Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 3 (FHEQ LEVEL 6)

MECHANICAL ENGINEERING

DEGREE PROGRAMMES

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

DISCLAIMER

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

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

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

The 22-23 academic year begins on 26 September 2022

Full term dates can be found here

DATES OF 22-23 TERMS

26 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

SEMESTER 1

26 September 2022 – 27 January 2023

SEMESTER 2

30 January 2023 – 09 June 2023

SUMMER

12 June 2023 – 22 September 2023

IMPORTANT

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

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

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

Welcome to the Faculty of Science and Engineering!

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

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

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

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

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

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

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

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
School of Aerospace, Civil, Electrical, General and Mechanical Engineering **Head of School: Professor Antonio Gil**	
School Education Lead	Professor Cris Arnold
Head of Mechanical Engineering	Dr Andrew Rees
Mechanical Engineering Programme Director	Dr Eifion Jewell e.jewell@swansea.ac.uk
Year 3 Coordinator	Dr Sanjay Pant Sanjay.Pant@Swansea.ac.uk

STUDENT SUPPORT

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

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

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

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

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

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

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

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

READING LISTS

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

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

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

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

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

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

BEng Mechanical Engineering[H300,H307]
BEng Mechanical Engineering with a Year Abroad[H308]
BEng Mechanical Engineering with a Year in Industry[H305]
MEng Mechanical Engineering[H304]
MEng Mechanical Engineering with a Year Abroad[H309]
MEng Mechanical Engineering with a Year in Industry

Coordinator: Dr S Pant

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-365 **Manufacturing Optimisation** **10 Credits** **Dr A Rees** **CORE**	**EG-3066** **Industry 4.0** **10 Credits** **Dr JS Thompson** **CORE**
EGA334 **Mechanical Engineering Design 3** **20 Credits** **Dr M Togneri/Prof TC Claypole/Prof DT Gethin/Dr EH Jewell/...** **CORE**	**EG-362** **Fluid Mechanics 3** **10 Credits** **Prof DT Gethin/Dr S Pant** **CORE**
EG-3080 **Engineering Management (Aero, EEE, Mech)** **10 Credits** **Prof JC Arnold/Prof MR Jennings/Dr EH Jewell/Mr JK Mcfadzean/Dr B Morgan/Dr A Rees** **CORE**	
EG-353 **Research Project** **30 Credits** **Dr MR Brown/Mr A Goodfellow/Prof PJ Holliman/Dr AC Tappenden** **CORE**	
EGA324 **Mechanical Engineering Practice** **10 Credits** **Dr AA Fahmy Abdo/Prof NPN Lavery/Dr B Morgan** **CORE**	
Total 120 Credits	

Optional Modules

Choose exactly 20 credits
Design Pathway

EG-323	Finite Element Method	Dr W Harrison	TB1	10 (CORE)
EG-360	Dynamics 2	Dr Y Yuan/Dr N Jamia	TB1	10 (CORE)

Or

Choose exactly 20 credits
Manufacturing Pathway

EG-323	Finite Element Method	Dr W Harrison	TB1	10 (CORE)
EG-360	Dynamics 2	Dr Y Yuan/Dr N Jamia	TB1	10 (CORE)
EGA366	Kinematics and Programming for Robot	Dr S Li	TB1	10 (CORE)

Year 3 (FHEQ Level 6) 2022/23
Mechanical Engineering
MEng Mechanical Engineering with a Year in Industry[H306]

Coordinator: Dr S Pant

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-365 **Manufacturing Optimisation** **10 Credits** **Dr A Rees** **CORE**	**EG-3066** **Industry 4.0** **10 Credits** **Dr JS Thompson** **CORE**
EGA334 **Mechanical Engineering Design 3** **20 Credits** **Dr M Togneri/Prof TC Claypole/Prof DT Gethin/Dr EH Jewell/...** **CORE**	**EG-362** **Fluid Mechanics 3** **10 Credits** **Prof DT Gethin/Dr S Pant** **CORE**
EG-233 **Placement Preparation: Engineering Industrial Year** **0 Credits** **Prof GTM Bunting/Dr CME Charbonneau/Dr P Esteban/Dr SA Rolland/Dr V Samaras/Dr S Sharma**	
EG-3080 **Engineering Management (Aero, EEE, Mech)** **10 Credits** **Prof JC Arnold/Prof MR Jennings/Dr EH Jewell/Mr JK Mcfadzean/Dr B Morgan/Dr A Rees** **CORE**	
EG-353 **Research Project** **30 Credits** **Dr MR Brown/Mr A Goodfellow/Prof PJ Holliman/Dr AC Tappenden** **CORE**	
EGA324 **Mechanical Engineering Practice** **10 Credits** **Dr AA Fahmy Abdo/Prof NPN Lavery/Dr B Morgan** **CORE**	
Total 120 Credits	

