Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 3 (FHEQ LEVEL 6)

AEROSPACE ENGINEERING

DEGREE PROGRAMMES

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

DISCLAIMER

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

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

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

The 22-23 academic year begins on 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)	Professor Paul Holland
School of Aerospace, Civil, Electrical, General and Mechanical Engineering **Head of School: Professor Antonio Gil**	
School Education Lead	Professor Cris Arnold
Head of Aerospace Engineering	Dr Ben Evans
Aerospace Engineering Programme Director	Dr Alexander Shaw A.D.Shaw@swansea.ac.uk
Year 3 Coordinator	Dr Hadi Madinei hadi.madinei@swansea.ac.uk

STUDENT SUPPORT

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

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

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

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

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

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

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

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

READING LISTS

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

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

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

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

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

Year 3 (FHEQ Level 6) 2022/23
Aerospace Engineering

BEng Aerospace Engineering[H400,H405]
BEng Aerospace Engineering with a Year Abroad[H401]
BEng Aerospace Engineering with a Year in Industry[H402]
MEng Aerospace Engineering[H403]

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-3081 **Rotorcraft Theory** **10 Credits** **Dr Y Yuan** **CORE**	**EG-397** **Propulsion** **10 Credits** **Prof MT Whittaker** **CORE**
EG-335 **Gas Dynamics** **10 Credits** **Dr I Sazonov** **CORE**	
EG-360 **Dynamics 2** **10 Credits** **Dr Y Yuan/Dr N Jamia** **CORE**	
EG-3080 **Engineering Management (Aero, EEE, Mech)** **10 Credits** **Prof JC Arnold/Prof MR Jennings/Dr EH Jewell/Mr JK Mcfadzean/Dr B Morgan/Dr A Rees** **CORE**	
EG-353 **Research Project** **30 Credits** **Dr MR Brown/Mr A Goodfellow/Prof PJ Holliman/Dr AC Tappenden** **CORE**	
EGA302A **Aerospace Engineering Design 3** **20 Credits** **Mr JK Mcfadzean/Prof BJ Evans/Dr Z Ren/Dr AD Shaw** **CORE**	
Total 120 Credits	

Optional Modules

Choose exactly 20 credits
Space Stream.

These options MUST be chosen by those on the Space Stream.

EGA321	Satellite Systems	Dr I Sazonov	TB1	10 (CORE)
EGA341	Space Propulsion and Power Systems	Dr Z Jelic/Dr K Wada	TB2	10 (CORE)

Or

Choose exactly 20 credits
Structural/Computational Stream

These options MUST be chosen by those on the Structural/Computational Stream.

EG-323	Finite Element Method	Dr W Harrison	TB1	10 (CORE)
EG-396	Computational Aerodynamics	Dr TN Croft	TB2	10 (CORE)

Or
Choose exactly 20 credits
Materials/Propulsion Stream.

These options MUST by chosen by those on the Materials/Propulsion Stream.

EG-381	Fracture and Fatigue	Prof RE Johnston	TB1	10 (CORE)
EGA301	Composite Materials	Dr FA Korkees	TB2	10 (CORE)

Year 3 (FHEQ Level 6) 2022/23
Aerospace Engineering
MEng Aerospace Engineering with a Year Abroad[H406]

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-3081 **Rotorcraft Theory** **10 Credits** **Dr Y Yuan** **CORE**	**EG-397** **Propulsion** **10 Credits** **Prof MT Whittaker** **CORE**
EG-335 **Gas Dynamics** **10 Credits** **Dr I Sazonov** **CORE**	
EG-360 **Dynamics 2** **10 Credits** **Dr Y Yuan/Dr N Jamia** **CORE**	
EG-3080 **Engineering Management (Aero, EEE, Mech)** **10 Credits** **Prof JC Arnold/Prof MR Jennings/Dr EH Jewell/Mr JK Mcfadzean/Dr B Morgan/Dr A Rees** **CORE**	
EG-353 **Research Project** **30 Credits** **Dr MR Brown/Mr A Goodfellow/Prof PJ Holliman/Dr AC Tappenden** **CORE**	
EGA302A **Aerospace Engineering Design 3** **20 Credits** **Mr JK Mcfadzean/Prof BJ Evans/Dr Z Ren/Dr AD Shaw** **CORE**	
Total 120 Credits	

Optional Modules
Choose exactly 20 credits
Space Stream.

These options MUST be chosen by those on the space stream

EGA321	Satellite Systems	Dr I Sazonov	TB1	10
EGA341	Space Propulsion and Power Systems	Dr Z Jelic/Dr K Wada	TB2	10

Or
Choose exactly 20 credits
Structural/Computational Stream

These options MUST be chosen by those on the structural/computational stream

EG-323	Finite Element Method	Dr W Harrison	TB1	10
EG-396	Computational Aerodynamics	Dr TN Croft	TB2	10

Or
Choose exactly 20 credits
Materials/Propulsion Stream.

These options MUST by chosen by those on the materials/propulsion stream

EG-381	Fracture and Fatigue	Prof RE Johnston	TB1	10
EGA301	Composite Materials	Dr FA Korkees	TB2	10

Year 3 (FHEQ Level 6) 2022/23
Aerospace Engineering
MEng Aerospace Engineering with a Year in Industry[H404]

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-3081 **Rotorcraft Theory** **10 Credits** **Dr Y Yuan** **CORE**	**EG-397** **Propulsion** **10 Credits** **Prof MT Whittaker** **CORE**
EG-335 **Gas Dynamics** **10 Credits** **Dr I Sazonov** **CORE**	
EG-360 **Dynamics 2** **10 Credits** **Dr Y Yuan/Dr N Jamia** **CORE**	
EG-233 **Placement Preparation: Engineering Industrial Year** **0 Credits** **Prof GTM Bunting/Dr CME Charbonneau/Dr P Esteban/Dr SA Rolland/Dr V Samaras/Dr S Sharma**	
EG-3080 **Engineering Management (Aero, EEE, Mech)** **10 Credits** **Prof JC Arnold/Prof MR Jennings/Dr EH Jewell/Mr JK Mcfadzean/Dr B Morgan/Dr A Rees** **CORE**	
EG-353 **Research Project** **30 Credits** **Dr MR Brown/Mr A Goodfellow/Prof PJ Holliman/Dr AC Tappenden** **CORE**	
EGA302A **Aerospace Engineering Design 3** **20 Credits** **Mr JK Mcfadzean/Prof BJ Evans/Dr Z Ren/Dr AD Shaw** **CORE**	
Total 120 Credits	

Optional Modules
Choose exactly 20 credits
Space Stream.

