Swansea University
Prifysgol Abertawe

# FACULTY OF SCIENCE AND ENGINEERING

## UNDERGRADUATE STUDENT HANDBOOK

## YEAR 2 (FHEQ LEVEL 5)

# MECHANICAL ENGINEERING

## DEGREE PROGRAMMES

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

## DISCLAIMER

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

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

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

**The 22-23 academic year begins on 26 September 2022**

Full term dates can be found here

**DATES OF 22-23 TERMS**

26 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

**SEMESTER 1**

26 September 2022 – 27 January 2023

**SEMESTER 2**

30 January 2023 – 09 June 2023

**SUMMER**

12 June 2023 – 22 September 2023

## IMPORTANT

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

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

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

**Welcome to the Faculty of Science and Engineering!**

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

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

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

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

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

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

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

| Faculty of Science and Engineering | |
|---|---|
| Interim Pro-Vice Chancellor/Interim Executive Dean | Professor Johann Sienz |
| Head of Operations | Mrs Ruth Bunting |
| Associate Dean – Student Learning and Experience (SLE) | Professor Paul Holland |
| **School of Aerospace, Civil, Electrical, General and Mechanical Engineering**<br>**Head of School: Professor Antonio Gil** | |
| School Education Lead | Professor Cris Arnold |
| Head of Mechanical Engineering | Dr Andrew Rees |
| Mechanical Engineering Programme Director | Dr Eifion Jewell e.jewell@swansea.ac.uk |
| Year 2 Coordinator | Dr Rajesh Ransing R.S.Ransing@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 2 (FHEQ Level 5) 2022/23
# Mechanical Engineering

**BEng Mechanical Engineering[H300,H307]**
**BEng Mechanical Engineering with a Year Abroad[H308]**
**MEng Mechanical Engineering[H304]**
**MEng Mechanical Engineering with a Year Abroad[H309]**

**Coordinator: Dr RS Ransing**

## Compulsory Modules

| Semester 1 Modules | Semester 2 Modules |
|---|---|
| **EG-261**<br>**Thermodynamics 2**<br>**10 Credits**<br>**Dr RS Ransing**<br>**CORE** | **EG-243**<br>**Control Systems**<br>**10 Credits**<br>**Dr A Egwebe**<br>**CORE** |
| **EG-264**<br>**Computer Aided Engineering**<br>**10 Credits**<br>**Dr AC Tappenden**<br>**CORE** | **EG-260**<br>**Dynamics 1 (Mech & Aero)**<br>**10 Credits**<br>**Prof H Haddad Khodaparast**<br>**CORE** |
| **EG-269**<br>**Design of Machine Elements**<br>**10 Credits**<br>**Dr CA Griffiths**<br>**CORE** | **EG-262**<br>**Stress Analysis 1**<br>**10 Credits**<br>**Dr JA Baker**<br>**CORE** |
| **EGA265**<br>**Fluid Mechanics 2**<br>**10 Credits**<br>**Dr S Pant**<br>**CORE** | **EG-284**<br>**Manufacturing Technology II**<br>**10 Credits**<br>**Prof TC Claypole**<br>**CORE** |
| | **EGA214**<br>**Mechanical Engineering Design 2**<br>**10 Credits**<br>**Dr PJ Dorrington/Dr W Harrison/Dr B Morgan/Dr JS Thompson**<br>**CORE** |
| **EG-268**<br>**Experimental Studies - Mechanical**<br>**10 Credits**<br>**Dr H Arora/Dr A Coccarelli/Dr H Madinei/Dr B Morgan/Dr S Pant**<br>**CORE** | |
| **EG-277**<br>**Research Project Preparation**<br>**0 Credits**<br>**Dr MR Brown/Mrs KM Thomas** | |
| **Total 120 Credits** | |

## Optional Modules

Choose exactly 20 credits
Design Pathway

| | | | | |
|---|---|---|---|---|
| **EG-231** | Heat Transfer | Dr A Coccarelli/Dr DR Daniels | TB1 | 10 (CORE) |
| **EG-255** | Circuit Analysis | Prof PM Holland | TB1 | 10 (CORE) |

**Or**

Choose exactly 20 credits
Manufacturing Pathway

| | | | | |
|---|---|---|---|---|
| **EG-231** | Heat Transfer | Dr A Coccarelli/Dr DR Daniels | TB1 | 10 (CORE) |
| **EG-255** | Circuit Analysis | Prof PM Holland | TB1 | 10 (CORE) |
| **EGA266** | Digital Manufacturing | Dr PJ Dorrington/Dr AA Fahmy Abdo/Mr AJ Morgan/.. | TB1 | 10 (CORE) |

# Year 2 (FHEQ Level 5) 2022/23
# Mechanical Engineering
### BEng Mechanical Engineering with a Year in Industry[H305]
### MEng Mechanical Engineering with a Year in Industry[H306]

**Coordinator: Dr RS Ransing**

## Compulsory Modules

| Semester 1 Modules | Semester 2 Modules |
|---|---|
| **EG-261**<br>**Thermodynamics 2**<br>**10 Credits**<br>**Dr RS Ransing**<br>**CORE** | **EG-243**<br>**Control Systems**<br>**10 Credits**<br>**Dr A Egwebe**<br>**CORE** |
| **EG-264**<br>**Computer Aided Engineering**<br>**10 Credits**<br>**Dr AC Tappenden**<br>**CORE** | **EG-260**<br>**Dynamics 1 (Mech & Aero)**<br>**10 Credits**<br>**Prof H Haddad Khodaparast**<br>**CORE** |
| **EG-269**<br>**Design of Machine Elements**<br>**10 Credits**<br>**Dr CA Griffiths**<br>**CORE** | **EG-262**<br>**Stress Analysis 1**<br>**10 Credits**<br>**Dr JA Baker**<br>**CORE** |
| **EGA265**<br>**Fluid Mechanics 2**<br>**10 Credits**<br>**Dr S Pant**<br>**CORE** | **EG-284**<br>**Manufacturing Technology II**<br>**10 Credits**<br>**Prof TC Claypole**<br>**CORE** |
| | **EGA214**<br>**Mechanical Engineering Design 2**<br>**10 Credits**<br>**Dr PJ Dorrington/Dr W Harrison/Dr B Morgan/Dr JS Thompson**<br>**CORE** |
| **EG-233**<br>**Placement Preparation: Engineering Industrial Year**<br>**0 Credits**<br>**Prof GTM Bunting/Dr CME Charbonneau/Dr P Esteban/Dr SA Rolland/Dr V Samaras/Dr S Sharma** | |
| **EG-268**<br>**Experimental Studies - Mechanical**<br>**10 Credits**<br>**Dr H Arora/Dr A Coccarelli/Dr H Madinei/Dr B Morgan/Dr S Pant**<br>**CORE** | |
| **EG-277**<br>**Research Project Preparation**<br>**0 Credits**<br>**Dr MR Brown/Mrs KM Thomas** | |
| **Total 120 Credits** | |

## Optional Modules

Choose exactly 20 credits

Design Pathway

| | | | | |
|---|---|---|---|---|
| **EG-231** | Heat Transfer | Dr A Coccarelli/Dr DR Daniels | TB1 | 10 (CORE) |
| **EG-255** | Circuit Analysis | Prof PM Holland | TB1 | 10 (CORE) |

**Or**

Choose exactly 20 credits

Manufacturing Pathway

| | | | | |
|---|---|---|---|---|
| **EG-231** | Heat Transfer | Dr A Coccarelli/Dr DR Daniels | TB1 | 10 (CORE) |
| **EG-255** | Circuit Analysis | Prof PM Holland | TB1 | 10 (CORE) |
| **EGA266** | Digital Manufacturing | Dr PJ Dorrington/Dr AA Fahmy Abdo/Mr AJ Morgan/.. | TB1 | 10 (CORE) |