Optional Modules

Choose exactly 20 credits
Design Pathway

EG-323	Finite Element Method	Dr W Harrison	TB1	10 (CORE)
EG-360	Dynamics 2	Dr Y Yuan/Dr N Jamia	TB1	10 (CORE)

Or

Choose exactly 20 credits
Manufacturing Pathway

EG-323	Finite Element Method	Dr W Harrison	TB1	10 (CORE)
EG-360	Dynamics 2	Dr Y Yuan/Dr N Jamia	TB1	10 (CORE)
EGA366	Kinematics and Programming for Robot	Dr S Li	TB1	10 (CORE)

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-3066 Industry 4.0

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JS Thompson

Format: 22 hrs lectures
10 hrs data lab/Case Study Workshops
70 hrs directed private study

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

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

Lectures/Case Study/Example Classes/Labs

Module Aims: This module introduces fundamental concepts and enabling digital technologies of Industry 4.0. Through practical case studies and exposure to latest research, students will be able to understand how digital technologies such as Big Data, Machine Learning, Augmented Reality, Robotics, Simulation and Additive Manufacturing can be utilised in an industrial context to improve product design, manufacturing processes and supply chain management. The course will equip the participant with the relevant skills to become capable of deploying and evaluating digital technologies in industrial production systems to achieve more flexible, customised and efficient operations in different industrial sectors.

Module Content: Industry 4.0 - an Overview

• Industry 4.0 - historical context
• Industry 4.0 - a global phenomenon
• Drivers of Industry 4.0 i.e. Internet of Things (etc.)
• End-to-end engineering; Vertical and Horizontal Integration
• Sustainability and Mass Customisation
• Industry 4.0 Architecture (RAMI and IIRA)
• Cyber Physical Systems
• Practical Case Studies (i.e. SWOT analysis)

Industry 4.0 - Digital Technologies and Systems

• Industrial Big Data and Machine Learning
• Robotics
• Additive Manufacture
• Augmented Reality
• Simulation and the Digital Twin
• Computational (Data Analytics) Labs

Deployment and Evaluation of Smart Manufacturing (Industry 4.0)

• Industry 4.0 Maturity Index
• Industry 4.0 Readiness Levels
• The implication of Industry 4.0 and Cyber Security

Intended Learning Outcomes:
Technical Outcomes
Upon completion of this module the student will:
• Be expected to have developed their knowledge of Industry 4.0.
• Understand how Smart Manufacturing and new approaches to Information and Communications Technology (ICT) are
changing production systems.
• Understand and use Big Data technologies in manufacturing operations and appreciate the uncertainty involved in such
methods.
• Gain an awareness of the driver technologies of Industry 4.0.
• Critically evaluate and measure the effectiveness of Smart Manufacturing Systems as part of Industry 4.0.
• Reflect on the human factor and possible issues in the successful implementation of Industry 4.0

Accreditation Outcomes (AHEP)
- Ability to work with technical uncertainty (P8)
- Knowledge of characteristics of particular materials, equipment, processes or products (P2)

Assessment: Examination (50%)
Assignment 1 (30%)
Assignment 2 (20%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination – An online test short answer essay style questions.
Coursework 1 – Coursework 1 – A Report based on the Data Analytics Labs
Coursework 2 – A group written assessment around aspects of Industry 4.0.

Moderation approach to main assessment: Universal double-blind marking

Assessment Feedback: The Coursework components will be submitted and marked through Canvas. Marks with associated feedback will be provided within 3 weeks of the submission date.
With regards the Examination; the student is informed of their provisional mark immediately after assessment, subject to ratification at the Swansea External Examination Board. The script and mark are made available to the student¿s supervisor who then has the opportunity to discuss the performance during regular review meetings.

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

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

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

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

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

Credits: 10 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Penalty for late submission of work: ZERO TOLERANCE.

The module is available to exchange students.

Notes and worked examples can be found on Canvas.

