Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 4 (FHEQ LEVEL 7)

AEROSPACE ENGINEERING

DEGREE PROGRAMMES

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2023-24

DISCLAIMER

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

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

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

The 23-24 academic year begins on 25 September 2023

Full term dates can be found here

DATES OF 23-24 TERMS
25 September 2023 – 15 December 2023
8 January 2024 – 22 March 2024
15 April 2024 – 07 June 2024

SEMESTER 1
25 September 2023 – 29 January 2024
SEMESTER 2
29 January 2024 – 07 June 2024
SUMMER
10 June 2024 – 20 September 2024

IMPORTANT

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

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

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity.

Welcome to the Faculty of Science and Engineering!

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

At Swansea University and in the Faculty of Science and Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone.

Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic, technical and administrative staff, administrators - I'm sure you will find many friendly helping hands ready to assist you. And make the most of living and working alongside your fellow students.

During your time with us, please learn, create, collaborate, and most of all – enjoy yourself!

Professor David Smith
Pro-Vice-Chancellor and Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Pro-Vice-Chancellor and Executive Dean	Professor David Smith
Director of Faculty Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Laura Roberts
School of Aerospace, Civil, Electrical, General and Mechanical Engineering **Head of School: Professor Antonio Gil**	
School Education Lead	Professor Cris Arnold
Head of Aerospace Engineering	Professor Ben Evans
Aerospace Engineering Programme Director	Dr Alexander Shaw A.D.Shaw@swansea.ac.uk
Year 4 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 8.30am-4pm.

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

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

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

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

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

https://myuni.swansea.ac.uk/fse/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 23-24 handbooks to ensure that you have access to the most up-to-date versions. We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

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

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

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

Year 4 (FHEQ Level 7) 2023/24
Aerospace Engineering
MEng Aerospace Engineering[H403]
MEng Aerospace Engineering with a Year Abroad
MEng Aerospace Engineering with a Year in Industry[H404]

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-M329 **Advanced Propulsion** **10 Credits** **Dr Z Ren** **CORE**	**EG-M330** **Next Generation Sustainable Aircraft Technologies** **10 Credits** **Prof BJ Evans** **CORE**
EG-M69 **Advanced Airframe Structures** **10 Credits** **Prof H Haddad Khodaparast** **CORE**	**EG-M47** **Business Leadership for Engineers** **10 Credits** **Prof AR Barron** **CORE**
EG-M81 **Flight Dynamics and Control** **10 Credits** **Dr H Madinei** **CORE**	**EG-M90** **Advanced Aerodynamics** **10 Credits** **Prof BJ Evans/Prof K Morgan** **CORE**
EGSM00 **Structural Integrity of Aerospace Metals** **10 Credits** **Prof C Pleydell-Pearce** **CORE**	**EGEM07** **Fluid-Structure Interaction** **10 Credits** **Prof WG Dettmer** **CORE**
EG-M62 **Group project (Aerospace)** **30 Credits** **Dr TN Croft/Dr Z Jelic/Dr NV Taylor** **CORE**	
Total 120 Credits	

Optional Modules

Choose exactly 10 credits

Please choose one module only from the options listed below, making sure all the necessary co-requisites are covered.

Note that EGIM09 is incompatible with EG-323 (Finite Element Method) and EG-M73 is incompatible with EGA301 (Composite Materials).

EG-M23	Finite Element Computational Analysis	Prof R Sevilla	TB1	10 (CORE)
EG-M73	Composite Materials	Dr FA Korkees	TB2	10 (CORE)
EG-M83	Simulation Based Product Design	Dr AJ Williams/Dr B Morgan	TB2	10 (CORE)
EGIM09	Finite Element Method	Dr W Harrison	TB1	10 (CORE)

Year 4 (FHEQ Level 7) 2023/24
Aerospace Engineering
MEng Aerospace Engineering with a Year Abroad[H406]

Total 10 Credits

Optional Modules
Choose exactly 10 credits
Please choose one module only from the options listed below, making sure all the necessary co-requisites are covered.