# Year 2 (FHEQ Level 5) 2022/23
# Mechanical Engineering
### MEng Mechanical Engineering with a Year in Industry

**Coordinator: Dr RS Ransing**

### Compulsory Modules

| Semester 1 Modules | Semester 2 Modules |
|---|---|
| **EG-261**<br>**Thermodynamics 2**<br>**10 Credits**<br>**Dr RS Ransing**<br>**CORE** | **EG-243**<br>**Control Systems**<br>**10 Credits**<br>**Dr A Egwebe**<br>**CORE** |
| **EG-264**<br>**Computer Aided Engineering**<br>**10 Credits**<br>**Dr AC Tappenden**<br>**CORE** | **EG-260**<br>**Dynamics 1 (Mech & Aero)**<br>**10 Credits**<br>**Prof H Haddad Khodaparast**<br>**CORE** |
| **EG-269**<br>**Design of Machine Elements**<br>**10 Credits**<br>**Dr CA Griffiths**<br>**CORE** | **EG-262**<br>**Stress Analysis 1**<br>**10 Credits**<br>**Dr JA Baker**<br>**CORE** |
| **EGA265**<br>**Fluid Mechanics 2**<br>**10 Credits**<br>**Dr S Pant**<br>**CORE** | **EG-284**<br>**Manufacturing Technology II**<br>**10 Credits**<br>**Prof TC Claypole**<br>**CORE** |
| | **EGA214**<br>**Mechanical Engineering Design 2**<br>**10 Credits**<br>**Dr PJ Dorrington/Dr W Harrison/Dr B Morgan/Dr JS Thompson**<br>**CORE** |
| **EG-233**<br>**Placement Preparation: Engineering Industrial Year**<br>**0 Credits**<br>**Prof GTM Bunting/Dr CME Charbonneau/Dr P Esteban/Dr SA Rolland/Dr V Samaras/Dr S Sharma**<br>**CORE** | |
| **EG-268**<br>**Experimental Studies - Mechanical**<br>**10 Credits**<br>**Dr H Arora/Dr A Coccarelli/Dr H Madinei/Dr B Morgan/Dr S Pant**<br>**CORE** | |
| **EG-277**<br>**Research Project Preparation**<br>**0 Credits**<br>**Dr MR Brown/Mrs KM Thomas** | |
| **Total 120 Credits** | |

### Optional Modules
Choose exactly 20 credits
Design Pathway

| | | | | |
|---|---|---|---|---|
| **EG-231** | Heat Transfer | Dr A Coccarelli/Dr DR Daniels | TB1 | 10 (CORE) |
| **EG-255** | Circuit Analysis | Prof PM Holland | TB1 | 10 (CORE) |

**Or**
Choose exactly 20 credits
Manufacturing Pathway

| | | | | |
|---|---|---|---|---|
| **EG-231** | Heat Transfer | Dr A Coccarelli/Dr DR Daniels | TB1 | 10 (CORE) |
| **EG-255** | Circuit Analysis | Prof PM Holland | TB1 | 10 (CORE) |
| **EGA266** | Digital Manufacturing | Dr PJ Dorrington/Dr AA Fahmy Abdo/Mr AJ Morgan/.. | TB1 | 10 (CORE) |

# EG-231 Heat Transfer

**Credits: 10 Session: 2022/23 September-January**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Dr A Coccarelli, Dr DR Daniels

**Format:** In-person or Zoom 25 hours
Discussion forum/email 5 hours
Canvas study 10 hours
Independent study 60 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.

**Module Aims:** The module aims to provide a comprehensive introduction to heat transfer principles and its applications. The encountered problems will involve mechanisms of conduction, convection and radiation.

**Module Content:** - Conduction: heat equation, Fourier's law, one-dimensional conduction, composite materials, thick cylinders, insulation, heat generation. [6]
- Convection: forced and natural convection, dimensional analysis, convective heat transfer coefficient derivation, flow in and outside tubes and planes, overall heat transfer coefficient, internal and external flow over banks of tubes, phase change effects. [5]
- Heat Exchangers: counter and co-current flow, log mean temperature difference, types of heat exchanger and applications, epsilon-NTU method. [6]
- Unsteady state heat transfer: heating and cooling fluid in confined domain. [2]
- Radiation: mechanism, Stefan-Boltzmann law, emissivity, wavelength and emissive power dependency, radiation into a large enclosure, radiative heat transfer coefficient. [4]
- Combined heat transfer mechanisms: net energy transfer. [2]

**Intended Learning Outcomes:** Technical Outcomes
Upon completion of this module, the student should be able to:
• Explain the fundamental concepts and mechanisms of heat transfer and identify them for a broad variety of representative problems, from everyday practical situations to mechanical and process engineering;
• Analyze and solve conductive and convective heat transfer problems including composite planar surfaces, thin and thick-walled pipes, spherical objects;
• Identify heat transfer coefficients by using experimentally-derived correlations;
• Design and analyze thermal performances of basic process equipment including heat exchangers and tanks;
• Analyze and solve problems involving radiative heat transfer from source to surroundings;
• Analyze, deconstruct and solve heat transfer problems involving combined heat transfer mechanisms.

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 identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2).

**Assessment:** Examination 1 (80%)
Class Test 1 - Coursework (10%)
Class Test 2 - Coursework (10%)
**Resit Assessment:** Examination (Resit instrument) (100%)

**Assessment Description:** 2 Canvas quizzes (10% each) and final exam 80%

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

**Assessment Feedback:** A feedback form for the examination will be available electronically.

**Failure Redemption:** Supplementary exam.

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

Available to visiting and exchange students.

# EG-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-243 Control Systems

**Credits: 10 Session: 2022/23 January-June**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Dr A Egwebe

**Format:** Lectures: 22 hours
Example classes: 10 hours
Directed private study: 68 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

Lectures with assessment by coursework and examination

**Module Aims:** The module introduces the topic of feedback control systems and presents methods of modelling that lead to transient, steady-state, and stability performances in control systems. An emphasis is placed on links between time responses and complex frequency domains. Principal topics are feedback systems, focusing on the system characteristic equation and its solution. There is an emphasis on the root-locus approach in studying stability conditions and compensation design. The overall aim is to understand and be able to apply basic techniques, using relevant software tools, for the analysis and design of feedback control systems.

**Module Content:** • Dynamic systems generally;
• Examples of feedback systems and practical performance criteria;
• Time and frequency response analysis;
• Differential equations and the implications of feedback;
• Open and closed loop control system configurations;
• Closed loop characteristics from open-loop transfer functions;
• Stability in the context of negative feedback;
• Complex frequency domain representations;
• Solutions of the characteristic equation, Bode, Nyquist and root-locus techniques;
• Design to meet stability and error performance criteria;
• Proportional, integral and differential (PID) compensation and their role in designs to meet a specification.

**Intended Learning Outcomes:**
Technical Outcomes
- Upon completion of this module the student should be able to demonstrate a knowledge and understanding of:
- The influence of feedback on dynamic systems;
- The characteristic equation and its importance in feedback systems;
- The link between open-loop and closed-loop transfer functions;
- Stability criteria;
- Steady-state accuracy;
- Time and frequency responses.

Accreditation Outcomes (AHEP)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3b/EA3p)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems (EA4b)
- 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/SM2p)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support the study of their own engineering discipline (SM3b/SM3p)
- Work with information that may be incomplete or uncertain and quantify the effect of this on the design (D3b/D3p)

**Assessment:** Examination 1 (70%)
Coursework 1 (5%)
Coursework 2 (10%)
Coursework 3 (15%)

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

**Assessment Description:**
Coursework:
Three electronic online tests with randomised coefficients/questions will be set during the semester. There will be an opportunity to practice similar exercises before attempting each test. Each test is an individual piece of coursework.

Coursework 1 - Weighting 5%

Coursework 2 - Weighting 10%

Coursework 3* - Weighting 15%

* Coursework 3 will include a one-hour continuous professional development course that students must complete online. It will be assessed by submitting a completion certificate and a reflective blog.

The closed-book examination is worth 70% of the module. The examination consists of 3 questions and students are expected to answer all questions. Question 1 is weighted 30%, and the 2 other questions each weigh 20%. The examination topics will be those presented in the lectures.

NOTE: In order for the coursework marks to be included in the overall module mark, students must achieve at least 30% in the examination. .

**Moderation approach to main assessment:** Partial second marking

**Assessment Feedback:** Standard University procedure via a generic form. Information is given on popularity of the individual questions, relative performances across the cohort and common mistakes.Other information includes the class grade for each question (1st class, 2:1 class, 2:2 class, 3rd class and fail) achieved by the cohort.

