr N Wint** **CORE**
EG-M69 **Advanced Airframe Structures** **10 Credits** **Prof H Haddad Khodaparast** **CORE**	**EG-M73** **Composite Materials** **10 Credits** **Dr FA Korkees** **CORE**
EG-M81 **Flight Dynamics and Control** **10 Credits** **Dr H Madinei** **CORE**	**EG-M83** **Simulation Based Product Design** **10 Credits** **Dr AJ Williams/Dr B Morgan** **CORE**
EGIM02 **Advanced Computational Methods for Engineers** **10 Credits** **Dr F Zhao** **CORE**	**EG-M90** **Advanced Aerodynamics** **10 Credits** **Prof BJ Evans/Prof K Morgan** **CORE**
EGIM16 **Communication Skills for Research Engineers** **10 Credits** **Dr SA Rolland/Dr T Lake** **CORE**	**EGEM07** **Fluid-Structure Interaction** **10 Credits** **Prof WG Dettmer** **CORE**
	EGSM00 **Structural Integrity of Aerospace Metals** **10 Credits** **Prof C Pleydell-Pearce** **CORE**
Dissertation	
EG-D02 **MSc Dissertation - Aerospace Engineering** **60 Credits** **Dr Y Xia** **CORE**	
Total 180 Credits	

Optional Modules

Choose exactly 10 credits

Students who have taken EG-323 previously must choose EG-M23. Students without past FEA background knowledge are advised to take EGIM09. Students with other experience of FEA should discuss this module choice with the MSc coordinator.

EG-M23	Finite Element Computational Analysis	Prof R Sevilla	TB1	10 (CORE)
EGIM09	Finite Element Method	Dr W Harrison	TB1	10 (CORE)

EG-D02 MSc Dissertation - Aerospace Engineering

Credits: 60 Session: 2022/23 June-September

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr Y Xia

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

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

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

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

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

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

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

Accreditation Outcomes (AHEP)
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7M)
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8M)
- Understanding of concepts relevant to the discipline (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 by the deadline of 30th September. 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; and
• 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.

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

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

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

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

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

The 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-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-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-M90 Advanced Aerodynamics

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof BJ Evans, Prof K Morgan

Format: Lectures 22 hrs (delivered in person and/or via Zoom)

pre-recorded e-lectures uploaded to Canvas 11hrs

Drop-in / examples sessions 11 hrs

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

Blended learning lectures (lecture room and videos/e-lectures) and directed self-study including use of CFD flow visualisation software (EnSight). Demonstrator support (in person and online) will also be available to support students with the EnSight software used in the assignments.

Module Aims: This module is intended to extend the theory of EG-293 Aerodynamics & EG-335 Gas Dynamics and apply it in the context of aerodynamic design across a range of length scales, Reynolds and Mach numbers. A number of case studies will be used to explore the concepts of aerodynamic design ranging from subsonic civilian aircraft to aerodynamic design in nature and hypersonic space vehicles.

The course is split into four sections: subsonic, transonic, supersonic and hypersonic. By the end of the course students should have developed a good understanding of why aerospace vehicles operating in these different speed regimes with varying mission objectives look the way they do from an aerodynamic perspective.

Module Content: Aerodynamic design in Subsonic, Transonic, Supersonic & Hypersonic flows

- Characterisation of hypersonic flow
- Hypersonic shock & expansion-wave relations
- Inviscid & viscous hypersonic flow
- Viscous heating
- Shock/BL interaction
- High temperature gas dynamics
- Surge and stall
- Application of method of characteristics
- Ideal and real rocket engines
- Inviscid core and mixing layer
- Two-phase flow
- Nozzle effects
- Thrust control
- Intake duct design
- The Knudsen regime
- A molecular description of gas flows
- The Boltzmann equation and applications to micro- and nano- flows & rarefied flow fields
- Effects of viscosity and other diffusivities
- Boundary layer equations
- Exact solutions for laminar boundary layers
- Separation and transition
- Turbulent boundary layers
- Shock free aerofoils
- Shock wave-BL interaction
- Drag estimations
- Laminar flow aircraft
- Supercritical aerofoils
- Wing sweep theory & delta wings
- Buffet
- Transonic flight
- Flight of the bumblebee
- Dynamic stall
- Oscillating aerofoils
- Greener by design: noise and climate factors affecting the future of flight