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

EG-323 Finite Element Method

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr W Harrison

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

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

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

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

Lectures: 1 hour per week
Examples classes: 1-2 hours per week
Additional support sessions: 10 hours in total
Directed private study: 3 hours per week

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

Module Content:

1D problems: Introduction. FE Formulation of 1-D Problems - Physical problem; conceptual model. 1-D problem of heat conduction and elastostatics. Analytical solution. Strong and weak forms. Galerkin approximation. Finite element discretisation. The linear 1-D bar: shape functions, load vector and stiffness matrix. Assembly procedure. Examples [9]

2D scalar problems: FE Modelling of 2-D Potential Flow Problems - Physical problem; conceptual model. Porous media flow; heat conduction; torsion of cylindrical members. Strong and weak forms. Galerkin approximation. Finite element discretisation. The linear shape triangle: shape functions, load vector and stiffness matrix. Assembly procedure. Solution. Examples. [8]

2D elasticity: FE Modelling of 2-D Elastic Solids - Plane strain and plane stress problems of 2-D elastostatics. Strong and weak forms. Galerkin approximation. Finite element discretisation. The linear shape triangle: shape functions, load vector and stiffness matrix. Examples [6]

Review [2] and Assessment.

Attendance is a course requirement. The module is assessed by an exam (open book) and two assignments that will require both hand calculation and computer simulations. Computer simulations will be using the existing finite element software, which includes small finite element programs.

Intended Learning Outcomes:
Technical Outcomes
Upon completion of this module, the student should be able to demonstrate:
- A knowledge and understanding of [SM2b]:
(i) Fundamentals of the finite element method as an approximation method for analysis of a variety of engineering problems.
(ii) Differences between mathematical (conceptual) and computer models.
- An ability to (practical skills) [EA3b]:
(i) Develop finite element formulation for analysis of a variety of engineering problems including: (a) elastostatics of 1-D bars and cables (b) heat conduction, potential flow, porous media flow, torsion (c) plane strain and plane stress problems.
(ii) Use finite element method to solve engineering problems (a)-(d).
(iii) Use a computer to model and analyse engineering problems (a)-(d).

Accreditation Outcomes (AHEP)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action EA3b)

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

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

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

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

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

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

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

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

Available to visiting and exchange students.

EG-353 Research Project

Credits: 30 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules:

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

Format: Formal Lectures 16 hours;
Directed private study (incl. meetings with supervisors) 284 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

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

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

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

Module Aims:

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

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

Module Content:

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

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

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

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

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

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

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

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

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

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

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

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

Full assessment criteria will be on Canvas.

Moderation approach to main assessment: Universal double-blind marking

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

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

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

Failure Redemption: There is no failure redemption for this module. Failure in this module would normally result in an exit qualification due to insufficient credits having been attained.

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

Only available to students following an Engineering Degree Programme.

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

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

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

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

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

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

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

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

EG-360 Dynamics 2

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-260

Co-requisite Modules:

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

Format: This will mostly be taught online with recorded lectures / examples. Depending on university regulations, there might be some in-person example classess.
There will be one hour online/in person live example class, and one online office hour per week (in person, might be possible depending on univeristy regulations).
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

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

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

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

Module Content:

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

Intended Learning Outcomes:

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

Accreditation Outcomes (AHEP)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b)

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

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

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

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

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

Standard University procedures for examination feedback.

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

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

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

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

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

EG-362 Fluid Mechanics 3

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules: EG-160; EG-211

Co-requisite Modules:

Lecturer(s): Prof DT Gethin, Dr S Pant

Format: Lectures 22 hours
Example classes 11 hours
Directed private study 40 hours
Preparation for assessment 30

Delivery Method: Class room based teaching.

Module Aims: This module aims to generate ability to solve the problems and explain physical phenomena on the topic of fluid mechanics. The module will cover inviscid fluids, momentum and mass conservation in viscous fluids, boundary layer flows and compressible fluid flow. The module includes turbomachinery including pumps (centrifugal and axial) and turbines (impulse and reaction).

Module Content:

• Ideal Fluid Flow: Introduction to various types of flow and their applications, Concept of inviscid flow with applications, derivation of the governing differential equations for irrotational flows.
• Incompressible fluid flow: Concepts of viscid flows and the differential form of the Continuity and Momentum equations.
• Solutions for simple flow problems.
• Boundary layer flows: The momentum integral equation. Example solutions for simple laminar flows over flat plates.
• Compressible Fluid Flow: Introduction to compressible fluid flow, application to internal flows (nozzles), isentropic flow, and Rayleigh flow.