Individual students can make appointments with the lecturer to receive general feedback on the examination where this is requested.

**Failure Redemption:** If a student is awarded a re-sit: Failure Redemption of this module will be by 100% Examination only.

**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

NOTE: In order for the coursework marks to be included in the overall module mark, students must achieve at least 30% in the examination. .

# EG-255 Circuit Analysis

**Credits: 10 Session: 2022/23 September-January**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Prof PM Holland

**Format:** In-person or Zoom 22 hours
Discussion forum/email 11 hours
Canvas study 22 hours
Independent study 56 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:** Circuit Analysis is developed as a blended learning module that is delivered online with optional in-person sessions for 2021/2022. There will be a self-contained asynchronous course in Canvas that students will study for 2-3 hours per week. The asynchronous course will be supported by three hours of timetabled in-person or Zoom synchronous class.

Canvas pages will host the asynchronous learning activities in the Canvas course, organised into weekly modules. Learning activities will include text-based theory pages; short theory videos; text-based examples; short video-based examples; online formative and summative quizzes and other online supplementary materials sourced from creative commons resources.

The synchronously delivered hour will consist of a series of different activities including class discussions; icebreakers; consolidation of theory and examples; problem-solving and review/preview of the week completed and the week ahead respectively. The basis for the design of Circuit Analysis is to apply the principles of active learning. The intention is to encourage as much interaction with, and between the students as possible using different learning activity types.

Assessment: 70% Examination and 30% Continual Assessment.

The 30% continual assessment will consist of 10 mini weekly Canvas Tests worth 3% each.

**Module Aims:** Provides an introduction to analog electrical circuits analysis.

**Module Content:**

• Introduction to circuit characteristics and analysis: resistance, voltage, current, power, a.c. d.c. capacitance, inductance, series and parallel configurations, Ohm's law, Kirchoff's laws, superposition theorem and nodal analysis.

• Ideal operational amplifier circuits including inverting, non-inverting, comparator, differentiator and the integrator.

• Analysis of simple LCR networks energised by AC sources. This will inlcude analysis in the time domain and using complex numbers and phasors in the frequency domain.

• Simplification techniques suitable for both DC and AC analysis such as Thevenin and Source Transformations.

**Intended Learning Outcomes:**
Technical Outcomes
- To understand and mathematically describe the physical concepts and parameters associated with voltage, current, resistance, capacitance, inductance, energy and power.
- Simplify and analyse electrical circuits using a range of techniques including resistor reduction, delta-y, Kirchhoff's Laws, Thevenin's theorem, source transformations, superposition and nodal analysis.
- Be able to identify and analyse a range of operational amplifier circuits.
- Determine the transient response of capacitors and inductors.
- Determine the behaviour of LCR circuits energised by AC sources in time domain and frequency domain forms.

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)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems (EA4b)

| | |
|---|---|
| **Assessment:** | Examination 1 (70%)<br>Online Multiple Choice Questions (30%) |
| **Resit Assessment:** | Examination (Resit instrument) (100%) |

**Assessment Description:** The assignment is worth 30% of the module marks. It is delivered over the whole semester but broken down into 10 parts that are delivered weekly as individual Canvas tests worth 3% of the module each. The Canvas tests are generally computer marked and will provide automatic feedback. A marked essay question is included during one of the weeks to prepare students for the exam essay questions. Students will answer a variety of questions ranging from multiple-choice, fill in the BLANK to full calculations, numerical value entry and essay style. The component values in some questions may be randomised to encourage individual understanding.

The examination is worth 70% of the module. It is multiple choice consisting of 14 questions. Questions 1-3 are worth 1 mark, questions 4-6 are worth 2 marks, questions 7-9 are worth 3 marks, questions 10-12 are worth 4 marks and questions 13 and 15 are essay style questions worth 20 marks. The examination topics will be those presented directly in the module.

In 2021/2022 the exam will be conducted online.

Specific rules for passing this module:
This module is assessed by a combination of examination and coursework. In order for the coursework marks to count, you have to have a mark of 30% or more in the exam component. If you have less than 30% in the exam, then the final module mark will be just the exam mark.

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

**Assessment Feedback:** For the assignment, students will be able to see their computer marked assignment with feedback that has been written by the module owner for both correct and incorrect answers. There will also be a rubric and specimen answers for any essay questions used. The module coordinator solves the quiz questions in live teaching sessions to help students check their understanding and give feedback on their attempt. They will also receive a generic feedback form at the end of the semester.

For the examination, the students will receive a generic form that tells the student what the common mistakes were. It also lists the mean mark and the number of 1st class, 2:1 class, 2:2 class, 3rd class and fails achieved by the group.

Individually a student can make an appointment with the lecturer to receive specific individual feedback on the assignment or examination if this is wanted.

**Failure Redemption:** If a student is awarded a re-sit - Failure Redemption of this module will be by Examination only (100%). Assignment marks are ignored. Level 2 supplementaries (re-sits) will be capped at 40%.

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

• PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION.
• AVAILABLE TO: visiting and exchange students.

# EG-260 Dynamics 1 (Mech & Aero)

**Credits: 10 Session: 2022/23 January-June**

**Pre-requisite Modules:** EG-116; EG-120; EG-155; EG-166

**Co-requisite Modules:**

**Lecturer(s):** Prof H Haddad Khodaparast

**Format:** Lectures 2 hours per week
Example classes 1 hour per week
Directed 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

Classroom based teaching. Lecture notes and recordings will be made available on Canvas.

**Module Aims:** Elements of vibrating systems; simple harmonic motion; use of complex exponential representation. One-degree-of-freedom systems; natural frequency; effect of damping; harmonic excitation; rotating out-of-balance; vibration transmission. Transient dynamics; frequency domain analysis; impulse response function. Undamped multi-degree-of-freedom systems; Calculation of natural frequencies and mode shapes of two degree of freedom systems.

**Module Content:**
• Introduction: Elements of vibrating systems. Basic concepts. Natural frequency. Simple harmonic motion.
• One-Degree-of-Freedom Systems: Application of Newton's second law to translating and rotating systems for the determination of differential equations of motion. Calculation of natural frequency. Effect of damping.
• Harmonic Excitation of Damped One-Degree-of-Freedom Systems: governing differential equations. Physical significance of complementary function and particular integral. Resonance. Examples including rotating out-of-balance, vibration isolation and transmission.
• Transient response on undamped and damped One-Degree-of-Freedom Systems: impulse response function, frequency response function, impact response, convolution integral.
• Undamped Multi-Degree-of-Freedom Systems: Method of normal modes. Analytical determination of natural frequencies (eigenvalues) and mode shapes (eigenvectors). Harmonically forced vibration.
• Lagrange's Equation: Derivation, physical interpretation, simple examples of its application.

**Intended Learning Outcomes:**
Technical Outcomes
On successful completion of this unit students will be expected, at threshold level, to be able to:
- Gain a knowledge and understanding of the importance of natural frequencies and resonance; the role of damping; the concept of degrees of freedom. (Assessed through examination and assignment 1)
- Estimate resonances of simple systems; derive the equations of motions of systems using Newton's second law and Lagrange's equation (assessed through examination and assignment 2)
- Apply the methods presented in the course to develop simple models of real structures; analyse these models to calculate natural frequencies and evaluate the response to harmonic forces (assessed through examination and assignment 3).
- Analyse the free vibration of undamped two degrees of freedom systems (assessed through examination and assignment 3)

Accreditation Outcomes (AHEP)
Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b)
Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
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)

**Assessment:** Assignment 1 (5%)
Assignment 2 (5%)
Assignment 3 (5%)
Examination 1 (85%)

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

**Assessment Description:** The examination is an open book.

A combination of examination and assignments assesses this module.

Final exam in May/June will have 85% weighting.

The final exam consists of two parts:

-Part 1: Multiple Choice Questions (MCQs). Part 1 contributes 45% to the final marks of the module.
-Part 2: 1 written questions, Part 2 contributes 40% to the final marks of the module.

There will be 3 Canvas assignments; each of the assignments contributes 5% to the module's final marks.

Each of these three assignments will include 5 MCQs and students will have 3 days.