Intended Learning Outcomes: Technical Outcomes
The student should be able to:
• Identify the different regimes within the Knudsen spectrum and applications where they are applicable (assessed via exam, SM1).
• Derive a range of aerodynamic governing equations (assessed via exam, SM2).
• Apply aerodynamic theory in the context of an aerospace vehicle design problem (assessed via exam, SM2).
• Evaluate the most suitable modelling approach when solving complex aerodynamic design problems (assessed via exam, SM5).
• Evaluate the appropriateness of design concepts for complex aerodynamic design problems from intuition (assessed via exam, SM1).
• Analyse a complex flow field using flow visualisation methods (assessed via assignment, EA3).

Accreditation Outcomes (AHEP)

MEng:
- A comprehensive knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1m)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and to implement appropriate action (EA3m)

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)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

Assessment:	Examination 1 (60%)
	Assignment 1 (3%)
	Assignment 2 (3%)
	Assignment 3 (4%)
	Assignment 4 (5%)
	Assignment 5 (25%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: 3 x short individual assignments (1,2,3) based on submission of short questions on material covered in the lectures (and lecture notes)

2 x individual assignments (4,5) submitted via Canvas requiring students to use a flow visualisation package (EnSight) to identify key features in a pre-computed flow field and evaluate their importance in terms of the aerodynamic characteristics of the vehicle in question e.g. shock waves, boundary layer separation, vortices.

Exam: 1 x closed book examination

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

Assessment Feedback:
Written (via Canvas) and oral feedback (via timetabled feedback discussion session) from formative assessment 1

Written feedback provided within 1 week for assignments 1,2 and 3

Written feedback (via Canvas) for assignment 4

Written feedback (via Canvas) for assignment 5

Verbal feedback in office hour slots

The standard engineering feedback form will be completed for the examination

Failure Redemption: Via supplementary exam

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; SUBMISSION ON EACH ASSIGNMENT MANDATORY.

EGEM07 Fluid-Structure Interaction

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof WG Dettmer

Format: Lectures and example classes: 30 hours

Directed private study and revision: 70 hours

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

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

This module is based on lectures and on-line example classes supported by additional on-line content.

Module Aims: The understanding and the computer simulation of fluid-structure interaction (FSI) is of increasing importance in
many areas of modern engineering including Civil, Aerospace and Mechanical Engineering. In this module, various phenomena, such as divergence, roll stability of floating bodies, vortex-induced vibrations, galloping and flutter, oscillating pipes and wind turbines, are studied and a number of basic numerical solution strategies are developed. In the context of high-fidelity finite element or finite volume based computational strategies, the module focuses on the challenges arising from the strong coupling between the fluid flow and the solid structure.

Module Content: FSI phenomena and instabilities:
• hydrostatic pressure, lift and drag forces, pitching moment,
• structural divergence,
• added mass,
• oscillating pipes,
• water hammer,
• roll stability of floating bodies,
• vortex-induced vibration, lock-in,
• galloping and flutter,
• wind turbines

Computational FSI:
• Blade Element Momentum theory for wind turbines,
• 1D finite element models for divergence and oscillating pipes,
• general concepts for spatial and temporal discretisation,
• Gauss-Seidel iteration, relaxation, convergence, Aitken acceleration,
• numerical added mass instability

Intended Learning Outcomes: Upon successful completion of this module, students will be expected, at threshold level, to be able to:
• assess the stability of different FSI systems (assessed in the assignment and in the exam, SM1, EA2),
• develop numerical solution methods for basic FSI problems (assessed in the assignment, EA1, EA2, EA3),
• assess the suitability of computational strategies for different FSI problem classes (assessed in the exam, EA4).