These options MUST be chosen by those on the space stream

EGA321	Satellite Systems	Dr I Sazonov	TB1	10
EGA341	Space Propulsion and Power Systems	Dr Z Jelic/Dr K Wada	TB2	10

Or
Choose exactly 20 credits
Structural/Computational Stream

These options MUST be chosen by those on the structural/computational stream

EG-323	Finite Element Method	Dr W Harrison	TB1	10
EG-396	Computational Aerodynamics	Dr TN Croft	TB2	10

Or
Choose exactly 20 credits
Materials/Propulsion Stream.

These options MUST by chosen by those on the materials/propulsion stream

EG-381	Fracture and Fatigue	Prof RE Johnston	TB1	10
EGA301	Composite Materials	Dr FA Korkees	TB2	10

EG-233 Placement Preparation: Engineering Industrial Year

Credits: 0 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof GTM Bunting, Dr CME Charbonneau, Dr P Esteban, Dr SA Rolland, Dr V Samaras, Dr S Sharma

Format: 11 hours consisting of a mix of seminars and workshops. 11 one hour drop-in advice sessions. Review of CV and cover letter.
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

This module is delivered through directed and self-directed learning, careers resources, interactive workshops, reflective learning practice and drop-in advice sessions. The module is delivered on the Bay Campus.

Module Aims: This generic cross-disciplinary module is for all students who have enrolled (or transferred) onto the Engineering Year in Industry scheme. The module focuses on the underpinning and fundamental requisites required to gain, enter and progress effectively through an industrial placement. Learners will be introduced to a) sourcing placements, CV writing and application techniques; (b) interview techniques - how to pitch yourself and be successful; (c) workplace fundamentals and IP awareness, behaviours and expectations; (d) key employability skills; getting the most from your Industrial Placement; and (e) health and safety in the workplace.

Module Content:

The module will focus on the key requirements to gain and be successful whilst on a placement. Directed and self-directed activity will address the following topics;

1) Engineering Industrial Placements - what they are, how to search and how to apply.
2) CV writing, cover letters and application processes.
3) Assessment centres, interview techniques and mock interviews.
4) Recognising and developing employability skills.
5) Reflecting and maximising the placement experience.
6) One to one meeting with careers and employability staff.
7) Health and safety in the workplace.

Intended Learning Outcomes:

Technical Outcomes
By the end of this module, students will:
- Know how to find and apply for placements, create a CV and complete a placement application.
- Understand the interview process and gain interview experience.
- Discuss and share what is expected within the workplace including behavioural and professional conduct.
- Identify personal employability skills and how these will be used in a workplace setting.

Accreditation Outcomes (AHEP)
EL5b Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues
EL6b Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk,

Assessment: Placements (100%)

Assessment Description:

Students are required to attend the health and safety lecture. Students who do not attend and have no valid reason will not be permitted to continue on an Engineering Industrial Placement Year programme of study.

Moderation approach to main assessment: Not applicable

Assessment Feedback:

N/A: students will however be able to discuss and seek feedback/advice on their search for an industrial placement, during the drop-in sessions.

Failure Redemption:

Successful completion of this module depends upon attendance at, and engagement with, the health and safety lecture. Therefore there will normally be no opportunity to redeem failure. However, special provision will be made for students with extenuating or special circumstances.

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

This module is only available for students enrolled on the Engineering Year in Industry scheme.

EG-3080 Engineering Management (Aero, EEE, Mech)

Credits: 10 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof JC Arnold, Prof MR Jennings, Dr EH Jewell, Mr JK Mcfadzean, Dr B Morgan, Dr A Rees

Format: Core Lectures: 16
Discipline specific lectures: 3
Support tutorials: 3

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

Discipline-specific lectures will cover the first 3 weeks to introduce and explain the subject-specific project. Lectures in the core components will follow over the next 7 weeks.

Important - Careers Services Support lectures will take place in TB1 but formal assessment marks will be released in TB2. Please be aware that this is compulsory and will appear on the TB1 timetable.

Module Aims: The goal of this course is to provide the skills for professional engineers to meet the challenges of their future careers, whether they be in academia, industry, or as an entrepreneur. Irrespective of future careers engineers will be involved in projects, management and business organisations and an awareness of these issues is important for all team members. It should be recognized that the topics included in the course are not limited to scientists and engineers, they are useful for people in any careers. This course is not aimed at making you a certified project manager, but to provide the skills that will allow you to be a more effective project team member and also when you start to take on the role of project manager.

With respect to business management aspects, the course will cover the basic concept of entrepreneurship before breaking down the essential elements of a business plan. The course will give the more entrepreneurial students guidance about how to go about commercialising their ideas and the less entrepreneurial students an understanding of what makes some of their colleagues tick. The learn by example approach adopted for this module guides the student through the complexities of financial and human resource management and encourages students to develop their own business plans. Students will also be introduced to the subject area of ethics, liability and responsibilities within business. This module will also provide support on careers services with students creating CVs and Linked-In accounts.

Module Content: Pre-component
Careers Services Support - CV and Linked-In account

Section A. Programme Specific Component
There are three programme specific components:
All include lectures and then a subject-specific case study assignment covering the planning, scheduling and financial modelling of manufacturing processes in the relevant sector.
• Aerospace Engineering
• Mechanical Engineering
• Electrical and Electronic Engineering

Section B. Core Component
Financial aspects of Engineering Management
Introduction to financial planning, modelling and accounting, including consideration of fixed and variable costs, return on investments.
Entrepreneurship: Team building & Finance / Business Start-ups / The Business Planning process.

Project Management
Definition of a project and the stages within a project; project characteristics, project Stakeholders, what makes a successful project manager; triple constraint; standards and knowledge; management knowledge and skills
Project Life Cycle
Initiation, planning, execution and closure; Project charter; Objectives and Scope; Project planning; Scope; Requirements; Work breakdown structure; network diagram; resource planning and activity scheduling; Risk management.

Legal and ethical aspects of Engineering Management
Legal frameworks, liabilities, employee / employer aspects, the management of intellectual property. International standards and certifications.