The first assignment covers free vibration of single degree of freedom (chapter 1), (Canvas)
The second assignment includes questions on harmonic forced vibration (chapter 2) (Canvas)
The third assignment consists of questions from Chapters 3 and 4. (Canvas)

Resits in August will have a 100% weighting and is similar to the May/June exam. i.e. two parts, part 1: MCQs (45*100/85) and part 2: 1 written question (40*100/85).

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

**Assessment Feedback:** Via model answers for the assessments and overview of generic issues from written examinations. For the 3 assignments Feedback will be left on Canvas after deadline.

**Failure Redemption:** An opportunity to redeem failures will be available within the rules of the University. A supplementary exam will form 100% of the module mark.

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

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION

Available to visiting and exchange students.

Office hours will be posted on Canvas and will be also included in introductory lecture notes.

Submission of the assignments will be via Canvas ONLY. Email submissions will NOT be accepted.

All notes and other teaching materials will be delivered via Canvas ONLY.

# EG-261 Thermodynamics 2

**Credits: 10 Session: 2022/23 September-January**

**Pre-requisite Modules:** EG-161

**Co-requisite Modules:**

**Lecturer(s):** Dr RS Ransing

**Format:** Contact Hours: 26 (Lectures)
Office Hour: 11 (Once per week)
Reading/private study 33 hours
Preparation for assessments 30 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, example classes, practical sessions and office hours

**Delivery Method:** Thermodynamics II is developed as a blended learning module. There will be a self-contained asynchronous course in Canvas that students will study for 2-3 hours per week. The asynchronous course will be supported by two-three hours of timetabled in-person or Zoom synchronous class.

Canvas pages will host the asynchronous learning activities in the Canvas course, organised into weekly modules. Learning activities will include access to power point slides; text-based examples and solutions; short video-based solutions to examples; online formative and summative quizzes and other online supplementary materials sourced from creative commons resources.

The synchronously delivered hour will consist of a series of different activities including class discussions; icebreakers; consolidation of theory and examples; problem-solving and review/preview of the week completed and the week ahead respectively. The basis for the design of Thermodynamics II is to apply the principles of active learning. Students have access to a real jet engine The intention is to encourage as much interaction with, and between the students as possible using different learning activity types.

Assessment: 60% Examination and 40% Continual Assessment.

The 40% continual assessment will consist of two Canvas Tests worth 20% each.

**Module Aims:** The module aims to introduce two main concepts: (i) thermodynamic efficiency and (ii) irreversibility applied to a variety of energy conversion processes involving heat to work transfer and vice a versa. Engineering examples will include heat, work and/or mass transfer associated with a number of steady/unsteady flow systems.

**Module Content:** Week 1: Welcome & Induction (Start of Term)

Week 2: Air Conditioning with psychrometric chart.
You will learn how to achieve desired humidity and temperature values for the air from given initial conditions? We will only use atmospheric pressure value for our problems. For human comfort, the control of humidity, temperature and air speed are important. We will ignore air speed but focus on the dependency of the moisture carrying capacity of air on its temperature.

Week 3: Refrigeration and Heat Pumps.
Satisfying our future heating and cooling needs in a most environmentally friendly way will remain as a challenge over next few decades. The global warming potential of current refrigerants is not good – in fact, it is very bad. You will learn the basic and perhaps potentially environmentally unfriendly refrigeration (vapour compression) cycle but also gain insights on how thermodynamics can help you to address this global challenge efficiently. In particular, the knowledge you will gain in Week 7 will become handy when designs go back to the drawing board.

Did you know that the industry achieved the journey from a D rating to A rating for domestic refrigerators by just improving insulation! This resulted in reducing the time that compressor runs from 50% to 33%.

Week 4: Carnot cycles, entropy generation and irreversibility.
In a resource constrained world of 2050, the focus on energy efficiency is necessary but is not sufficient. You will learn that there are three parts of irreversibility: work loss in a work transfer process, unaccounted heat dissipation in a heat transfer process and less commonly known – loss of Carnot work opportunity as heat is transferred across finite temperature difference. You will also learn how the entropy generation term is a measure of generation of all three parts of irreversibility during an energy transfer process. Many of you may need to ‘unlearn’ the current interpretation of entropy as an exclusive measure of molecular disorder and chaos – even if it is taught in A level chemistry books by various exam boards.

Did you know whenever we transfer heat across a finite temperature difference, we are losing an opportunity to create Carnot (reversible) work?

Week 5: Second law analysis of compressors.
The term isentropic efficiency of compressors is commonly used in thermodynamics analysis. However, this definition is not useful in estimating reversible work if the compressor loses heat. You will understand the difference between reversible and internally reversible work input to compressor and how it relates to the three parts of the irreversibility learnt in Week 4. This understanding will help you to imagine solutions that can potentially achieve the reversible work input.

Have you ever wondered why the work input to an internally reversible and isothermal compressor is not same as the reversible isothermal compressor work input?

Week 6: Performance analysis of an ideal stationary jet engine.
A compressor pressure ratio and the maximum temperature of products of combustion that a turbine blade can withstand are among the important design decisions. You will learn how ideal analysis is useful in predicting jet engine thrust as well as velocity and temperature values for combustion gases at exit. You will learn limitations of ideal assumptions, discover reasons for deviations and compare your predicted values with experimentally measured values.

A live – in person – demonstration of the jet engine is a highlight of this module.

Week 7: Second law analysis of engineering problems when working fluid changes phase.
Quantifying irreversibility when heat is input to the control volume by burning natural gas (methane), electric resistance heaters or heat pumps is an interesting problem that you will learn. When working fluid changes phase in a rigid tank, it adds to the complexity. You will understand terms that contribute to reversible work input to achieve the necessary heat transfer. You should be able to feel confident in applying the second law of thermodynamics to many engineering processes.

Next time a salesperson claims that electric heaters are the best as they are almost 100% efficient, you would know they need a course on thermodynamics!

Week 8: Combustion of fuel
We all know that oxygen, heat, and fuel is needed to start and sustain combustion of hydro-carbon fuels. We are ignoring the speed of air though!
You will learn how to calculate minimum oxygen, and hence air, required to burn hydro-carbon fuels from its chemical composition. You can understand lean, stoichiometric, and rich air to fuel ratios. You will be able to undertake volumetric and gravimetric analysis as well as dry and wet exhaust gas analysis.

When you measure the air to fuel ratio in the jet engine experiment, you will learn why one needs to be mindful of units used!

Week 9: Gas power plants with reheating, regeneration and intercooling.
Most of the gas power plants and large gas turbine engines to produce power would probably be phased out over next couple of decades as we move away from carbon-based economy. However, reheating, regeneration and intercooling concepts are useful and it provides a good example in learning now inspirations from Carnot cycles can be used to improve efficiency of a Brayton cycle!

Did you know that the reversible adiabatic expansion and compression processes in a Carnot engine produce zero nett work but are the only processes for producing nett work output in combustion engines?

Week 10: Flow through nozzle and combustion chamber under choked flow condition.
You will understand how a set of commonly used ideal equations give a valuable insight that the maximum air velocity one can achieve with a converging nozzle is sonic velocity. This is referred to as choked flow condition. You will learn why once you cross this stage, you need to increase the cross-sectional area, like a diffuser, to increase the velocity of air to supersonic speeds.

Similarly, we know that in a combustion chamber, as fuel is burnt and the pressure, temperature, and velocity values of products of combustion increase. The combustion chamber for a Jet engine is almost a constant cross-sectional area duct. You will learn that for a duct of constant cross-sectional area by adding heat to the air, the maximum velocity that you can increase is the sonic velocity. You will also learn from ideal equations, that as the sonic velocity condition is approached, the increase in the speed of air results in the drop of temperature of air. You will learn that for effective combustion, the speed of air needs to be in a subsonic region.

Have you ever wondered how supersonic jets manage to get subsonic flow before air enters the combustion chamber? Have you noticed why commercial flights never tend to exceed Mach number 0.85?

Week 11: Performance analysis of a cruising jet engine under choked flow condition.
Thermodynamic analysis, energy efficiency and minimisation of irreversibility during any energy transfer process needs to be undertaking alongside of heat transfer and fluid mechanics analysis. You will apply concepts learnt in Weeks 8, 9 and 10 to a jet engine problem assessing its performance under cruising conditions. You will learn why the jet engine flow is almost always choked under cruising conditions. You will understand the limitations of using a simple momentum equation to calculate thrust and why estimation of jet engine thrust is a complex problem.