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

Assessment Description: Examination:
The examination forms 70% of the module mark.

Assignments 1, 2 and 3: Examples and Applications
These are individual pieces of coursework to be completed on-line. Each is worth 10% of the module mark.

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

Assessment Feedback: Examination:
A general pro-forma is completed, covering errors/issues that were identified during the marking process, and produced as formal examination feedback.

Assignments 1, 2 and 3:
General feedback on the assignment will be given in a lecture.
Individual feedback will be given in office hours.

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.

Lecture notes, Matlab code, examples, exercises, worked solutions and past examination papers will be available on Canvas.

EGSM00 Structural Integrity of Aerospace Metals

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: EGTM60

Lecturer(s): Prof C Pleydell-Pearce

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

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

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

Lecture based.

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

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

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

Learning Outcomes (AHEP)
- A comprehensive knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1m)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- Awareness of developing technologies related to own specialisation (SM4m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
-Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and to implement appropriate action (EA3m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Ability to extract and evaluate pertinent data and to apply engineering analysis techniques in the solution of unfamiliar problems (EA6m)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1)
- Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards (D2)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk (EL6)
- Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction (EL7m)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (P1)
- Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components (P2m)
- Understanding of appropriate codes of practice and industry standards (P6)
- Ability to work with technical uncertainty (P8)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Ability to apply engineering techniques taking account of a range of commercial and industrial constraints (P10m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

MSc
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Ability both to apply appropriate engineering analysis methods for solving complex problems in

engineering and to assess their limitations (EA6m)
- Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D9)
- Awareness of the need for a high level of professional and ethical conduct in engineering (EL8m)
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9m)
- Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of the particular specialisation (EL10m)
- Awareness of relevant regulatory requirements governing engineering activities in the context of the particular specialisation (EL12m)
- Awareness of and ability to make general evaluations of risk issues in the context of the particular specialisation, including health & safety, environmental and commercial risk (EL13m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12m)
- Ability to apply engineering techniques taking account of a range of commercial and industrial constraints (P10m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

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

Assessment Description: A two-hour examination.

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

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

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

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-M193 Aerospace Group Project (MSc Jan Intake)

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr H Madinei

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.

Delivery Method: 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 supervisors. Students will be in direct contact with the supervisors as appropriate. Thereafter, regular project meetings will be arranged typically monthly 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 Blackboard.

Module Aims: This module enables students to participate in a group activity involving an integrated holistic 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: On successful completion of this module students will be expected, at threshold level, to be able to:
Plan for effective project implementation. This includes an ability to:
- Equivalent to AHEP P9m, P10m: 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.

Plan, organise, delegate, monitor-control tasks, people and resources to deliver a project. This includes an ability to:
- Equivalent to AHEP G1: Apply skills in problem solving, communication, working with peers, information gathering and management, and the effective use of computing and laboratory facilities;
- Equivalent to AHEP G2, G3m: Plan self-learning and make necessary adjustment to improve performance through monitor-control cycle on an on-going basis; and
- Equivalent to AHEP P11m, G4: Organise and lead work teams, coordinating project activities (understanding of different roles within a project team and take initiative and personal responsibility).

Assessment: Group Work - Project (100%)

Assessment Description: -

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

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

The module related information will be posted on Canvas.

EG-M23 Finite Element Computational Analysis

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-323

Co-requisite Modules:

Lecturer(s): Prof R Sevilla

Format: Lectures 2h per week
Example Classes 1h per week
Directed private study 3h per week

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

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

The module is delivered by lectures and example classes.

A comprehensive set of notes and a list of exercises will be are available for download via Canvas before the start of the course.

Communication and course announcements, including office hours details, will be made via Canvas.

Course materials, including the course notes and links to relevant webpages, will be available for download from Canvas.