Note that EGIM09 is incompatible with EG-323 (Finite Element Method) and EG-M73 is incompatible with EGA301 (Composite Materials).

EG-M23	Finite Element Computational Analysis	Prof R Sevilla	TB1	10 (CORE)
EG-M73	Composite Materials	Dr FA Korkees	TB2	10 (CORE)
EG-M83	Simulation Based Product Design	Dr AJ Williams/Dr B Morgan	TB2	10 (CORE)
EGIM09	Finite Element Method	Dr W Harrison	TB1	10 (CORE)

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%)
Resit Assessment:	Examination (Resit instrument) (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-M329 Advanced Propulsion

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-335; EG-397

Co-requisite Modules:

Lecturer(s): Dr Z Ren

Format: Lectures: 22 hours;
Example classes: 11 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.
Lectures are based at University campus.

Module Aims: The module is intended to extend the fundamental theory of propulsion and aims to provide a further understanding of advanced propulsion systems across a range of requirements such as high-speed flight, high fuel efficiency, and low emission. A series of case studies will be utilized to explore the concepts of advanced propulsion systems.
The course includes:
• Introduction of the typical systems for aero propulsion
• Supersonic/hypersonic propulsion
• Low emission propulsion
• Pressure gain combustion for advanced propulsion
• Combined cycle propulsion system

Module Content: • Background and overview with historical perspectives
• Governing aerothermodynamic equations
• Airbreathing engine performance measures
• Aerospace system performance measures
• Compression systems (inlets and shock structure)
• Combustion systems (deflagration vs. detonation, subsonic vs. supersonic, chemical kinetic limitations)
• Expansion systems
• Ramjets and scramjets, design and performance
• Utilization of hydrogen and ammonia for propulsion
• Electric and hybrid electric propulsion
• Design and performance of pulse detonation engines (PDE), rotating detonation engine (RDE), and oblique detonation engine (ODE).
• Combined cycle engines

Intended Learning Outcomes: On successful completion of this unit students will be expected, at the threshold level, to be able to:
- Describe the advantages and drawbacks of various advanced propulsion architectures. (Assignment 1, Exam)
- Understand the broader context of aircraft propulsion technology, including the environmental and economic issues. (Assignment 1, Exam)
- Provide preliminary design parameters for inlets and nozzles and characterize their performance. (Assignment 2, Exam)
- Provide preliminary design parameters and define key design issues, constraints and architectures for main combustors. (Assignment 2, Exam)
- Evaluate the operation and performance of advanced propulsion system. (Assignment 2, Exam)

Accreditation Outcomes (AHEP)
- Apply a comprehensive knowledge of mathematics, statistics, natural science and engineering principles to the solution of complex problems. Much of the knowledge will be at the forefront of the particular subject of study and informed by a critical awareness of new developments and the wider context of engineering. (M1, Evaluated in Assessment 1, Assessment2, Exam)
- Formulate and analyse complex problems to reach substantiated conclusions. This will involve evaluating available data using first principles of mathematics, statistics, natural science and engineering principles, and using engineering judgment to work with information that may be uncertain or incomplete, discussing the limitations of the techniques employed. (M2, Evaluated in Assessment 2, Exam)
- Apply an integrated or systems approach to the solution of complex problems. (M6, Evaluated in Assessment 2)

Assessment:	Assignment 1 (15%) Assignment 2 (15%) Examination 1 (70%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Assignment 1 Assignment November 15%
Assignment 2 Assignment December 15%
Examination Examination January 70%

• The first assignment will require the students to write a short report on a topic related to advanced propulsion concept.
• The second assignment will need the students to use a computational fluid dynamics software to study the internal flow and combustion of a kind of simplified engine to understand how the engine produce thrust.
• The examination will be a 2 hour exam.

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

Assessment Feedback: Feedbacks on the first assignment and second assignment will be available on Canvas.
Examination feedback will be available through the forms submitted to the Engineering Community page on Canvas.