Intended Learning Outcomes: Technical Outcomes
Upon completion of the module the student should be aware of and able to use:
- Some of the "tools" that assist in the efficient use of financial & human resources in manufacturing;
- Methods of writing a successful project plan
- Methods to assess the success of a project or business
- Approaches to ensure all projects and business activity is operating within a legal, ethical and responsible framework.

Accreditation Outcomes (AHEP)
D3p Work with information that may be incomplete or uncertain and quantify the effect of this on the design
ET5p Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues,
ET6p Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, and of risk assessment and risk management techniques.
EP5m Knowledge of relevant legal and contractual issues
EP6m Understanding of appropriate codes of practice and industry standards
EP7m Awareness of quality issues and their application to continuous improvement
EP11m 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

Assessment:	Coursework 1 (2%)
	Coursework 2 (3%)
	Assignment 1 (30%)
	Examination 1 (65%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: The core component is assessed via a two-hour in-person examination in May/June.

The program specific components are assessed through one piece of coursework that is program specific (contributing 30% to the module grade).

There will also be a 5% component on Careers Support that will be completed in TB1 - 3% for completion of 5 specified units of the ‘career development course’ and 2% for CV (which will be assessed using ‘VMOCK’).

This module is assessed by a combination of examination and continual assessment. In order for the continual assessment marks to count, you must achieve at least 30% in the exam component. If you achieve less than 30% in the exam, then the module mark will be just the exam mark.

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

Assessment Feedback:
Students will receive feedback on their coursework, together with a model answer, within three weeks of submission. Feedback for the examination will be released via the exam feedback form.

Failure Redemption: A resit examination (2 hours) making up 100% of the resit mark.

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

Penalty for late submission of work: ZERO TOLERANCE.

The module is available to exchange students.

Notes and worked examples can be found on Canvas.

This module is assessed by a combination of examination and continual assessment. In order for the continual assessment marks to count, you must achieve at least 30% in the exam component. If you achieve less than 30% in the exam component, then the module mark will be just the exam mark.

EG-3081 Rotorcraft Theory

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-293; EG-296; EGA228

Co-requisite Modules:

Lecturer(s): Dr Y Yuan

Format: 20 hours lectures
10 hours discussions/examples classes
70 hours personal directed study

Delivery Method: 20 hours lectures
10 hours discussions/examples classes
70 hours personal directed study

Module Aims: Develop an understanding of the theory of vertical flight, design and analysis of helicopters and other rotary-wing aircraft and gain an appreciation of the extra difficulties involved when the vehicle flow is cyclic in nature.

Module Content: • Identify the different Rotorcraft configurations and layouts (1h)
• Rotor in Vertical Flight (3h)
o Momentum Theory
o Blade Element Theory
o Vertical Performance Analysis
• Rotor Mechanisms for forward flight (4h)
• Rotor Aerodynamics in Forward flight (2h)
• Rotorcraft Aerodynamic Design (3h)
• Rotorcraft Performance (3h)
• Rotorcraft Trim, stability and control (4h)

Intended Learning Outcomes: Technique outcomes:
• identify the different Rotorcraft configurations and layouts
• estimate the performance of rotorcraft in:
o Hover
o Forward Flight
o Vertical Flight
• determine the equations of motion of the rotor blades
• determine the loads on the rotor hub
• estimate the performance of rotor-powered vehicles.
• determining the stability characteristics of a helicopter.

Accreditation Outcomes (AHEP)
• Apply knowledge of mathematics, statistics, natural science and engineering principles to broadly-defined problems. Some of the knowledge will be informed by current developments in the subject of study. (B1)
• Select and apply appropriate computational and analytical techniques to model broadly-defined problems, recognising the limitations of the techniques employed. (B3)
• Apply an integrated or systems approach to the solution of broadly-defined problems. (B6)
• 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)
• 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)

Assessment: Assignment 1 (20%)
Assignment 2 (10%)
Examination (70%)

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

Assessment Description: Assignment 1 (from Week 3 to Week 6)
Assignment 2 (from Week 6 to Week 9)
Final examination

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

Assessment Feedback: Assessment 1: Feedback on the second assignment will be through the return of the marked submission.
Assessment 2: Feedback on the second assignment will be through the return of the marked submission.
Examination feedback will be available through the forms submitted to the Engineering Community page on Canvas.

Failure Redemption: Year 3 BEng: BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.
Year 3 MEng: MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Additional Notes: 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.
Attendance will be monitored.

EG-323 Finite Element Method

Credits: 10 Session: 2022/23 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 additional support 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.

Lectures: 1 hour per week
Examples classes: 1-2 hours per week
Additional support sessions: 10 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. The module is assessed by an exam (open book) and 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:
- A knowledge and understanding of [SM2b]:
(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.
- An ability to (practical skills) [EA3b]:
(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.
(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 mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action EA3b)

Assessment: Examination 1 (75%)
Assignment 1 (10%)
Assignment 2 (15%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description:
(i) Assignment 1: Solve 1D problems using both hand calculations and computer codes (10%).
(ii) Assignment 2: Solve multidimensional problems using both hand calculations and computer codes (15%).
(iii) Final examination (75%).

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

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

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

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

Penalty for late submission of continuous assessment assignments: zero tolerance.

Available to visiting and exchange students.

EG-335 Gas Dynamics

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-115; EG-261; EG-293

Co-requisite Modules: EG-397

Lecturer(s): Dr I Sazonov

Format: Lectures 20 hours
Example classes 10 hours
Directed private study 70 hours

Delivery Method:
This module will consist of lectures, which concentrate on the fundamentals of Gas dynamics, and example classes, which concentrate on applying the theory to solve practical examples.

Module Aims:
This module introduces students to dynamics of a compressible gas flow, shock waves and other discontinuities.

Module Content:
Module content:
• Introductory concepts of compressible flow.
• Isentropic one-dimensional flow.
• Normal shocks - stationary and moving, applications.
• Shock tubes.
• Supersonic Pitot' probes
• Oblique shock waves, their interaction and reflection from boundaries.
• Under and over expanded nozzles.
• Shock expansion method for flow over airfoils.
• Prandtl - Meyer expansion flow.
• Fanno line: flow with friction
• Rayleigh line: flow with heating/cooling.
• Prandtl - Glauert and Goethert rules.
• Small perturbation equations for subsonic, transonic, supersonic and hypersonic flow.
• Ackeret's supersonic airfoil theory.
• Brief introduction to the methods of characteristics.
• Computational methods for gas dynamics.
• Measurements of compressible flow.