Turbomachines:
• Basic flow equations and their application to machines
• Pelton wheel, radial and axial flow turbines
• Centrifugal and axial flow pumps and fans

Intended Learning Outcomes:

Technical Outcomes
Upon completion of the module the student should be able to demonstrate a knowledge and understanding of:
- Idealised inviscid fluid flows and the governing equations for irrotational flow. [LO1]
- Incompressible flow of a Newtonian fluid and the solution of such flows via the governing differential equations. [LO2]
- Boundary layer flow and the analysis of such flows via a momentum integral equation. [LO3]
- Compressibility and its relevance in fluid flows, isentropic flow, nozzles, and Rayleigh flows. [LO4]
- Fluid energy and power. Momentum equation applied to pumps and turbines. Velocity diagrams at pump and turbine blades. Cavitation. [LO5]

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)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3b)

Assessment: Examination 1 (90%)
Class Test 1 - Coursework (10%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Assessment: 10% internal assessment (Class Test) [LO1, LO2, LO5]

2 hour examination at the end of the Semester (90%) [LO1 -- LO5]

Resits in August will have 100% weighting.

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

Assessment Feedback: Overview of generic issues from written examinations, including cohort analysis. Solutions for the class test will be discussed in the lectures following the class test.

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

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

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

Available to visiting and exchange students.

EG-365 Manufacturing Optimisation

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-182; EG-284

Co-requisite Modules:

Lecturer(s): Dr A Rees

Format: Lectures 20 hours
Directed private study 80 hours

Delivery Method: On campus lectures

Module Aims: The module provides an introduction to the philosophy and tools used within the Lean Six Sigma methodology. The module will provide an overview of the Toyota Production System (TPS) and the quality systems applicable within manufacturing.

Module Content: Design of Manufacturing Systems
Toyota Production System (TPS)
Lean Six Sigma tools
Strategic stages in planning of manufacturing systems
Systems for high volume and low variety
Systems for low variety and high volume, including cellular systems
Quality Management (Philosophies of Denning, Crosby, Juran)
Quality Systems
Good Automated Manufacturing Processing (GAMP)
Process Optimisation
Design of experiments, Solving orthogonal array problems

Intended Learning Outcomes:
Technical Outcomes
Upon completion of the module the student should be able to demonstrate a knowledge and understanding of:
- Business drivers and how they influence manufacturing system design
- Applying analytical tools to guide the design of a manufacturing system
- Strategies for managing manufacturing systems
- Value Stream Mapping
- Experimental strategies that may be used to guide process improvement and optimisation
- The importance of quality and standards

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)
- Awareness of quality issues and their application to continuous improvement (P7)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (P1)

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

Assessment Description:
Two hour examination, three questions.

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

Assessment Feedback: There will be an overview of generic issues that will be published on the engineering intranet, including a breakdown of cohort performance.

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

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

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

Available to visiting and exchange students.

EGA324 Mechanical Engineering Practice

Credits: 10 Session: 2022/23 September-June

Pre-requisite Modules: EG-268

Co-requisite Modules:

Lecturer(s): Dr AA Fahmy Abdo, Prof NPN Lavery, Dr B Morgan

Format: 10 hours of lectures, 15 hours lab and practical work,
75 hours directed private study
Contact Hours will be delivered through a blend of synchronous and asynchronous, and may include, for example, lectures, seminars, lab workshop 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 each week through a combination of synchronous and asynchronous lectures, experiments, lab workshops & PC labs

The assessment will be based on three formal reports based on the experimental and computational work, as well as two quizzes via CANVAS.
Assessment: 100% Continual Assessment

Penalty for late submission of continual assessment: Zero mark

Module Aims: The course builds on the knowledge and experience developed by the students in experimental studies during Level 2. A number of advanced scientific experiments will be undertaken. In addition, students will carry out a number of modelling benchmark problems in order to develop their ability to create appropriate models, interpret the predictions and compare them with alternative solutions.

Module Content:
A number of scientific experiments will be completed:

• Experiment 1 - Stresses in bolted joints (Multi-assembly loading analysis).
• Experiment 2 - Flow over an Aerofoil in the Subsonic Wind Tunnel (Fluid dynamics).
• Experiment 3 - Stress concentration features (Stress analysis).
• Modelling Tutorials (Fluid & Stress using ANSYS).