Have you ever wondered why jet engine is almost always positioned ahead of a commercial aircraft wing!

Week 12: Revision
Reflection on the course and some exam tips.

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**Intended Learning Outcomes:** After completing this course, you should be able answer the following questions:

1. How efficiently can I convert heat energy to useful work?
2. How much air do we need to completely burn a given mass or volume of a hydrocarbon fuel and what are the products of combustion?
3. How efficiently can I extract heat from a cold environment and transfer to a warm environment?
4. How to achieve desired humidity and temperature values for the air from given initial conditions?
5. How to quantify irreversibility in a variety of processes including understanding of the irreversibility in relation to the isentropic efficiency of a compressor.
6. Understand the difference between the 1st and 2nd Law Efficiency.

Accreditation Outcomes and how they are achieved

Apply knowledge of mathematics and engineering principles to the solution of complex problems. Some of the knowledge will be at the forefront of the particular subject of study.
How it is achieved: Irreversibility and Second law of thermodynamics analysis of flow/non-flow, steady/unsteady with and without phase change of the working fluid. Understanding thermal irreversibility concepts and application of the second law analysis at the forefront of the thermodynamics application.

Analyse complex problems to reach substantiated conclusions using first principles of engineering principles. This will involve evaluating available data using first principle and using engineering judgment to work with information that may be uncertain or incomplete, discussing the limitations of the techniques employed
How it is achieved: Performance analysis of a jet engine and solving of relevant engineering problems.

Evaluate the environmental and societal impact of solutions to complex problems and minimise adverse impacts.
How it is achieved: Study combustion of carbon based fuels, refrigerants and alternatives. Learn how to minimise irreversibility with the help of the second law of thermodynamics during any energy conversion process.

Use practical laboratory skills to investigate complex problems.
How it is achieved:
Experience of a laboratory demonstration of a jet engine in operation and analysis of the data measured.

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| **Assessment:** | Online Class Test (20%) |
| | Online Class Test (20%) |
| | Examination (60%) |
| **Resit Assessment:** | Examination (Resit instrument) (100%) |

**Assessment Description:** Component 1 is a Canvas online test and will cover syllabus taught in weeks 2 - 5.

Component 2 is a Canvas online test and will cover syllabus taught in weeks 6-7.
Jet Engine Experiment is part of EG-261. Unless you have extenuating circumstances, in-person attendance is compulsory else you will loose ALL marks on jet engine questions in this component.

Component 3 is traditional final closed book exam and covers the whole of the syllabus.

**Moderation approach to main assessment:** Second marking as sampling or moderation

**Assessment Feedback:** Students receive feedback from Canvas multiple choice questions by being given their scores in each question. The overall feedback will be discussed in the class. Sample answers for the final exam paper will be made available on Canvas.

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

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

• PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION.
• AVAILABLE TO: visiting and exchange students if they satisfy the pre-requisite (EG-161) requirements for this module.

This is a core module for several degree schemes

# EG-262 Stress Analysis 1

**Credits: 10 Session: 2022/23 January-June**

**Pre-requisite Modules:** EG-120

**Co-requisite Modules:**

**Lecturer(s):** Dr JA Baker

**Format:** Lectures: 20 hours
Example classes: 10 hours

Directed private study and revision: 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 is based on lectures and example classes and additional supporting on-line content.

A complementary experiment will be carried out within EG-268. The experiment will build on theory studied in this module.

**Module Aims:** This module continues on from EG-120 and includes: section properties; unsymmetrical bending; stresses in thick cylinders; rotating discs; theories of failure; stress concentration effects; fatigue and linear elastic fracture mechanics.

**Module Content:**
• Stress and strain: Stress equilibrium, strain compatibility, stress-strain relationships.
• Section Properties: Second moment of area; product moment of area; principal axes; unsymmetrical bending.
• Thin cylinder formulae.
• Thick Cylinders: Derivation of Lame equations; built-up cylinders and shrink/interference fits.
• Rotating Discs: Derivation of basic equations; effect of 'fit' and external loads.
• Failure Theories: Failure mechanisms; ductile and brittle failure; Tresca theory, von Mises theory; other relevant theories.
• Stress Concentration Effects: Causes and effects; examples of stress concentration factors and design data; effect of surface finish, residual stresses etc.; design to minimise stress concentration effects.
• Fatigue: Nature of fatigue; low and high cycle fatigue; presentation of fatigue data; fatigue strength; notch sensitivity; variable loading and cumulative damage; design for infinite life and acceptable finite life.
• Linear Elastic Fracture Mechanics: Modes of failure; stress function approach; fracture toughness; LEFM applied to fatigue; environmental effects.

**Intended Learning Outcomes:**
Technical Outcomes
Upon successful completion of this module, students will be expected, at threshold level, to be able to:
Understand and apply relevant engineering principles to analyse key engineering processes including (EA1b) (evaluated in examination):
• The significance and theory of unsymmetrical bending
• Thin and thick cylinders and rotating disc theory
• Theories of ductile and brittle material failure
• Stress concentration features and their effects on design
• Fatigue and fracture theories

Identify, classify and describe the performance of components through the use of analytical methods (EA2) (evaluated in examination) including an ability to:
• Identify the sources and types of stress and stress concentration in components and structures under various loading regimes and choose suitable methods of analysis based on the loading and boundary conditions.
• Apply the equations of unsymmetrical bending, thin and thick cylinders and rotating discs to practical problems.
• Design simple components and structures to avoid failure by yielding, fatigue and/or fracture, including the effects of stress concentration features.

Accreditation Outcomes (AHEP)
- 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)

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

**Assessment Description:**
Examination: The examination forms 70% of the module mark.
Assignment 1 will be a Canvas test (15%)
Assignment 2 will be a case study (15%)

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

**Assessment Feedback:** A general pro-forma is completed, covering errors/issues that were identified during the marking process, and produced as formal examination feedback.
The marks for assignment 1 will be provided at the deadline time. Further feedback, including worked solutions will be provided within the week after the deadline.
Assignment 2 will be marked and feedback will be provided within 3 weeks of the deadline.

**Failure Redemption:** A supplementary written examination will be set which will form 100% of the mark.

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

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

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

Available to visiting and exchange students.

Office hours will be posted on Canvas.

# EG-264 Computer Aided Engineering

**Credits: 10 Session: 2022/23 September-January**

**Pre-requisite Modules:** EG-163

**Co-requisite Modules:**

**Lecturer(s):** Dr AC Tappenden

**Format:** Q&A Lectures: 11 hours
PC Lab Activity time:22 hours
(Combined into 3 hour timetabled sessions).
Directed private study: 67 hours
Contact Hours will be delivered on-campus in computer labs with combined lectures and PC lab work time. The sessions will be held through screensharing software to ensure clarity of the subject material during the lectures and practical computer sessions.

**Delivery Method:** 1 hour Lecture/Exercise class held in computer lab, after which the 2 hour computer lab session immediately follows to allow students to implement learnt material.

**Module Aims:** This module deals with the significance of computers in numerical analysis. Integration by MATLAB and Finite Element Analysis (FEA) - (a) Review of MATLAB programming techniques; (b) Introduction of FEA and the techniques to implement FEA by using Solidworks, including design studies and stress simulations.

Module Aims: Competence in SOLIDWORKS to implement FEA method and MATLAB to solve mathematical problems.

**Module Content:** Module content:
MATLAB - (a) Review of MATLAB programming techniques; (b) Introduction of numerical analysis basics, including solution of nonlinear algebraic equations and numerical integration etc.

FEA Method: (a) Introduction of FEA method; (b) Fundamental techniques to implement FEA by using SOLIDWORKS software; and (c) Implementation of FEA method for stress analysis of different mechanical structures, e.g., beams and plates subject to different loadings.

**Intended Learning Outcomes:**
Assessed by:
- MATLAB Individual Assignment 50%:
- Solidworks Individual Assignment 50%

Technical Outcomes
After completing this module students should be able to:
- Demonstrate an ability to implement FEA by using Solidworks and utilise MATLAB to implement numerical methods in solving mathematical problems.