Failure Redemption: Failure in the module can be redeemed through a combination of the equivalent of the first assignment and the resit examination.

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

EG-M330 Next Generation Sustainable Aircraft Technologies

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof BJ Evans

Format: Delivered over 11 weeks, hours per week:
2 hours of lecture/seminar
4 hours of directed study
1 hour office surgery

Delivery Method: Delivery of this module will be mixture of taught lectures and seminars requiring students to engage in class discussion.

Module Aims: This module will introduce students to leading research technologies that will play a part in enabling future 'net zero' aircraft using Sustainable Aviation Fuels (SAF), hydrogen-based propulsion, electrification or a combination thereof. After introducing students to the motivation and likely timescales of next generation aircraft utilising these new propulsion approaches the module run as a series of research seminars, including class discussion and Q&A, on technology areas that will be necessary to facilitate practical implementation of future 'net zero' aircraft. By the end of the module students should have a good understanding of the challenges facing the aerospace industry to achieve sustainable aircraft over the next 2 – 3 decades as well as some of the technologies that will enable the transition.

Module Content: - An introduction to the challenges facing the aerospace industry, in the context of climate change and sustainability, over the next 30 years
- The role of industry, academia, government bodies and politics in the evolution of the aerospace industry
- The Aerospace Technology Institute (ATI) 'Fly Zero' project and the role of SAF, electrification and hydrogen propulsion in future civilian aviation
- Research seminars covering:
 Computational Aerodynamic Optimisation using Evolutionary Algorithms
 Morphing Aircraft and Structures
 Hydrogen Combustion Modelling
 Solar Technology
 Structural and Multidisciplinary Optimisation for the 'dry wing'
 Experimental Aerodynamics and Aeroacoustics
 Future Battery Technology
 SMART materials and bio-composites
 Charaterisation of metals and composites in the context of cryogenic liquid hydrogen
- Future (SAF, hydrogen, electric, hybrid) aircraft design concepts

Intended Learning Outcomes: - awareness and understanding of the importance of the aerospace sector's transition to sustainable aviation solutions
- awareness of the role of industry, academia and government bodies and politics in facilitating a transition to sustainable aviation
- familiarity with current research areas with potential impact on the transition towards net zero aircraft
- ability to evaluate the likely effectiveness and impact of novel research ideas and proposals on industry

Assessment:
Class Test 4 - Held under exam conditions (5%)
Class Test 5 - Held under exam conditions (5%)
Class Test 6 - Held under exam conditions (5%)
Class Test 7 - Held under exam conditions (5%)
Group Work - Presentation (25%)
Report (40%)
Class Test 1 - Practical Assessment Not Exam Cond (5%)
Class Test 2 - Held under exam conditions (5%)
Class Test 3 - Held under exam conditions (5%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Canvas Quiz 1 5% Canvas Quiz 2 5% Canvas Quiz 3 5% Canvas Quiz 4 5% Canvas Quiz 5 5% Canvas Quiz 6 5% Canvas Quiz 7 5% Group Presentation 25% Individual Written Report 40%
Moderation approach to main assessment: Universal Non-Blind Double Marking of the whole cohort
Assessment Feedback: Instant feedback will be provided on each Canvas quiz along with opportunity to discuss marks in an office surgery. Immediate verbal feedback will be provided on the group presentation and a detailed written feedback will be provided on the written report.
Failure Redemption: Supplementary coursework will be provided to redeem a failure in this module.
Additional Notes: The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EG-M47 Business Leadership for Engineers

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof AR Barron

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

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

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

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

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

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

Accreditation Outcomes (AHEP)

- Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards (D2)
- Demonstrate the ability to generate an innovative design for products, systems, components or processes to fulfil new needs (D8m)
- Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of the particular specialisation, (ET3fl)
- Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate, (ET4fl)
- Awareness of and ability to make general evaluations of risk issues in the context of the particular specialisation, including health & safety, environmental and commercial risk. (ET6fl)
- Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction. (ET7m)

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

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

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

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

Moderation approach to main assessment: Partial moderation

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

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

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

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

Related assignments are used to assess this module.