Module Aims: This module introduces the fundamentals of the Finite Element Method to enable the student to use it in the solution of a range of problems of engineering interest. The classes of engineering problems covered in this module include elastic analysis of structures, heat conduction problems, seepage flow through soils and ideal fluid flow. In this context, MATLAB sample programs will be provided to illustrate the structure of a finite element software capable of solving these classes of problems.

Module Content:
• Review of the Finite Element Method for 1D elasticity and steady-state heat transfer
• Isoparametric finite elements
• High-order finite elements
• Numerical integration. Gaussian quadratures
• 2D heat transfer
• Seepage flow
• Irrotational flow.
• Quadrilateral elements
• 2D high-order finite elements
• Mesh generation
• Error measures
• 2D elasticity (plane stress, plane strain and axisymmetric problems)
• 3D elasticity
• Transient heat transfer
• Dynamics

Intended Learning Outcomes: Upon completion of this module students should be able to:
• Use the weighted residual method to solve an engineering problem governed by partial differential equations.
• Convert a realistic elasticity, heat conduction, seepage flow and ideal fluid flow engineering problems into finite element models.
• Solve elasticity, heat transfer, seepage flow and ideal fluid flow problems by hand using the finite element method.
• Use a software to set up and produce finite element solutions of engineering problems.
• Analyse/assess the output of finite element simulations.

Accreditation Outcomes (AHEP)

MEng
SM1 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
SM2m Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems
SM3m 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
SM4m Awareness of developing technologies related to own specialisation
SM5m A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations
SM6m 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
EA1m Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes
EA2i Ability to apply quantitative methods in order to understand the performance of systems and components
EA3m Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and implement appropriate action
EA4 Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems
EA6m Ability to extract and evaluate pertinent data and to apply engineering analysis techniques in the solution of unfamiliar problems
P1 Understanding of contexts in which engineering knowledge can be applied (for example operations and management, application and development of technology, etc.)
P3 Ability to apply relevant practical and laboratory skills
P4 Understanding of the use of technical literature and other information sources
P9m A thorough understanding of current practice and its limitations, and some appreciation of likely new developments
P11m 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
G1 Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities
G2 Plan self-learning and improve performance, as the foundation for lifelong learning/CPD
G3m Monitor and adjust a personal programme of work on an on-going basis
G4 Exercise initiative and personal responsibility, which may be as a team member or leader

MSc
SM1m A comprehensive understanding of the relevant scientific principles of the specialisation.
SM2m A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation.
SM3m 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.
EA1m Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations
EA3m 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.
D1m 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
P2m A thorough understanding of current practice and its limitations, and some appreciation of likely new developments.
P4m 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.
G1 Ability to apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities
G2 Plan self-learning and improve performance, as the foundation for lifelong learning/CPD.
G3 Monitor and adjust a personal programme of work on an on-going basis.

Assessment: Examination 1 (60%)
Assignment 1 (40%)

Assessment Description: - Examination (60% of the module marks)
Standard university examination (open book).

- Assignment (40% of the module marks)
Group assignment where students are required to choose one of the following options:
1. Create a finite element model using commercial software to solve a realistic engineering problem in solid or fluid mechanics.
2. Modify an existing MATLAB program to solve an engineering problem using finite elements.

(*) Option 1 will require students to have access and to independently learn how to use the commercial software ANSYS.
To support this task, students will have access to
- online resources
- support from the Math and CAE Cafe offered by the College of Engineering.

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

Assessment Feedback:
Examination - Standard university exam feedback form.

Assignment - Comments on submitted work will be sent to the groups.

Failure Redemption: Exam re-sits according to University regulations. A supplementary exam will form 60% of the module marks, with remaining 40% coming from the previously submitted coursework element.

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 continual assessment assignment: No marks awarded for late submissions.

Available to visiting and exchange students.