Accreditation Outcomes (AHEP)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems (EA4b)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3b)

**Assessment:** Coursework 1 (50%)
Coursework 2 (50%)

**Assessment Description:** Coursework 1 (50%) - Individual Assessment - MATLAB question sheet assessment based on numerical integration and root finding through MATLAB.
Coursework 2 (50%) – Individual Assessment - Technical design based report using Solidworks, FEA and optimisation.

Assignments for two sections of the module are marked after each section.

Important information: In order to pass the module, students must achieve a minimum of 40% in both Coursework 1 and Coursework 2. If you do not achieve 40% in each component, you will receive a QF outcome, and will be required to complete a supplementary assessment in the failed component(s) during the July/ August supplementary period.

**Moderation approach to main assessment:** Second marking as sampling or moderation

**Assessment Feedback:** Students will receive feedback on their assignment in lectures, office hours and on Canvas

**Failure Redemption:** If the module is not passed, students will resit the components that they have failed. i.e. if Coursework 1 or 2 is failed, you will have to complete a supplementary coursework in Coursework 1 or 2. If both components are failed, you will have to complete supplementary coursework in both components.

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

N.B. Both module sections (MATLAB and Solidworks) must be passed to pass the module. The minimum pass mark for each area is 40%. If grades of 40% or higher are not attained in the MATLAB or Solidworks components, supplementary assessments will be required to be taken during July - August, for which ever component is failed, or both if neither have been passed.

LATE SUBMISSION PENALTY: ZERO TOLERANCE - For late submissions of continual assessment assignments, ZERO marks will be awarded. To consider late submissions for marking, university procedures for extenuating circumstances must be followed and approved.

AVAILABLE TO VISITING AND EXCHANGE STUDENTS.

THIS MODULE IS NORMALLY ONLY ASSESSED IN SEMESTER 1.

Office hours will be posted on the Canvas course.

# EG-268 Experimental Studies - Mechanical

**Credits: 10 Session: 2022/23 September-June**

**Pre-requisite Modules:** EG-163

**Co-requisite Modules:**

**Lecturer(s):** Dr H Arora, Dr A Coccarelli, Dr H Madinei, Dr B Morgan, Dr S Pant

**Format:** Coordinator = 1hr/week
Academic + Demonstrator = 1 hour per week each
Lectures 5 hours it in total, throughout the module
Practical classes 4 hours per week
Directed private study 4 hours per week
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

Lecture, practical and directed independent study.

**Module Aims:** The course introduces the students to experimental studies in a wide range of subjects. There are four individual experiments (HEAT/JET/STRESS/VIBRATION)

Each experiment is self contained and the student will be assessed via either:
- A lab report which will have a set of experiment specific questions to answer.
- An online Canvas assessment.

All students work is scheduled in groups and individuals will carry out four experiments. The assessments are all individually submitted.

The students keep a log-book of the experimental observations and results, which is used for reference for the technical report from each experiment written-up in the week after the experiment.

**Module Content: -** Revision of lab report writing, and statistical data / error analysis [3].
- Measurement techniques for physical parameters: position, velocity, acceleration, temperature, pressure, strain, flow.

Laboratory classes are:
- Four Individual experiments (HEAT/JET/STRESS/VIBRATION).

**Intended Learning Outcomes:**
Technical Outcomes
- A knowledge and understanding of: a wide range of experimental techniques.
- An ability to: understand and follow experimental procedures.
- An ability to: consider health and safety issues when working in labs.
- An ability to: maintain accurate informal notes.
- An ability to: report findings in written form.
- An ability to: interpret experimental data and use it to make constructive criticisms of analytical models.

Accreditation Outcomes (AHEP)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems (EA4b)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc.) (P1)
- Knowledge of characteristics of particular materials, equipment, processes or products (P2)
- Ability to apply relevant practical and laboratory skills (P3)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

**Assessment:** Coursework 1 (25%)
Coursework 2 (25%)
Coursework 3 (25%)
Coursework 4 (25%)
**Resit Assessment:** Coursework reassessment instrument (100%)

**Assessment Description:**
1. Experimental reports and/or Canvas tests for each experiment (C1 to C4) are handed in a week after the experiment (exact dates outlined for each group).

Each C1 to C4 experiment carries a total of 25%: CW1 = Jet Engine; CW2 = Fluids; CW3 = Stress/Strain; and CW4 = Vibration.

2. All assignments are submitted electronically on Canvas using templates.

**Moderation approach to main assessment:** Second marking as sampling or moderation

**Assessment Feedback:** Feedback and marking via Online assessments.
Lab reports are returned with feedback via Canvas within three weeks from submission.

**Failure Redemption:** A supplementary piece of coursework will be set which will form 100% of the mark.
Written work may be resubmitted in the supplementary period but it is not possible to repeat experiments.

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

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

Students will not gain any marks for practicals (or on-line equivalents) that they have not attended, even if a report is submitted, unless there are valid extenuating circumstances.

All assignments are submitted electronically and the University rules on Plagiarism apply.

Final mark is based on: Four Assessments based on Four Experiments (25% each)

# EG-269 Design of Machine Elements

**Credits: 10 Session: 2022/23 September-January**

**Pre-requisite Modules:** EG-165; EG-165

**Co-requisite Modules:**

**Lecturer(s):** Dr CA Griffiths

**Format:** Lectures 20 hours
Example classes 10 hours (to be delivered online)
Directed private study 70 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

Lectures

**Module Aims:** The module introduces the students to the design and analysis of a number of common machine elements including drives and couplings, gears, bearings and power screws. Balancing of rotating machinery is also covered.

**Module Content:**
- Drives and couplings - clutches, brakes, belts and couplings
- Balancing - rotating and reciprocating systems
- Gear design - gears, the analysis of gearboxes, including epicyclics
- Bearings - types of bearings, bearing design, bearing selection
- Screws and threads - power screws

**Intended Learning Outcomes:**
Technical Outcomes
- A knowledge and understanding of: the design and selection process for typical machinery components.
- An ability to: identify the important machine components under various loading regimes and choose suitable methods of analysis based on the loading and boundary conditions.
- An ability to: apply the knowledge to practical machine design problems.

Accreditation Outcomes (AHEP)
- Work with information that may be incomplete or uncertain and quantify the effect of this on the design (D3b)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems (EA4b)

**Assessment:** Examination 1 (100%)
**Resit Assessment:** Examination (Resit instrument) (100%)

**Assessment Description:** Closed book examination.

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

**Assessment Feedback:** Students receive their marked coursework with feedback within three weeks of the submission deadline and in time for exam revision. A general pro-forma is completed, covering errors/issues that were identified during the marking process, and produced as formal examination feedback.

**Failure Redemption:** A supplementary written examination will be set which will form 100% of the mark.

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

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

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

# EG-277 Research Project Preparation

**Credits: 0 Session: 2022/23 September-June**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Dr MR Brown, Mrs KM Thomas

**Format:** Formal Lectures - 2-3 hours

**Delivery Method:** 2-3 formal lectures throughout the academic year concerning project design and selection.

**Module Aims:**
This module has been designed to provide you with information needed ahead of undertaking a research project in Year 3 of studies.

The research project in Year 3 is worth 30 credits, and will involve the application of scientific and engineering principles to the solution of a practical problem associated with engineering systems and processes.

In the research project you 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.

The preparation for the research project commences in Year 2 where you are required to engage in project selection. In this preparation module we will confirm the options available to you to either define your own project or to select from a list of project titles and descriptors put forward by academic staff. Communications concerned project selection will be done via the Canvas course page. Additional supplementary resources will also be provided.

**Module Content:** In conjunction the formal lectures and supplementary resources will cover:

• Key staff members - contact details
• Key dates for Year 2 regarding project selection - defining your own project or selecting from staff titles
• How to design a project concept and what to consider before approaching a possible supervisor
• Where to start in finding a possible supervisor
• What to do if you're hoping to undertake a placement year
• Selecting from staff titles
• Further information around the allocation process
• First steps in EG-353 when you commence Year 3

**Intended Learning Outcomes:** NA

**Assessment:** Participation Exercise (100%)

**Assessment Description:** This module is not assessed but we would strongly suggest participation to ensure that you understand how the project selection system will work.