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to demonstrate:
• A knowledge and understanding of: the mechanism of compressible gas flow and its interaction with objects, forming of shock waves and other discontinuities in a supersonic flow; effects of friction and heating on the flow.
• An ability to (thinking skills): analyze different regimes of a compressible gas flow, to sketch different wave patterns forming when the flow interacts with an object.
• An ability to (practical skills): compute parameters of compressible flow and shock waves for engineering application (engine nozzle, airfoil, etc.); apply physical and mathematical principles of gas dynamics to various engineering applications.
• An ability to (key skills): study independently, use library and Internet resources and manage working time.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- 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 (SM2b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3b)

Assessment:	Assignment 1 (10%) Assignment 2 (15%) Examination 1 (75%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description:
Examination:
A 4-hour on-line exam done via Canvas (75%)

Coursework:
As a part of coursework (25%) you will be asked to solve different problems on Gas dynamics and answer theoretical questions.

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

Assessment Feedback:
An opportunity to have individual feedback on the coursework submission will be available.

Feedback for the examination will be made available electronically.

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 & YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

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

Available to visiting and exchange students.

This module is assessed by a combination of examination and coursework (two assignments).

25% from continuous assessment (two assignments: 10% week 5, 15% week 9);
75% from end of semester examination - closed book

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

EG-353 Research Project

Credits: 30 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr MR Brown, Mr A Goodfellow, Prof PJ Holliman, Dr AC Tappenden

Format: Formal Lectures 16 hours;
Directed private study (incl. meetings with supervisors) 284 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

Weekly briefings on all aspects of project work, risk assessment, planning, research methods, and ethics as it applies to engineering and research work.

English for academic purposes, writing up, referencing and presenting, the engineering institutions, continuing professional development.

These will be backed up by regular one-on-one meetings with a supervisor who will provide guidance and feedback on an ongoing basis.

Module Aims:

The module involves the application of scientific and engineering principles to the solution of a practical problem associated with engineering systems and processes.

The student will gain experience in working independently on a substantial, individually assigned task, using accepted planning procedures. It will require and develop self-organisation and the critical evaluation of options and results, as well as developing technical knowledge in the chosen topic.

Module Content:

A series of compulsory weekly briefings in Semester 1 will cover topics such as:

- Introduction to the module
- Health, Safety and Risk Assessment
- Project Planning
- Using the Library for Research
- Engineering and Research Ethics
- Academic Integrity
- Referencing

There will also be a series of sessions delivered as part of the Academic Success Programme in Semester 2 to help students with writing of their final paper and preparing for their viva.

The schedule for all taught sessions will be available on Canvas, all briefings will be recorded and also available on Canvas.

Intended Learning Outcomes:
Learning Outcomes are mapped to those required to partially satisfy the educational requirements for Engineering Council Registration as a Chartered Engineer as part of an Accredited BEng Honours Degree Standard (UK HEQF Level 6) as defined by the UK Standard for Professional Engineering Competence (UK-SPEC) and the Accreditation of Higher Education Programmes 3rd Edition (AHEP 3).

The AHEP Learning Outcomes are categorised under six headings:
• Science and mathematics (SM1b, SM2b, SM3b)
• Engineering analysis (EA1b, EA2, EA3b, EA4b)
• Design (D1, D2, D3b, D4, D5, D6)
• Economic, legal, social, ethical and environmental context (EL1, EL2, EL3, EL4. EL5, EL6)
• Engineering practice (P1, P2, P3, P4, P5, P6, P7, P8, P11)
• Additional general skills (G1, G2, G3, G4)

Precisely which subset of skills and learning outcomes will be covered in any particular project will vary, but all projects are expected to demonstrate the following Learning Outcomes at a threshold level:

• SM1b (all assessment components)
• SM3b (all assessment components)
• EA1b (all assessment components)
• EA2 (final paper and viva)
• EA3b (final paper and viva)
• D6 (final paper and viva)
• EL1 (ethics assessment)
• EL3 (project plan, project management)
• P1 (final paper and viva)
• P2 (final paper and viva)
• P4 (final paper and draft introduction)
• P8 (final paper, viva and project management)
• G1 (all assessment components)
• G2 (all assessment components)
• G3 (all assessment components)
• G4 (all assessment components)

Please see the Accreditation of Higher Education Programmes 3rd Edition for full descriptions of the above Learning Outcomes.

Assessment:	Project Planning Statement (5%) Project Management (0%) Progress Report (5%) Project Management (5%) Ethics Assessment (0%) Final Paper (60%) Oral Presentation (20%) Project Management (5%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: Credit bearing assessments:
- Project Planning Statement (5%)
- Progress Report (5%)
- Project Management 1 (5%)
- Final Paper (60%)
- Oral Presentation/Viva (20%)
- Project Management 2 (5%)

Non-credit bearing assessments:
- Ethics Assessment (pass/fail COMPULSORY assessment, must be passed to pass the module)
- Project Management check-in (0%)

Full assessment criteria will be on Canvas.

Moderation approach to main assessment: Universal double-blind marking

Assessment Feedback:
Continuous feedback on progress will be delivered via meetings with supervisors.

Written feedback on assessment components will be delivered via the Feedback Studio.

There will be a formal opportunity to submit a Draft paper for preliminary review to provide detailed feedback to the student and provide the student with an opportunity to make modifications to the paper before final submission.

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.

Only available to students following an Engineering Degree Programme.

The nature of the research project varies from one student to another. Projects may involve design, theoretical, experimental or computational studies.

The academic staff of the Faculty of Science and Engineering produce a list of project descriptors and students are given a chance to select a project over the summer before the start of the academic year. Alternatively students are offered the opportunity to define the topic of their own research project.

Students must attend all relevant weekly briefings, a detailed schedule of which will be available on Canvas.

Each student will be allocated a supervisor and it is recommended that students meet their supervisors at least once a fortnight to discuss progress.

There are a number of compulsory submissions (a project plan; an ethics assessment; a draft introduction; a progress report; a 10-page research paper; evidence of project management and a viva examination).
Precise assessment criteria, deadlines, submission formats and instructions will be disseminated via Canvas.

The Faculty of Science and Engineering ZERO TOLERANCE penalty policy for late submission of coursework and continuous assessment will apply to all assessment elements apart from the final paper submission and viva.