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

EG-M62 Group project (Aerospace)

Credits: 30 Session: 2023/24 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr TN Croft, Dr Z Jelic, Dr NV Taylor

Format: Group allocation and team building at start of the project followed by practical sessions group and individual work. Project Briefing and Meetings with academic supervisors and technicians (online or onsite) will be arranged.

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

Project briefing (module coordinator/academic supervisor(s)/technician(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 biweekly during the term time. The project progression will be made in accordance with the project brief, requirements and guideline. Details on the project requirements for students (i.e. deliverables with respective submission deadline) will be announced by the module coordinator at the project briefing session and/or via Canvas.

Module Aims: This module enables students to participate in a group activity involving 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: compliance, quality, material selection, failure and risk, safety, reliability 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. Economic Considerations and Business Plan.

Intended Learning Outcomes: On successful completion of this module each student will be expected, at threshold level, to be able to:
I1) Equivalent to AHEP4 M5: Design solutions for complex problems that evidence some originality and meet a combination of societal, user, business and customer needs as appropriate. This will involve consideration of applicable health and safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards.
I2) Equivalent to AHEP4 M16: Function effectively as an individual, and as a member or leader of a team. Evaluate effectiveness of own and team performance.
I3) Equivalent to AHEP4 M17: Communicate effectively on complex engineering matters with technical and non-technical audiences, evaluating the effectiveness of the methods used.

On successful completion of this module the group will be expected, at threshold level, to be able to:
G1) Equivalent to AHEP4 M3: Select and apply appropriate computational and analytical techniques to model complex problems, discussing the limitations of the techniques employed.
G2) Equivalent to AHEP4 M11: Select and apply appropriate materials, equipment, engineering technologies and processes, recognising their limitations.
G3) Equivalent to AHEP4 M9: Identify, evaluate and mitigate risks (the effects of uncertainty) associated with a particular project or activity
G4) Equivalent to AHEP4 M6: Apply an integrated or systems approach to the solution of complex problems.

Assessment: Group Work - Project (100%)

Assessment Description: The group project will be assessed against the Learning Outcomes. The assessment will be split into two equal parts: the group mark (50%) and an individual mark (50%). Feedback on the assessment items will be given either formative (comments with suggestion for making improvement, no marks) or summative (both comments and indicative marks).
The assessment items are comprised of, typically:
• Project plan (deliverable: report)
• Final conceptual design and design specification (deliverable: report)
• First design with completed results from individual tasks and draft business plan (deliverable: report + presentation)
• Final design including business plan (deliverable: report)
• Project management (deliverable: progress reports)
• Final poster + Presentation + Viva (deliverable: poster + presentation)
• Flight simulator model (deliverable: report + flight simulator model)

Note:
The group mark will be scaled by using peer review assessment.

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

Assessment Feedback: Feedback will be given by the 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-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%)
Resit Assessment:	Examination (Resit instrument) (100%)

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-M73 Composite Materials

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr FA Korkees

Format: 20 hrs Lectures
6 hrs Example classes/Tutorials
46 hrs Directed private study
30 hrs Preparation for assessment
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

Lectures and examples classes will be delivered on-campus.
Assessment is via an in-person (on campus) Examination (75%), and Assignment (25%).

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

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

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

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

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

Accreditation Outcomes (AHEP)
MEng
- A comprehensive knowledge and understanding of the scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1m)
- Awareness of developing technologies related to own specialisation (SM4m)
- Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems (EA4m)

MSc
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8m)
- Understanding of concepts relevant to the discipline, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects (SM9m)
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Ability to apply engineering techniques, taking account of a range of commercial and industrial constraints (P10m)

Assessment:	Examination (75%) Assignment 1 (25%)
Resit Assessment:	Examination (Resit instrument) (100%)

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

Important - To pass the module you must i. achieve a minimum of 40% for each component and ii. obtain 50% overall for the module.
If you do not meet the component level requirements for the module you will receive a QF outcome. This means that you will be required to take supplementary coursework even if your module mark is above 40%. It is therefore important that you complete and submit each component.