This module requires a prior knowledge of:
1. Basic Finite Elements - more specifically, knowledge of the content of the module EG-323 is assumed.
2. Computer programming - more specifically, MATLAB programming language - at a fairly basic level.

EG-M69 Advanced Airframe Structures

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-120; EG-166; EG-260; EG-294; EG-360; EG-360; Or equivalent

Co-requisite Modules:

Lecturer(s): Prof H Haddad Khodaparast

Format: Lectures and example classes: 30 hours
3 hours/week, one hour example class (interactive) and 2*1 hours lecture

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 is lecture based with regular example classes and lab demonstration. In person and/or online delivery is envisaged.

Module Aims: Following a brief introduction to aircraft structures and structural components, the Advanced Aircraft Structures module covers advanced structural topics such as static aeroelasticity, buckling and dynamics aeroelasticity.

Module Content:

Introduction, History of Aircraft Structures
Materials for Airframes
Role and layout of structural members
Airworthiness
Introduction to loads (Basic concepts and dynamics)
Structural idealization
Stress analysis of aircraft components
Loads and aeroelasiticty- static
Buckling analysis of aircraft components
Loads and aeroelasiticty- dynamic

Intended Learning Outcomes: Technical Outcomes
On successful completion of this unit students will be expected, at threshold level, to be able to:
- Gain a knowledge of aerospace structures and the corresponding loading (Assessed through the examination)
- Understand the concept of static and dynamics loads and load paths on the airframe and the structural requirements of airworthiness and be able to calculate the loads (Assessed through the examination and assignment)
- Analyse stress and buckling of aircraft components (Assessed through the examination and assignment)
- Understand the concept of 3D aeroelasticity (Assessed through the examination and assignment)

Accreditation Outcomes (AHEP)

MEng
- A comprehensive knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1m)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- Awareness of developing technologies related to own specialisation (SM4m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5)
- Ability to extract and evaluate pertinent data and to apply engineering analysis techniques in the solution of unfamiliar problems (EA6m)

MSc
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations (EA6m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

Assessment: Examination 1 (50%)
Assignment 1 (30%)
Assignment 2 (20%)

Assessment Description: Assignment 1: 30%
Assignment 2: 20%
Final exam 50 %: Final exam includes two parts:
Part 1 20%: Multiple Choice Questions (single answer correct).
Part 2 30%: worked questions

All assignments should be completed via Canvas.
The resit examination is in the same format as the final exam and includes two parts:
Part 1 20 (*100/50): Multiple Choice Questions (single answer correct).
Part 2 30 (*100/50): worked questions

Part 1 of the final exam will be conducted in person and will be a closed-book test. Part 2 of the final exam, will be held online and will be open-book. These two parts of the exam will be scheduled at separate times.

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

Assessment Feedback: Written comments on assignments.
Standard University procedure for examination feedback.

Failure Redemption: A supplementary examination following the same style of the class test and the written exam will form 100% of the module mark.

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

Available to visiting and exchange students

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

EG-M81 Flight Dynamics and Control

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-243; EG-296; EG-399

Co-requisite Modules:

Lecturer(s): Dr H Madinei

Format: Lectures 30 hours
Directed private study 30 hours
Preparation for assessment 40 hours

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

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

On campus, classroom based teaching.

Module Aims: The course introduces the students to aircraft dynamics simulation and control by giving the necessary background about the flight dynamics, controller design and basic autopilot, and by using several commercial/educational/open source software/codes and the in-house flight simulator to provide practical experience.

Module Content:
The module covers the following topics:
• Review of Aerodynamics Fundamentals and Static Stability
• Equations of Motions and Axis System
• Aerodynamic and Thrust Forces and Moments, Linearization, Aerodynamic Stability Derivatives and Coefficients
• Aircraft Dynamics (Longitudinal Dynamics Approximation: short period, phugoid; Lateral/Directional Dynamics: Spiral, Roll, and Dutch Roll Modes)
• Overview of Classical Control Theory
• Basic Longitudinal Control
• State Space Control
• Aircraft Lateral Autopilots
• Aircraft Longitudinal Autopilots
• Simulation tools: Matlab, Aerospace toolbox, Merlin flight simulator.