Any late submissions on the final paper (not covered by extenuating circumstances) will be capped at 40%.

If a student fails to attend their scheduled Viva (not covered by extenuating circumstances) rescheduling may be permitted but both elements (presentation and defense) will be capped at 40%.

EG-360 Dynamics 2

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-260

Co-requisite Modules:

Lecturer(s): Dr Y Yuan, Dr N Jamia

Format: This will mostly be taught online with recorded lectures / examples. Depending on university regulations, there might be some in-person example classess.
There will be one hour online/in person live example class, and one online office hour per week (in person, might be possible depending on univeristy regulations).
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

This will mostly be taught online with recorded lectures / examples.

There will be one hour online live example class, and one online office hour per week. Depending on univeristy regualtion, these example classess and office hour can be held in person.
All notes, examples sheets, assignments and past papers available on Canvas.

Module Aims: Building on Dynamics 1, this module introduces the students to matrix analysis in discrete mass-spring damper systems, natural frequencies and mode shapes, principle of orthogonality, normal coordinates, detailed study of 2 degree of freedom systems, higher order systems, forced response, viscous damping, harmonic response, response to general forces, continuous structures, energy methods, displacement models, Rayleigh and Rayleigh-Ritz methods, methods of excitation, transducers, mounting structures, Fourier transforms in forced vibration, aliasing, leakage, FRF estimation, coherence, peak picking, circle fitting, rotordynamics, co-ordinate systems, unbalance and gyroscopic moments, the Jeffcott rotor, whirl, critical speeds, Campbell diagram.

Module Content:

• Matrix analysis in discrete mass-spring damper systems. Natural frequencies and mode shapes. Principle of orthogonality. Normal coordinates. Detailed study of 2 degree of freedom systems. Higher order systems. Forced response. Viscous damping, harmonic response. Response to general forces.
• Continuous structures. Energy methods, displacement models. Rayleigh and Rayleigh-Ritz methods.
• Experimental Modal Analysis. Methods of excitation, transducers, mounting structures. Fourier transforms in forced vibration, aliasing, leakage, FRF estimation, coherence. Peak picking, circle fitting.
• Introduction to rotordynamics. Co-ordinate systems, unbalance and gyroscopic moments. The Jeffcott Rotor, whirl, critical speeds, Campbell diagram.

Intended Learning Outcomes:

Technical Outcomes
- Identify the equations that can be applied to the solution of problems in structural and rotor dynamics. (Evaluated in the examination).
- Demonstrate knowledge and comprehension of the fundamental engineering principles of structural and rotor dynamics (Evaluated in the examination).
- Demonstrate knowledge of vibration test procedures and data acquisition in structural dynamics (Evaluated in the examination).

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 mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b)

Assessment: Examination 1 (80%)
Assignment 1 (10%)
Assignment 2 (10%)

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

Assessment Description: Examination (80%) will be closed-book. A data sheet is available on Canvas.
The assignments (two at 10% each) will consist of quizzes on Canvas.

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

Assessment Feedback:
Automated feedback on the quizzes will be available on Canvas.

Standard University procedures for examination feedback.

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

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

Visiting/Exchange students are eligible to enroll on this module.

Canvas will be used as a repository of all module related documents.

EG-381 Fracture and Fatigue

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-184

Co-requisite Modules:

Lecturer(s): Prof RE Johnston

Format: Lectures: 20 hours
Directed private study: 50 hours
Preparation for assessment: 30 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

The module will be taught mainly through the medium of lectures and tutorials delivered on campus, supplemented by case studies.

Module Aims:
To provide a detailed understanding of fracture mechanics and fatigue of materials; relating to real-world case studies and current cutting-edge research. Failure of biological and engineered materials.

Module Content:
• Static Fracture; theoretical strengths, ductile failure, brittle failure mechanisms, ductile to brittle transitions, recognising microstructures features of damage and artificial intelligence ways of classifying.
• Biological material failure and toughening mechanisms.
• Stress intensity factors; plane strain and plane stress, crack opening modes, stress concentrations, local yielding.
• Measurement of fracture toughness, KQ and K1C.
• Fatigue; mechanisms, initiation and growth, mechanisms of initiation, fatigue fracture surfaces.
• Stress and strain dependence of fatigue; S-N curves, low & high cycle fatigue, cycle softening & hardening, hysteresis loops.
• Damage tolerance approach to fatigue; stress intensity range, the Paris relationship, measurement of crack propagation.
• Fatigue crack thresholds.
• Crack closure mechanisms; R values, stress reversals.

Intended Learning Outcomes: Technical Outcomes
On successful completion of the module, students should be able to demonstrate knowledge and understanding of:
• The behaviour of cracks in materials and the associated theoretical modelling of them.
• Failure in biological materials, and natural mechanisms to prevent failure
• Fracture mechanics and how it can be used to prevent static and fatigue failure.
• How the structure of materials can be used to control the crack-growth behaviour.
• How to apply mathematical concepts to predicting crack behaviour and use this to design to avoid failure.
• The use of modern fracture mechanics methods to undertake materials design, predict lifetimes, and undertake failure analysis.
• How to relate underlying microstructural details to engineering applications.
• The application of mathematical techniques to solve engineering design issues.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2)

Assessment:	Coursework 1 (35%) Coursework 2 (5%) Coursework 3 (30%) Coursework 4 (10%) Coursework 5 (20%)

Assessment Description: C1: Fracture and microstructures
C2: Escape Room
C3: K1C
C4: Miner's Rule
C5: Course wrap up

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

Assessment Feedback:
Feedback will be provided via a document that highlights potential areas for improvement, based on the examination. This will highlight common areas where mistakes were made, where improvements could be included, and also good practice.
During the coursework, discussion classes will be held after coursework is complete to discuss the students' approaches and to give the opportunity for questions and discussion.

Also, standard Feedback Forms will be completed and made available to students

Failure Redemption: Students will be expected to undertake a resit in all failed components.

Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of resitting the failed coursework components.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of resitting the failed coursework components.

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
Detailed course notes provided as slides, screencasts, recorded lectures, with accompanying background notes.

EG-396 Computational Aerodynamics

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr TN Croft

Format: The primary contact hours for the module are 22 hours of lectures and 11 hours of computer laboratories. In addition there will be an optional office hour in each week of the teaching weeks.