**Moderation approach to main assessment:** Not applicable

**Assessment Feedback:** NA

**Failure Redemption:** NA

**Additional Notes:** Only available to students following an Engineering Degree Programme.

# EG-284 Manufacturing Technology II

**Credits: 10 Session: 2022/23 January-June**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Prof TC Claypole

**Format:** Lectures 24 hours
Tutorials / Example classes 12 hours
Directed private study 36 hours
Preparation for assessment 28 hours

**Delivery Method:** Assessment:
Examination – 70%
Assignments – 30%
- State of the art notes for each the 3 topics (10% per topic)
- Annotate the provided notes and slides
 -With personal notes/comments
 -Literature review of journal papers correctly referenced
 -Bibliography

**Module Aims:** The course builds on information presented in Manufacturing Technology I (EG-182) by describing advanced processes for special machining and surface modification and by examining available joining techniques for assembly of components. The advantages and limitations of specific processes are outlined and procedure for optimum design and manufacture provided.
Module Aims: to provide awareness and understanding of advanced manufacturing methods used for engineering materials and components.

**Module Content:**
Module content:

Topic 1 – Non-traditional machining
• Fabrication – machining of flat stock
o Laser
o Plasma
o Waterjet
• Micro machining
o Applications
o Advanced Manufacture by Printing
 Flexography
o Screen printing
o Ink jet
o Aerosol jet deposition
o Vacuum Metallising
o Laser micromachining
Topic 2 – Additive manufacture
• Measurement of surface profile
o Stylus system
o Infinite focus microscopy
o White light interferometry
• Coating
o Anodising
o Plasma Carburising and Nitriding
o Electroplating
• 3D Printing
o Fused Deposition
o Stereolithography/Resin 3D printing
o Ink jet resin injection
o Laser sintering
Topic 3 – Joining
• Welding
o Fusion welding
o Solid state welding
• Brazing
• Soldering
• Adhesive Bonding
o Joint design
o Adhesive types
• Mechanical Assembly
o Threaded fasteners
o Rivets
o Assembly methods based on interference fits
o Other mechanical fastening methods
o Moulding inserts and integral fasteners
o Design for assembly

**Intended Learning Outcomes:**
Technical Outcomes
Upon completion of the module the student should be able to:
- Understand the principles, advantages and limitations of the main non-traditional machining processes.
- Discuss coating technology, joining techniques and their advantages and limitations.
- Select appropriate machining, coating and joining techniques.
- Relate the effects of large scale processes on the microscopic structure of materials.
- Compare information from several sources to select optimum processing.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)
- Knowledge of characteristics of particular materials, equipment, processes or products (P2)

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| **Assessment:** | Assignment 1 (10%) |
| | Examination (70%) |
| | Assignment 2 (10%) |
| | Assignment 3 (10%) |
| **Resit Assessment:** | Examination (Resit instrument) (100%) |

**Assessment Description:** Examination – 70%
Assignments – 30%
- State of the art notes for each of the 3 topics (10% per topic)
-Annotate the provided notes and slides
-With personal notes/comments
-Literature review of journal papers correctly referenced
-Bibliography

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

**Assessment Feedback:** Through Faculty of Science and Engineering feedback procedure

**Failure Redemption:** Supplementary Examination 100% in August

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

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION

# EGA214 Mechanical Engineering Design 2

**Credits: 10 Session: 2022/23 January-June**

**Pre-requisite Modules:** EG-163; EG-165

**Co-requisite Modules:** EG-264

**Lecturer(s):** Dr PJ Dorrington, Dr W Harrison, Dr B Morgan, Dr JS Thompson

**Format:** Lectures 7 x 1 hour lectures plus 2 x Q&A Lectures;
Creativity sessions (idea generation and Virtual Reality) 6 hours;
PCLabs/ design support 7 x 2 hours; two lecturers, two sets of 8x 1hour office hours.
Directed private study 50 hours.
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, workshops, virtual reality and office hours.

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

Lectures to put the design projects into context, but the majority of work will take place in CAD computer design lab sessions and independent working, individually and as a group. Assessment: continual assessment 100%. A number of short design projects.

**Module Aims:** Within this module students will be expected to complete a series of exercises that will the form the basis of a 'major' design. The scope of the module will involve the students to work in groups where they will consider, as a team, conceptual designs, embodiment using innovative approaches to design processes and standards etc., leading to final design documentations and manufacturing techniques.

**Module Content:** This module involves working through the stages of an open-ended major design project. Working in groups, students will apply their engineering knowledge to develop concept designs and refine these designs based on materials, manufacturing and environmental considerations.

**Intended Learning Outcomes:** Technical Outcomes
At the end of this module, you should have:
- A 'greater' knowledge and understanding of multi-disciplinary aspects of the design process leading to a total design solution.
- An ability to apply theoretical subjects to a real engineering problems.

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)
- 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)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3b)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, and of risk assessment and risk management techniques (EL6)
- Exercise initiative and personal responsibility, which may be as a team member or leader (G4)
- Understanding of, and the ability to work in, different roles within an engineering team (P11)

**Assessment:** Peer Assessment (5%)
Group Work - Presentation (20%)
Report - Group (70%)
Peer Assessment (5%)

**Resit Assessment:** Coursework reassessment instrument (100%)

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| **Assessment Description:** Assignment 1 – Peer review 1 (5%)<br>Assignment 2 - Group Presentation of early concept designs - 20% (5% of this is individual mark)<br>Assignment 3 - Final Group Report + Individual Report - 70 % (15% group + 55% individual)<br>Assignment 4 – Peer review 2 (5%)<br><br>Resit Component:<br>Design report (100%) |
| **Moderation approach to main assessment:** Universal second marking as check or audit |
| **Assessment Feedback:** Lectures will provide feedback on presentations during lecture and laboratory sessions. Tutorial sessions may also be used for general feedback and guidance. |
| **Failure Redemption:** A failure would be redeemed by doing a design exercise and submitting a formal report during the normal August Supplementary period. This would form 100% of the mark. |
| **Additional Notes:** Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.<br><br>PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION<br>This module has a mixture of group work and individual assessment.<br>The work you submit must be your own work.<br>**This means that you cannot use existing product examples and call them your own 'concepts' or 'ideas'.<br>It is acceptable to reference existing market products stating if/how they may have influenced your design thinking, BUT they must be fully referenced and separate from your own designs**.<br>If you copy any CAD files or designs then you will be referred for academic misconduct.<br>The usual University regulations regarding academic misconduct apply.<br>For further information regarding Academic Misconduct please follow the link below:<br>https://myuni.swansea.ac.uk/academic-life/academic-regulations/assessment-and-progress/academic-misconduct-procedure/ |

# EGA265 Fluid Mechanics 2

**Credits: 10 Session: 2022/23 September-January**

**Pre-requisite Modules:** EG-160

**Co-requisite Modules:**

**Lecturer(s):** Dr S Pant

**Format:**
-- Live or online lectures (also recorded): 30 hours
-- On-demand pre-recorded material: 10 hours
-- Directed private study 40 hours (includes the study of on-demand material)
-- Preparation for assessment 30 hours

**Delivery Method:** Delivery of approximately 30 hours of live lectures will either be physically on-campus (Covid-19 situation permitting) or online via Zoom. These lectures will be recorded. A blended learning approach will be taken for example problems, where pre-recorded fully worked examples will be made available on Canvas Digital Learning Platform.

**Module Aims:** This module aims to build on the concepts taught on stationary and flowing fluids in EG-160 (Fluid Mechanics 1) and extend the knowledge to solve the problems and explain physical phenomena that involve internal and external flows. The module will cover:
(i) dimensional analysis and modelling;
(ii) flow through piping networks and pump selection, flow rate and velocity measurement;
(iii) prediction of lift and drag for flows over common geometries,
(iv) fluid kinematics and preliminary differential analysis of fluid flow.