Intended Learning Outcomes: Technical Outcomes
On successful completion of this unit students will be expected, at the threshold level, to be able to:
1. Understand the mathematical modelling of flight dynamics and control
2. Implement the simulation of aircraft dynamics
3. Design the controllers for various modes of flight
4. Program the in-house flight simulator

On successful completion of this unit students will be expected, at the threshold level, to be able to demonstrate:
a) Flight Dynamics, Longitudinal/Directional/Lateral Dynamics, Mode Controller Design, Basic Autopilot.
b) Understand and employ the mathematical modelling of flight dynamics
c) Simulate the aircraft dynamics, and design the controllers for various modes of flight
d) Study independently, use library resources and manage working time.

Accreditation Outcomes (AHEP)
- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

Assessment: Examination 1 (80%)
Coursework 1 (20%)

Assessment Description:
Coursework on dynamic analysis and autopilot design – 20%
A two-hour examination at the end of the Semester - 80%.
Resits in August will have 100% weighting.

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

Assessment Feedback: Via model answers for the continuous assessments and overview of generic issues from written examinations. Feedback will be via Canvas.
Failure Redemption: An opportunity to redeem failures will be available within the rules of the University.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. Failure to sit an examination or submit work by the specified date will result in a mark of 0% being recorded. Submission of the assignments will be via Canvas ONLY. Email submissions will NOT be accepted. All notes and other teaching materials will be delivered via Canvas.

EGIM02 Advanced Computational Methods for Engineers

Credits: 10 Session: 2023/24 September-January

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

Co-requisite Modules:

Lecturer(s): Dr F Zhao

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

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

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

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

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

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

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

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

Accreditation Outcomes (AHEP)
- A comprehensive knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1m)
-Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively (SM3m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Understanding of concepts from a range of areas including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects (SM6m)

Assessment: Examination (70%)
Assignment 1 (30%)

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

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

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

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

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

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

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

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

Lecture notes provided.

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

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

EGIM09 Finite Element Method

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr W Harrison

Format: This module will be taught with a combination of lectures and examples classes. Pre-recorded videos and online content will also be provided. Office hours will be available for additional support..

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

The module is delivered by lectures, example classes and computer laboratory sessions.
Communication and course announcements, including office hours details, will be made via Canvas.
Course materials, including the course notes, will be available for download from Canvas.

Online live lectures: 1 hour per week
Examples classes: 1-2 hours per week of online content.
Online support sessions: 12 hours in total
Directed private study: 3 hours per week

Module Aims: This module provides a concise introduction to the elementary concepts and methods of finite element analysis, with applications to heat flow, solid mechanics, groundwater flow and other engineering problems. It also provides practice in using finite element software/codes.

Module Content:
• 1D problems: Introduction. FE Formulation of 1-D Problems - Physical problem; conceptual model. 1-D problem of heat conduction and elastostatics. Analytical solution. Strong and weak forms. Galerkin approximation. Finite element discretisation. The linear 1-D bar: shape functions, load vector and stiffness matrix. Assembly procedure. Examples [9]
• 2D scalar problems: FE Modelling of 2-D Potential Flow Problems - Physical problem; conceptual model. Porous media flow; heat conduction; torsion of cylindrical members. Strong and weak forms. Galerkin approximation. Finite element discretisation. The linear shape triangle: shape functions, load vector and stiffness matrix. Assembly procedure. Solution. Examples. [8]
• 2D elasticity: FE Modelling of 2-D Elastic Solids - Plane strain and plane stress problems of 2-D elastostatics. Strong and weak forms. Galerkin approximation. Finite element discretisation. The linear shape triangle: shape functions, load vector and stiffness matrix. Examples [6]
• Review [2] and Assessment.
• Attendance is a course requirement. Each student will need to complete two assignments that will require both hand calculation and computer simulations. Computer simulations will be using the existing finite element software, which includes small finite element programs.