Delivery Method: 22 hours of lectures will be used to deliver the theory associated with the module. This will be supported by reading material and short recordings that will be available in Canvas. There will additionally be 11 hours of computer laboratories that will provide support in learning to use computational fluid dynamics software and time to work on the assignments. Recordings that will provide tutorials for the use of the computer software (Ansys Fluent, SolidWorks) and algorithms (MATLAB) for support of the assignments will be available on Canvas.

In addition to the schedule contact hours students will be expected to spend around 25 hours completing the assignments, 30 hours of self-learning and 12 hours preparing and completing the the examination.

Module Aims: This module provides a concise overview on the basic principles of computational fluid dynamics as used in subsonic aerodynamics. The topics include the governing equations, finite difference and finite volume methods and iterative linear solvers. Training will also be provided on the use of computational fluid dynamics software as well as the implementation of relevant computational methods.

Module Content: Introduction to the module [1]
The physics of aerodynamics [1]
The aerodynamics equations [4]
An overview of the computational methods [4]
The finite difference method [4]
Linear solvers [4]
The finite volume method [4]

Intended Learning Outcomes: On successful completion of this module, students should be able, at threshold level, to:

• Construct a computational fluid dynamics model for a aerodynamics problem and evaluate the model's predictions. (Evaluated in the first assignment, B3)
• Implement and compare computational methods used by computational fluid dynamics software and review the performance of the methods. (Evaluated in the second assignment, B3)
• Demonstrate knowledge, application and evaluation of the principles of computational fluid dynamics. (Evaluated in the examination, B3)

Note: The B3 et cetera codes relate to accreditation learning outcomes

Assessment: Examination 1 (60%)
Assignment 1 (20%)
Assignment 2 (20%)

Resit Assessment: Examination (Resit instrument) (60%)
Assignment resit (20%)
Assignment resit (20%)

Assessment Description: Assignment 1 - The assignment will require the students to set up a computational model of an aeronautical related application. The initial set up will closely follow a tutorial. The students will then be asked to review the results they have obtained and investigate ways to improve them. The submission will be a formal report, 10 pages maximum. The format for the report will be described in the assignment descriptor. This is an individual piece of coursework..

Assignment 2 - The assignment will require the students to implement and compare computational methods used by computational fluids dynamics software. The submission will be a formal report, 10 pages maximum, plus any code developed as part of the solution. The format of the report will be the same as that used in the first assignment. This is an individual piece of coursework.

Examination - This will be an in person, closed book examination with a duration of 2 hours. The examination will consist of a mixture of compulsory questions and some optional questions.

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

Assessment Feedback: Feedback on the assignments will be available on Canvas. This will take the form of a worked solution to the set problems.

Examination feedback will be available through the standard feedback forms used by engineering and made available through the Canvas community pages.

Failure Redemption: Failure in the module can be redeemed through repeating the equivalent of any failed assessment. Marks in assessments passed at the first attempt will carry through to the equivalent assessment in the resit. The module mark will be capped for the resit but individual assessment marks will not be capped.

Additional Notes: Penalty for late submission of continuous assessment assignment:
No marks awarded for late submission.

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

EG-397 Propulsion

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof MT Whittaker

Format: Lectures: 20 hours
Example classes: 10 hours
Reading/Private Study: 40 hours
Preparation for Assessment: 30 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

Lecture based at University campus

Module Aims: The course aims to provide a basic understanding of propulsion systems in order to contribute to graduating students obtaining a holistic understanding of the aerospace sector. The course includes:
• Propulsion unit requirements for subsonic and supersonic flight
• Piston engine components and operation
• Propeller theory
• Gas turbine engines: operation, components and cycle analysis
• Thermodynamics of high speed gas flow
• Efficiency of components
• Rocket motors: operation, components and design
• Dynamics of rocket flight
• Environmental issues

Module Content:
• Propulsion unit requirements for subsonic and supersonic flight
• Piston engine components and operation
• Propeller theory
• Gas turbine engines: operation, components and cycle analysis
• Thermodynamics of high speed gas flow
• Efficiency of components
• Rocket motors: operation, components and design
• Dynamics of rocket flight
• Environmental issues

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to demonstrate:

• A knowledge and understanding of:
Propulsion techniques used for aircraft, spacecraft and helicopters (Coursework assessment, exam).

• An ability to:(assessed by)
- Analyse various types of propulsion system and where they are most applicable (exam)
- Evaluate the thermodynamic performance of a propulsion system (Coursework assessment, exam)
- Critically analyse the basic performance characteristics of engines relevant to the performance of the craft which they power (exam).

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)

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

Assessment Description: 2 hr examination (80%)

Coursework assignment (via Canvas) - Piston engines/Gas turbines/Rockets - Summative assessment (20%). This Canvas test aims to develop understanding of the workings of, and calculations for gas turbine and rocket engines including high speed gas flows. This is an individual piece of coursework.

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

Assessment Feedback: Written feedback provided on coursework assignments.
Verbal feedback provided through model answers on coursework assignments in examples classes.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

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

Available to visiting students.

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

Assessment: 20% Coursework, 80% examination

Notes, past papers and supporting material for this module can be found on Canvas

EGA301 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 delivered on-campus.

Assessment will be by a combination of in-person (on-Campus) Exam (85%) and coursework (15%)

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 and 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 ; (2 hrs)

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to:
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.

Learning Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- 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 (SM2b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Communicate their work to technical and non-technical audiences (D6)
- Knowledge of characteristics of particular materials, equipment, processes, or products (P2)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

Assessment: Examination 1 (85%)
Coursework 1 (15%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Assessment is via a take-home examination (85%) at the end of the Semester and a coursework assignment worth 15%.

Moderation approach to main assessment: Universal second marking 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 coursework via Canvas.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

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

Available to visiting and exchange students.

Detailed course material provided on Canvas which students should engage with in their own time.

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION

EGA302A Aerospace Engineering Design 3

Credits: 20 Session: 2022/23 September-June

Pre-requisite Modules: EG-263

Co-requisite Modules:

Lecturer(s): Mr JK Mcfadzean, Prof BJ Evans, Dr Z Ren, Dr AD Shaw

Format: 10 hours of lectures (some of which will be delivered as video lectures)
2 hours of feedback classes
40 hours of lab classes
10 hours of group meetings
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

Continuous Assessment 100%

Some lectures/presentations and brain storming sessions as required, but the majority of work will be group-based and take place in CAD computer design lab sessions with supervision. There will also be regular drop in sessions with the module coordinator for queries and progress and feedback discussions.