Each of these will have supporting lectures.

Lab workshop attendance is compulsory.

Intended Learning Outcomes:
Technical Outcomes
On completion of this module, students will be able to demonstrate:
- Advanced Technical Reporting – Understand & analyse scientific experiments and report the outcome in a well written technical report.
- Experimental Practice - Advanced knowledge and critical understanding of experimental techniques, experimental test programmes to meet open-end objectives. An ability to select and implement suitable measuring equipment and develop appropriate advanced experimental procedures to meet the experimental objectives.
- Computational Validation - Advanced knowledge and critical understanding of computational modelling techniques in order to achieve accurate predictions. An ability to critically appraise the accuracy of numerical predictions, by comparison with alternative solutions

Accreditation Outcomes (AHEP)
- Ability to apply relevant practical and laboratory skills (P3)
- Knowledge of characteristics of particular materials, equipment, processes or products (P2)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)

Assessment: Coursework 1 (10%)
Coursework 2 (40%)
Coursework 3 (40%)
Class Test 1 - Coursework (5%)
Class Test 2 - Coursework (5%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: All coursework is to be undertaken INDIVIDUALLY:

C1 (10%): An 5-page formal report on the bolted joint experiment (experiment 1). The report will be marked on the basis of quality of reporting to meet the learning objectives (LO1/LO2). Feedback given on CANVAS. Data sets will be provided/collected experimentally.

C2 (40%): An 8-page formal report on the flow over an aerofoil (experiment 2) - covering both the experimental & computational modelling. The report will be marked on the basis of quality of reporting to meet the learning objectives (LO1/LO2/LO3). Feedback given on CANVAS. Data sets will be provided/collected experimentally.

C3 (40%): An 8-page formal report on the stress concentration experiment (experiment 3) - covering both the experimental & computational modelling. The report will be marked on the basis of quality of reporting to meet the learning objectives (LO1/LO2/LO3). Feedback given on CANVAS. Data sets will be provided/collected experimentally.

Online Canvas tests (10%) - Two short CANVAS tests on the ANSYS beginner (5%) and ANSYS intermediate (5%) tutorials.

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

Assessment Feedback: A general pro-forma is completed, covering errors/issues that were identified during the marking process, is produced as formal feedback provided through Canvas. Feedback for online tests will come via Canvas once deadline has passed.

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

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

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

Available to visiting and exchange students.

Attendance to lab workshops is compulsory. Coursework's cannot be submitted without this attendance.

All coursework's are to be undertaken individually.

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

Lecture notes and recordings, lab sheets and guidance notes for this module can be found on Canvas.

EGA334 Mechanical Engineering Design 3

Credits: 20 Session: 2022/23 September-January

Pre-requisite Modules: eg-163; eg-165; eg-263; eg-264

Co-requisite Modules:

Lecturer(s): Dr M Togneri, Prof TC Claypole, Prof DT Gethin, Dr EH Jewell, Dr B Morgan, Dr WH Newton, Dr S Potts

Format:

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
Weekly group session for focussed work on particular sections of project
Weekly group supervision meetings for feedback on project progress
Computer lab sessions for software support.

Module Aims: This module demonstrates the outcomes of three years of learning and applies multiple skills to a design project. The project will show that students can manage and deliver a design task, as a team, through all stages of the design process. Students should progress from specification to concept design, undertake analysis (using computer tools as appropriate) and produce a design report and assembly drawings.

Module Content: Group design project with potential industrial applications.

Projects will be of a multi-disciplinary nature and will involve both conceptual and adaptive design. Students will be required to produce 'in-depth' design submissions including the evaluation of critical detail design aspects, and an assessment of manufacturing and cost implications.

While retaining group activity, each student will be required to take responsibility for particular aspects of the design, which must include an element of engineering analysis which will form an important part of the assessment process. This analysis will be either a finite element stress analysis or detailed hand calculations. The work is presented in the form of a group design report, individual contributions and engineering drawings.

Intended Learning Outcomes:

Accreditation Outcomes (AHEP)
- Exercise initiative and personal responsibility, which may be as a team member or leader (G4)
- Understanding of appropriate codes of practice and industry standards (P6)
- Work with information that may be incomplete or uncertain and quantify the effect of this on the design (D3b)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action(EA3b)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1)
- 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)
- Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues (EL5)

Assessment: Group Work - Project (24%)
Group Work - Project (58%)
Group Work - Project (12%)
Group Work - Project (6%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: The November assessment is in the format of a group presentation (20% weight: 10% for group mark and 10% for individual).