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

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

Failure Redemption: Resit examination worth 100% in August.

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-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%)

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

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.

EG-M83 Simulation Based Product Design

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AJ Williams, Dr B Morgan

Format: Lectures 6, Computer Lab 20, Reading/Private Study 20, Preparation for Assessment 54

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

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

Lectures and Computer Laboratory sessions will be delivered on campus.

Module Aims: This module provides an overview of the role that simulation can play in the design process of a product. A series of lectures introduce computational modelling and the computational tools and techniques employed in the design process. The application of simulation in the design of a number of industry based research projects is presented. Computer workshops lead students in using simulation tools and applying the tools in the optimisation of the design of a product.

Module Content:
- Introduction to computational modelling and the use of simulation in the design process: Examples, advantages, disadvantages.
- Information about commercial packages for each stage of the design process.
- Overview of steps involved in the modelling process; Identification of the physics involved, The effect of problem simplifications and assumptions on the solution, Determining an appropriate analysis type, The importance of validation.
- Introduction to steps involved in computational modelling, CAD and meshing: Examples of common problems associated with these stages of the design process and techniques to avoid them; importance of solution mesh independence, Solution procedures, simulation solver software, Post-processing, Interpretation of results, visualisation and optimisation,
- Introduction to software tools used in this module, CAD, meshing, analysis and visualisation packages.
- Analysis techniques: Overview of finite difference, finite volume and finite element methods, their advantages and disadvantages, and common applications for each method type.
- Case studies: application of the knowledge gained during the lectures to a) investigate the importance of solution mesh independence and b) optimise the design of a product using simulation.

Intended Learning Outcomes:
Technical Outcomes
On completion of this module the student will:
- Have the ability to apply computer-based models for solving problems in engineering and recognise the factors that influence model limitations. Assessed using Assignment 1 and 2.
- Demonstrate the ability to develop and apply a test strategy to produce an optimised design. Assessed using Assignment 2.
- Demonstrate an understanding of the modelling process and the role of simulation in design. Assessed using Assignment 2.

Accreditation Outcomes (AHEP):

MEng:
- Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and implement appropriate action (EA3m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D3m)
- Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D7m)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1)

MSc:
- Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations (EA6m)
- Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D9m)
- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D10m)

Assessment:	Assignment 1 (20%)
	Assignment 2 (80%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description:
• Assignment 1: Mesh Sensitivity Study.This is an individual piece of coursework.This coursework will involve the investigation of the influence of mesh dependence, convergence criteria and physical phenomena on a simulation solution. The results of the investigation will be presented in a written report (maximum of 15 pages).
• Assignment 2: Design Optimisation. This is an individual piece of coursework.This coursework will require the student to use simulation tools to optimise the design of a component subject to given criteria.The student will also be required to show their understanding of the role that simulation plays in the design process using examples presented within the module.This coursework will be presented in a written report (maximum of 20 pages).
• Supplementary Coursework.This is an individual piece of coursework. This coursework will require the student to use simulation tools to investigate and optimise the design of a given device. This coursework will be presented in a written report (maximum of 20 pages).

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

Assessment Feedback: Individual written feedback will be given using Canvas. An overall assessment of the cohort's performance for the coursework will also be published on Canvas.

Failure Redemption: A supplementary piece of coursework will be set which will form 100% of the mark. This assessment will cover the learning outcomes of both coursework 1 & 2.

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

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

EG-M90 Advanced Aerodynamics

Credits: 10 Session: 2023/24 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: 2023/24 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%)

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

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.

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

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.

EGSM00 Structural Integrity of Aerospace Metals

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules: EGTM60

Lecturer(s): Prof C Pleydell-Pearce

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

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

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

Lecture based.

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

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

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

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

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

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

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

Assessment Description: A two-hour examination.

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

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

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

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.