Additional notes:

Projects are allocated during week 1 and groups should meet with their supervisor regularly (fortnightly recommended).
Guidance on writing project reports will be given separately.
Practical sessions for simulation and model build, majority in Semester Two

Module Aims: The module is a group design project for year 3 aerospace engineering students. Students are required to design an aerospace vehicle from an initial set of mission requirements and constraints through concept design to detailed design and flight testing. It requires students to draw on knowledge from a range of modules across the aerospace engineering course. Each student will specialise in one of six areas: aerodynamics, structures, materials & propulsion, weight & performance, control systems or dynamics & stability.

Groups will be required to submit a series of group design reports at each stage in the design process as well as deliver presentations to the rest of the class. Each student will also take a turn acting as chief engineer and a reflective essay is required after the student's time as the chief engineer.

By the end of the module students should have an understanding of the process and complexities involved in designing an aerospace vehicle from scratch and appreciate the multi-disciplinary nature of this task. Note that since this module is, in part, explicitly assessing students' ability to work effectively within a team environment the group submissions and peer review components of assessment cannot be excluded for extenuating circumstances.

Module Content: Group design project of a multi-disciplinary nature and involving conceptual, preliminary and detailed design. The project will have the opportunity for industrial links and applications. Students will be required to produce highly technical design concepts whilst evaluating manufacturing and cost implications. Each student will be required to take responsibility for particular aspects of the design during the term which will form an important part of the assessment process. The work will be presented in the form of group project reports and group presentations.

Intended Learning Outcomes: Technical Outcomes
On successful completion of this unit students will be expected, at threshold level, to be able to:
• Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context (D1) - assessed via Concept Design Presentation
• 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) - assessed via Final Report assignment
• 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 (D3) - assessed via Final Report assignment
• Apply advanced problem-solving skills, technical knowledge and understanding, to establish rigorous & creative solutions that are fit for purpose for all aspects of the problem including production, operation and maintenance (D4) - assessed via Detailed Design Presentation
• Plan and manage the design process (D5) - assessed through Chief Engineer Reflection and Design Diary assignments
• Communicate their work to technical and non-technical audiences (D6) - assessed through presentation assignments and final poster assignment
• Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D7) - assessed via Final Report assignment
• Demonstrate the ability to generate an innovative design for products, systems, components or processes to fulfil new needs (D8) - assessed via Final Report assignment

Accreditation Outcomes (AHEP)
- 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)
- Work with information that may be incomplete or uncertain and quantify the effect of this on the design (D3)
- Apply advanced problem-solving skills, technical knowledge and understanding, to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal (D4)
- Plan and manage the design process, including cost drivers, and evaluate outcomes (D5)
- Communicate their work to technical and non-technical audiences (D6)

- 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)
-Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D7m)

- Apply an integrated or systems approach to the solution of broadly-defined problems (B6)
- Use a risk management process to identify, evaluate and mitigate risks (the effects of uncertainty) associated with a particular project or activity (B9)
- Adopt a holistic and proportionate approach to the mitigation of security risks (B10)
- Apply knowledge of engineering management principles, commercial context, project management and relevant legal matters (B15)
- Function effectively as an individual, and as a member or leader of a team (B16)
- Communicate effectively with technical and non-technical audiences (B17)

Assessment:	Group Work - Presentation (5%) Group Work - Coursework (15%) Group Work - Presentation (10%) Group Work - Practical (15%) Group Work - Coursework (30%) Group Work - Coursework (10%) Group Work - Project (15%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: EGA302A requires individuals to support the overall group project objectives and fully participate in activities, presentations, and written project work. The groupwork component marks are scaled according to the Individual contribution (IC) marks from your peers and supervisor, and this will have a significant impact on your final grade, in addition to the 15% weighting that the IC component receives. As an example, a group average of 60% could see a highly motivated student with good IC marks and contribution be scaled to a 70% plus mark. A poor student with low IC marks and contribution will find themselves around the 40% mark. An individual student must ensure the group work and effort is fully supported throughout the year or you may lose marks. Equally, those who contribute fully will be recognised for their group and individual effort and support.

Assessment 1: Concept design presentation
Assessment 2: Preliminary design report
Assessment 3: Detailed design progress presentation
Assessment 4: Model fabrication and flight testing
Assessment 5: Final report and poster
Assessment 6: Chief engineer reflection & design diary
Assessment 7: Individual contribution and peer review

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

Assessment Feedback: Lecturers will provide feedback on presentations during lecture and laboratory sessions.
Written assessments will be submitted via Turnitin with electronic feedback provided via Canvas.
Fortnightly design review sessions will be provided for ongoing face-to-face feedback.
Peer review for continuous assessments will be given more emphasis to alleviate any student concerns about individual contributions being recognised within group work.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit this will take the form of 100% supplementary coursework.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit this will take the form of 100% supplementary coursework.

Additional Notes: Delivery of both teaching and assessment will be blended, primarily as face to face lectures and computer labs on campus. There will be online activities included. Practical work will form part of the teaching and assessment.

There will be a ZERO TOLERANCE policy for late submission of coursework on this module.

NOT AVAILABLE to visiting and exchange students.

EGA321 Satellite Systems

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-260; EGA215

Co-requisite Modules: EG-335; EG-360; EGA341

Lecturer(s): Dr I Sazonov

Format: Lectures 20 hours.
Example classes 10 hours.
Direct 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

This module will consist of lectures focused on satellite environment, orbiting, satellite platform, communications, satellite navigation, etc; and example classes concentrating on application of the theoretical principals to solution of practical examples related to satellites.

Module Aims:

This module introduces students to earth orbiting satellites, their launch, the environment they operate in and how they are controlled, before moving on to satellite communcation technologies, applications of earth orbiting satellites and the technologies behind this.