The January assessment is in the format of a design report (68% weight: 30% for group mark and 38% for individual mark). The report will be submitted in December, with a compulsory viva in January to give feedback and complete the assessment of the submitted report. The group mark will be weighted evenly by default, but if a signed statement from all members indicates that there is a significant disparity in effort this will affect the apportionment of the group mark.

The continuous assessment will be in the format of 6 approx. fortnightly leadership reports, each worth 2% for a total weight of 12% (individual mark).

Moderation approach to main assessment: Universal non-blind double marking

Assessment Feedback: Feedback on the initial design will be given during the presentation of the first assessment.
General feedback on design drawings will be given in the week after the first assessment.
Weekly group supervision sessions will be used to give informal feedback at every stage of the project.
Final feedback focussing on the second assessment will be given in a viva in January

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of supplementary coursework.Two projects will be set during the supplementary period with a 60:40 weighting.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of supplementary coursework. Two projects will be set during the supplementary period with a 60:40 weighting.

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

PENALTY FOR LATE SUBMISSION:ZERO TOLERANCE

A zero mark may be entered if the student fails to attend the oral examination.

Project groups are allocated during Week 1 and groups should meet every week.

This module is not available for Visiting - Exchange students.

EGA366 Kinematics and Programming for Robot

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr S Li

Format:
10h lectures
16h computer labs (8h tutorial, 8h supervised)
1h concept testing in Robot Lab (4 students per group)
16h self-guided programming in computer lab
57h self-directed study

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

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

Lectures; Tutorials; Supervised project in computer lab/robot lab; Self-guided projects in computer lab/robot lab .

Module Aims: This module first examines the historical development of robotics, both technical and sociological. And then introduces various application of robot technologies focusing on manufacturing, both existing and potential are examined. The core of the module lies in the studies of robot kinematics including trajectory planning and programming. As part of this, industrial standard robot models are analysed and practically experienced through simulation toolkit and commercial software.

Module Content: 1. History and development of robotics;
2. Overview of robot industry and applications;
3. Robot actuators, sensors and end effectors.
4. Repeatability and accuracy of robot manipulation;
5. The kinematic model, including Rotation Matrix, Homogeneous Transformation matrix and Euler Angles;
6. Calculation of forwarding and Inverse kinematics;
7. Differential kinematics including Linear and angular velocities and accelerations of manipulator links as well as Jacobian matrix;
8. Trajectory planning including both polynomial and LSPB methods;
9. Robot controllers (open/closed loop);
10. Robot programming and simulation, then the module mark will be just the exam mark.

Intended Learning Outcomes:
Technical Outcomes
At the end of the module the student will be expected to be able to:
- Discuss the historical development of robotics from technical, philosophical and sociological viewpoints.
- Identify, classify and construct kinematic models for a wide range of robots.
- Calculate forward and inverse kinematics and plan motion trajectories.
- Skillfully use simulation tool kits and commercial software to construct robot models and to plan its motion.

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)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3b)

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

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

Assessment Description:
2 hours written examination covering (1) - (5): 50%
Coursework based on 2 projects covering (3) and (6): 50%

(1) Robotic history and development: the history from ancient automated machine to modern industrial and service robot; identification of the application fields and associated industry.

(2) Robotic actuators, sensors and end effectors: electromagnetic, pneumatic, and memory alloy types of actuators; both passive and active types of sensors typically equipped on a robot; the design of the robot end-effector; the advantage and disadvantage of each type.

(3) Robot kinematics: homogeneous transformation; Denavit-Hartenburg (DH) model which enable standard robot modelling.

(4) Differential kinematics: the mapping between velocities in joint space and in Cartesian space, i.e., Jacobian matrix.

(5) Trajectory planning: polynomial approach, e.g., quintic polynomial trajectory, and linear segment with parabolic bend (LSPB) approach

(6) Robot programming and simulation: introduce 3D simulation of the robot's motion based on the DH models, as well as motion planning and task simulation based on the commercial software. Teach the means to transfer codes from a simulator to a physical robot.

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

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

Assessment Feedback:
General feedback for written exam;
Individual feedback for projects based coursework.

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

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

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

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