Intended Learning Outcomes: Technical Outcomes:
Upon completion of this module, the student should be able to demonstrate:

1. A knowledge and understanding of [SM2m]:
(i) Fundamentals of the finite element method as an approximation method for analysis of a variety of engineering problems.
(ii) Differences between mathematical (conceptual) and computer models.

2. An ability to (thinking skills) [SM5m]:
(i) Distinguish between strong and weak form of the engineering problem at hand.
(ii) Understand levels of approximation inherent in computer modelling approaches to the solution of engineering problems.

3. An ability to (practical skills) [EA3m]:
(i) Develop finite element formulation for analysis of a variety of engineering problems including: (a) elastostatics of 1-D bars and cables (b) heat conduction, potential flow, porous media flow, torsion (c) plane strain and plane stress problems. (d) transient problems.
(ii) Use finite element method to solve engineering problems (a)-(d).
(iii) Use a computer to model and analyse engineering problems (a)-(d).

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)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and to implement appropriate action (EA3m)

MSc:
Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations (EA6m)

Assessment: Examination 1 (75%)
Assignment 1 (10%)
Assignment 2 (15%)

Assessment Description:
• Assignment 1: Solve 1D problems using both hand calculations and computer codes (10%).
• Assignment 2: Solve multidimensional problems using both hand calculations and computer codes (15%).
• Final examination: Closed book exam (75%).

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

Assessment Feedback:
Assignments 1 and 2 are assessed via Canvas. Individual student feedback will be provided through Canvas. An overall feedback on the final examination will be posted online.

Failure Redemption: Resit may be permitted in line with University regulations.
Assessment - 100% examination.

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 continuous assessment assignments: zero tolerance.
Available to visiting and exchange students.

EGIM16 Communication Skills for Research Engineers

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

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

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

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

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

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

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

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

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

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

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

Assessment Description: The first sit assessment will consist of 3 assignments. The first assessment component will be a written piece, which will test the students' understanding of the literature-based research process, test their ability to articulate the findings, and draw relevant, well-supported conclusions. This is an individual piece of coursework. This assignment is a precursor to assignment 3 (article). The oral examination will involve the students presenting the outcome of their chosen research topic (literature-based only, no original research requirement in the module), through an oral presentation. The target duration of the oral presentation will usually be between 8 to 10 minutes. The exact duration will be specified in the assignment descriptor. This is an individual piece of coursework. The final, third, component will require the student to write a technical article or equivalent. This paper will be between four to five pages in length and will be written to a format described in the assignment descriptor. This is an individual piece of coursework. The pass mark for a module at Level 4/M is 50%. In addition to this Students must achieve at least 40% in the Oral Examination AND 40% in the Writing assessment to pass the module. The reassessment will consist of 2 assignments, detailed in a further section.
Moderation approach to main assessment: Moderation by sampling of the cohort
Assessment Feedback: CANVAS will be used to provide individual feedback to the students on all the components that contribute to the final mark. For the first assessment component a class feedback document is also generally included on CANVAS. As part of the practical sessions the students will receive verbal feedback on their performance. These sessions do not contribute to the final mark.
Failure Redemption: Candidates shall be given one opportunity to redeem a failure in the module during the summer supplementary period. In addition, the 40 % oral and written assignments of the first must be passed individually to pass the module, and will have to be redeemed even if a pass mark is achieved for the module overall on first sit. A pass mark on both main assessment components will be required to pass the module. All components are redeemable individually in the event of failure across the module. Students may be required to take supplementary examination of examined components they have already passed if the combination of marks is such that the module may be failed.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. All lectures and course material will be provided on CANVAS. The pass mark for a module at Level 4/M is 50%. In addition to this Students must achieve at least 40% in the Oral Examination AND 40% in the Writing assessment to pass the module. The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.