**Module Content:** • Internal Flow: Laminar and turbulent flow in pipes, Minor loses, Piping networks and pump selection, Flow rate and velocity measurement.
• External Flow: Friction and pressure drag, Lift, Drag coefficients of common geometries, Flow over flat plates, cylinders and spheres.
• Dimensional Analysis and Modelling: Bukingham Pi Theorem, Correlation of experimental data, Incomplete similarity, wind tunnel testing, flow with free surfaces.
• Fluid Kinematics and differential analysis of fluid flow: Lagrangian and Eulerian descriptions of fluid flow, vorticity, Reynolds Transport Theorem, and the continuity equation.

**Intended Learning Outcomes:** Technical Outcomes
Upon completion of the module the student should be able to:
- Maintain and extend a sound theoretical approach to the application of fluid mechanics in engineering practice.
- Contribute to the design and development of engineering solutions for products and processes involving fluids and fluid mechanics. Evaluate possible engineering solutions taking into account fitness for purpose. Collect and analyse results.

Upon completion of the module the student should be able to demonstrate a knowledge and understanding of:
- Dimensional analysis, experimental testing and correlation with experimental data and incomplete similarity.
- Series and parallel piping systems with pumps and turbines.
- Flow rates and velocity measurement techniques.
- Drag and lift coefficients, flow over flat plates, cylinders and spheres.
- Lagrangian and Eulerian descriptions of flow and the Reynolds Transport theorem, vorticity, and continuity equation.

Accreditation Outcomes (AHEP)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3b)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (P1)

**Assessment:** Examination 1 (90%)
Online Multiple Choice Questions (10%)

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

**Assessment Description:** Online Multiple Choice Questions: 30-45 minutes online test with multiple choice questions held via Canvas (10%).

In-person examination - 2 hours and 30 minutes (90%).

Confirmation of the resit method: it would only be done if the aggregate module mark is less than 40%.

Resits (supplementary examinations) in August will have 100% weighting, i.e. a single separate resit assessment will determine the entire module mark.

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

**Assessment Feedback: -** Problem sets will be released regularly for students to attempt and full solutions will be released after two weeks.
- Feedback solutions on example sheets will be made available on the Canvas.
- Overview of generic issues and common errors from written examinations will be discussed in lectures.
- Feedback solutions of past two year's exam papers will be made available on Canvas.
- Feedback solutions of online test will be made available on Canvas and discussed in the lectures. The test's solutions, common errors, and full length solutions will be discussed within the classroom.

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

**Additional Notes:**

Delivery of approximately 30 hours of live lectures will either be physically on-campus or online via Zoom. These lectures will be recorded. A blended learning approach will be taken for examples, where pre-recorded fully worked examples will be made available on Canvas Digital Learning Platform.

Available to visiting and exchange students.

# EGA266 Digital Manufacturing

**Credits: 10 Session: 2022/23 September-January**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Dr PJ Dorrington, Dr AA Fahmy Abdo, Mr AJ Morgan

**Format:** Lectures: 8x 1 hour/week; Labs: 3-5 sets of 4 hours/week; Directed private study: 3 hours/week. Contact Hours will be delivered on-campus, and may include, for example, lectures, practical sessions, PCLabs. Office hours will be a blend of online and offline.

**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 to put digital manufacturing into context and introduce theory, with most of the work being undertaken in the digital manufacturing lab sessions. This will be supported by independent working in the lab; private study to learn about the fabrication process of 3DPrinters, along with problem-solving in a group.

Additional sessions may be added to the timetable at the lecturer's discretion to allow students to print their test parts, and their final designs. These must be made use of as organising lab space last minute is difficult.

**Module Aims:** Within this module students will learn about digital manufacturing, from its role in concept development through to prototype production and small batch manufacture. They will be introduced to the way in which manufacturing is changing and the future possibilities presented by emerging digital manufacturing technologies. They will work individually to fabricate a digital manufacturing machine (3DPrinter), which they will calibrate and produce test parts on, as well as their own design of a 3DPrinted engineering design.

**Module Content:**
This module will cover the following content (in varying levels of depth):

• Basic Principles and applications of digital manufacturing;
• Basic working principles of a filament 3D printer;
• Designing/Computer modelling, manufacturing and assembling for filament 3DPrinting.
• Project: build, make, calibrate and test a 3D printer.

**Intended Learning Outcomes:**
Technical Outcomes
By the end of this module students will:
- Be expected to have developed their process knowledge of digital manufacturing – in particular 3D Printing – through experimentation with a 3D printer they assemble in a group. They must select suitable processing parameters to experiment with on their machine, analyse the findings and implement changes to improve the quality of printed parts resulting from the findings of their experiments.
- Be able to apply relevant practical and laboratory skills through the assembly and testing of a 3D Printer, determining how the different parts relate to one another to form a working digital manufacturing machine.
- Have made use of and understood the different types of technical literature and other information sources which engineers utilise when building digital manufacturing equipment. Students will need to discover relevant knowledge from these sources to understand and overcome any technical uncertainty (problems) which may arise during assembly of the 3D printer.
- Have applied 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 of their 3D printers. They will achieve these learning outcomes through practical lab-based activities to construct a working 3D printer. This will be supported by individual logbooks, which will outline key decision points throughout the manufacturing process, and demonstrate how individuals have contributed to elements of the group project.

Accreditation Outcomes (AHEP)
- Knowledge of characteristics of particular materials, equipment, processes or products (P2)
- Ability to apply relevant practical and laboratory skills (P3)
- Understanding of the use of technical literature (P4)
- Ability to work with technical uncertainty (P8)
- 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)
- Exercise initiative and personal responsibility (G4)

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| **Assessment:** | Assignment 1 (5%)<br>Assignment 2 (15%)<br>Assignment 3 (5%)<br>Assignment 4 (60%)<br>Assignment 5 (15%) |
| **Resit Assessment:** | Coursework reassessment instrument (100%) |

**Assessment Description:** Assignment 1 **-** Completion of Risk Assessment, 5%
Assignment 2 – Scrutineering video/or lab assessment 15%
Assignment 3 – Printed test print, 5%
Assignment 4 – 3DPrinting report, 60%
Assignment 3 – Printed prototype for review/testing, 15%
Note:-
- specific requirements of each assignment will be outlined during the module
- these are all individual assignments.

**Moderation approach to main assessment:** Partial second marking

**Assessment Feedback:** Lectures will provide feedback on observed progress, hints and tips on building the machines as the module progresses.
Lecturers, Teaching Assistants and technicians will provide additional feedback during online PCLab sessions, and during office hours.
Office hours may also be used for general feedback and guidance.
Feedback and suggestions for improvement will be provided in a written or audio format on assessments which are submitted via Canvas (e.g. report).

**Failure Redemption:** A failure would be redeemed by doing a design exercise for the development of a new, innovative element of a 3D printer OR a product that is designed specifically for the 3DP process and submitting a formal report during the normal August supplementary period. This would form 100% of the mark. This would be capped at 40%.

**Additional Notes:** This module will be be delivered onsite.
You will build a 3DPrinter onsite during this module; once you have built the printer assigned to you, there will be the option of collecting it and operating it in a safe environment at your residence. However, you must complete a full Risk Assessment prior to doing this, and you must use the machine in a well-ventilated area, only use PLA, and not leave the machine unattended for longer than 30minute periods, and do not run the machine overnight. This is to ensure you get the valuable 'hands-on' design, build and testing of an actual printer.

PENALTY: ZERO TOLERANCE FOR LATE SUBMISSION OF ALL COURSEWORK.
It is strongly recommended that individuals give themselves a slightly earlier deadline than the FINAL submission deadline, e.g. a day before, or at least a few hours. This will provide you with time if you have any formatting errors or upload issues on Canvas/Turnitin/other submission portals.

Canvas contains course information, background content and core module material. Announcements relating to the module will also appear here, you are expected to read announcements regularly.

This module provides individuals with practical experience of building and using a 3DPrinter onsite with the optional use of using it at home to develop their learning without the constraints of lab opening times. The student is responsible for carrying out their own risk assessment prior to building and running the machine in their own home. They must only operate the machine as it is intended to be used, and always follow health and safety procedures as would be
expected within a university laboratory (these will be on Canvas as a reference, and it is assumed you have read these before commencing any machine building).

For those of you building and operating machines off-site you will need to read the terms of loan agreement and sign prior to the machine being sent to you. This is your responsibility.
NOT AVAILABLE TO Visiting and Exchange Students