Module Content:

1. Satellite missions and types of orbits associated with the given mission.
2. Environment in which satellites operate at different stage of their mission
3. Satellite orbiting and orbit manouevre
4. Satellite and launcher propulsion systems
5. Attitude, power and thermal control
6. Satellite communications
7. Telecommunication antennas
8. Satellite navigation
9. Small satellites
10. Impact protection for satellites

Intended Learning Outcomes: Technical Outcomes

After completing this module you should be able to demonstrate:

• A good knowledge about various satellite systems
• A good knowledge about the satellite platform and satellite control methods
• An understanding about satellite environment and how it should be accounted in the satellite design
• An understanding of satellite communication technologies
• A good knowledge of satellite applications
• Ability to solve various engineering problems related to satellite systems

Accreditation Outcomes (AHEP)

- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- 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 (SM2b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1b)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3b)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems. (EA4b)

Assessment:	Assignment 1 (10%) Assignment 2 (15%) Examination 1 (75%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description:
Examination:
A 4-hour on-line exam done via Canvas (75%)

Coursework:
As a part of coursework (25%) you will be asked to solve different problems on Gas dynamics and answer theoretical questions.

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

Assessment Feedback:
An opportunity to have individual feedback on the coursework submission will be available.

Feedback for the examination will be made available electronically.

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

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

Available to visiting and exchange students.

This module is assessed by a combination of examination and coursework (two assignments).

25% from continuous assessment (two assignments: 10% week 6, 15% week 10);
75% from end of semester examination - closed book

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

EGA341 Space Propulsion and Power Systems

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr Z Jelic, Dr K Wada

Format: 20 hours of lectures, 10 hours of example classes.
100 hours of directed study.

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

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

This module will be delivered on campus.

Module Aims: The module will introduce past, current and future developments in technology used in space propulsion and power systems for space vehicles. The lecturing topics will cover majority of relevant theories and practical applications related to the space vehicles launch phase, manoeuvring and deep space missions.

Module Content: - Rocket Propulsion Introduction: thrust, impulse, specific impulse; Ideal Rocket and Ideal Rocket Nozzle: Ideal performances, characteristic velocity C* and thrust coefficient Cf
- Real Nozzles : Convergent Divergent Nozzle Geometry, Nozzle flow, Over-expansion, Under-expansion, Nozzle Losses
- Chemical Propulsion - Classification of the Propellants: Liquid, Solid, Hybrid
- Rocket propellants thermochemistry: molar mass , enthalpy, Gibbs free energy, specific heat ratio and adiabatic flame temperature calculation for combustion product mixture; Chemical equilibrium analysis and calculations: chemical kinetic, equilibrium flow, frozen flow
- Liquid rocket engines: interior ballistics – engine cycles, injection process, combustion pressure, pressure drops, and characteristic length;
- Solid rocket motors: propellant grain shapes, interior ballistics, burning rate, combustion chamber pressure, thermal sensitivity, two phase flow
- Hybrid rocket motors: interior ballistic, propellant grain, steady-state operation
- Liquid rocket engine subsystems: turbo pumps, valves, injectors, piping. Liquid rocket engine control: ignition, thrust vector, thrust magnitude control
- Heat transfer inside rocket engines: convection, conduction and radiation; thermal insulation, ablative protection, radiative, film, dump and regenerative cooling;
- Thin walled structures – solid rocket combustion chambers, liquid rocket combustion chambers, liquid rocket propellant tanks
- Nuclear Thermal Rocket Engine
- Electric Propulsion Systems (Thrusters): electromagnetism, charged particles – ionization of gases, plasma
- Electrothermal Propulsion: Resistojets, Arcjets, Electrical Discharges
- Electromagnetic Propulsion: Lorentz Force, MagnetoPlasmaDynamic Thrusters, Pulsed Plasma Thrusters
- Electrostatic Propulsion: Ion Engines, Hall Thrusters, Field Emission Electric Propulsion
- Solar sail and solar power sail
- Spacecraft Energy Systems, Onboard Electrical Power Sources, Power Generation, Storage and Distribution
- Power Sources: batteries, fuel cells, radio isotope generators, nuclear reactors, solar power, solar cells
- Power Storage: accumulators, regenerative fuel cells, flywheels
- Power Distribution, Power Regulation and Control

Intended Learning Outcomes: Technical Outcomes
On successful completion of this module students will be expected, at threshold level, to be able to:
• Describe and explain various propulsion systems and their advantages during different mission stages, for example launch, manoeuvring and deep space missions (Assessed in the examination; SM1p,m; SM2p,m; SM3p,m; SM4m; EA1p,m; EA2p,m;)
• Describe and explain various energy systems used on spacecraft including the power sources, power storage devices and power distribution (Assessed in the examination; SM1p,m; SM2p.m; SM3p,m; SM4m; EA1p,m; EA2p,m;)
• Identify and calculate basic requirements for space propulsion and power systems (Assessed in the examination; SM1p,m; SM2p,m; SM3p,m; SM4m; EA1p,m; EA2p,m;)
• Analyse design aspects of a propulsion system and to calculate its performance (Assessed in the coursework; SM1p,m; SM2p,m; SM3p,m; SM4m; EA1p,m; EA2p,m; D4p,m;)

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1b)
- 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 (SM2b)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1p)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Apply advanced problem-solving skills, technical knowledge and understanding, to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal (D4)

Extended Learning Outcomes:
KU2 Have an appreciation of the wider multidisciplinary engineering context and its underlying principles, particularly when applied to design.
KU3 Appreciate the social, environmental, ethical, economic and commercial considerations affecting the exercise of their engineering judgement.
D1 Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues.
D4 Use creativity to establish innovative solutions.
D5 Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal
P1 Knowledge of characteristics of particular equipment, processes or products
P6 Understanding of appropriate codes of practice and industry standards
P8 Ability to work with technical uncertainty
PS1 Possess practical engineering skills acquired through, work carried out in laboratories and workshops; in individual and group project work; in design work; and in the use of computer software in design, analysis and control
S3 Understanding of the requirement for engineering activities to promote sustainable development
S4 Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues.
S5 Understanding of the need for a high level of professional and ethical conduct in engineering

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

Assessment Description:
The coursework will require the student to undertake an exercise related to propulsion system design and/or to calculate power system requirements. The coursework will be an individual exercise.

The standard examination format, in examination venue, will require three questions out of four to be answered. The duration of the examination will be 2 hours. The examination will be closed book.

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

Assessment Feedback: Feedback on the coursework will be provided through VLE - CANVAS. Dependent on the nature of the assignment this may be the solution to the coursework, marked version of the student¿s individual submission or via a marking rubric.

Feedback on the examination will be via the The Faculty of Science and Engineering examination feedback form.

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 (e.g. Level 6 - Level M) progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

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

Available to visiting and exchange students.

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