Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

STUDENT HANDBOOK

MSc (FHEQ LEVEL 7)

MSc
COMPUTATIONAL ENGINEERING WITH INDUSTRY
DEGREE PROGRAMME

SUBJECT SPECIFIC
(PART TWO OF TWO)
MODULE AND COURSE STRUCTURE
2022/23

DISCLAIMER

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

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

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

The 22-23 academic year begins on 19 September 2022

Full term dates can be found here

DATES OF 22-23 TERMS

19 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

SEMESTER 1

19 September 2022 – 27 January 2023

SEMESTER 2

30 January 2023 – 09 June 2023

SUMMER

12 June 2023 – 22 September 2023

IMPORTANT

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

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

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

Welcome to the Faculty of Science and Engineering!

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

This has been a challenging period for everyone. The COVID-19 pandemic has prompted a huge change in society as well as how we deliver our programmes at Swansea University and the way in which you study, research, learn and collaborate. We have been working hard to make sure you will have or continue to 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 Civil Engineering	Professor Eduardo De Souza Neto
Civil Engineering Programme Director	Dr Clare Wood
Year Coordinators	Professor Yuntian Feng

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 and also 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 also 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 contains useful information and links to other resources:

https://myuni.swansea.ac.uk/college-of-engineering/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 21-22 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. For Engineering courses, we do not expect you to purchase textbooks, unless it is a specified key text for the course.

MSc (FHEQ Level 7) 2022/23
Computational Engineering
MSc Computational Engineering

Semester 1 Modules	Semester 2 Modules
EG-M23 **Finite Element Computational Analysis** **10 Credits** **Prof R Sevilla** **CORE**	**EG-M07** **Optimisation** **10 Credits** **Prof C Giannetti/Dr L Evans** **CORE**
EGIM02 **Advanced Computational Methods for Engineers** **10 Credits** **Dr F Zhao** **CORE**	**EG-M190** **Social, environmental and economic context of research** **10 Credits** **Dr N Wint** **CORE**
EGIM03 **Solid Mechanics** **10 Credits** **Prof D Peric** **CORE**	**EG-M192** **Research Case Study** **10 Credits** **Prof HU Karunarathna** **CORE**
EGIM04 **Advanced Fluid Mechanics** **10 Credits** **Prof K Morgan** **CORE**	**EGEM07** **Fluid-Structure Interaction** **10 Credits** **Prof WG Dettmer** **CORE**
EGIM07 **Dynamics and Earthquake Analysis of Structures** **10 Credits** **Prof Y Feng** **CORE**	**EGIM06** **Computational Fluid Dynamics** **10 Credits** **Prof P Nithiarasu** **CORE**
EGIM16 **Communication Skills for Research Engineers** **10 Credits** **Dr SA Rolland/Dr T Lake** **CORE**	**EGIM08** **Plasticity in Structural and Geotechnical Engineering** **10 Credits** **Prof D Peric** **CORE**
Dissertation	
EG-D04 **MSc Dissertation - Civil and Computational Engineering** **60 Credits** **Prof Y Feng** **CORE**	
Total 180 Credits	

EG-D04 MSc Dissertation - Civil and Computational Engineering

Credits: 60 Session: 2022/23 June-September

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof Y Feng

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

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

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

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

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

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

Intended Learning Outcomes: On completion of this module, students should have the ability to:

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

AHEP3 Learning Outcomes

SM1m A comprehensive understanding of the relevant scientific principles of the specialisation.

SM2m A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation.

EA1m Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations

G1 Ability to apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities

G2 Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

G3m Monitor and adjust a personal programme of work on an on-going basis

Assessment: Report (100%)

Assessment Description: The research project and dissertation forms Part Two of the Masters degree.

Students should refer to:
https://www.swansea.ac.uk/academic-services/academic-guide/postgraduate-taught-awards-regulations/standard-taught-masters/

In particular, section 14 will provide further Information about dissertation preparation and submission.

The word limit is 20,000. This is for the main text and does not include appendices (if any), essential footnotes, introductory parts and statements or the bibliography and index.

Each student is to submit an electronic copy of their dissertation through the Turnitin link on Canvas. The online system will automatically check the similarity of the report.

The dissertation must contain:

• A statement that it is being submitted in partial fulfilment of the requirements for the degree;
• A summary of the dissertation not exceeding 300 words in length;
• A statement, signed by you, showing to what extent the work submitted is the result of your own investigation.
• Acknowledgement of other sources shall be made by footnotes giving explicit references. A full bibliography should be appended to the work;
• A declaration, signed by you, to certify that the work has not already been accepted in substance for any degree, and is not being concurrently submitted in candidature for any degree; and
• A signed statement regarding availability of the thesis.

The dissertation is marked by the supervisor and another member of staff and sent to an External Examiner for moderation. An Internal Exam Board is then held to confirm the mark. Finally, all marks are ratified at the University Postgraduate Taught Examination Board.

Deadlines as follows:

MSc Civil, Structural and Computational Engineering (without resits) - September 30th

MSc Civil, Structural and Computational Engineering (with resits) - December 15th

Moderation approach to main assessment: Universal double-blind marking

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

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

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

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

The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.
If an extension is deemed appropriate a Postgraduate Taught Masters ‘Application for Extension to the Submission Deadline/ Period of Candidature’ Form will need to be submitted as follows:
• 30th September – deadline for Part Two students (non-resit students)
• 15th December – deadline for Part Two Students (students who had resits)

EG-M07 Optimisation

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof C Giannetti, Dr L Evans

Format: Timetabled lectures and example classes 30 hours;
Directed private study 70 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

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

Assessment:
Exam: Extended Coursework 80% (LO1, 2 & 3)
Continuous Assessment: 20% - Assignment 1 (LO1 & 2) and Assignment 2 (LO 2 & 3)

Module Aims: This module provides an introduction to some important techniques of optimisation that may be used across a broad range of engineering disciplines. The focus is on understanding the methods through hand calculation rather than the use of particular software packages. Numerical examples are employed to illustrate concepts and potential applications.

Module Content:
Indicative syllabus content:
1. Statement of optimisation and reliability problems.
2. Lagrange multipliers
3. One-Dimensional Minimisation Methods. Direct and indirect methods: unrestricted search; dichotomous search; golden section method; quadratic interpolation; Newton's procedures.
4. Extrema of functions of several variables.
5. Multidimensional Minimisation Problems - direct methods such as: Taxi-cab; conjugate search procedure
6. Multidimensional Minimisation Problems - indirect methods such as: Steepest descent method; Newton's method.
7. Linear Programming - the Simplex Method

Intended Learning Outcomes:
Technical Outcomes
Upon completion of the module the student should:
- Understand and be able to set up and carry out the necessary calculations for univariate unimodal optimisation problems LO1)
- Be able to use search techniques to determine the optima of unconstrained and constrained multivariable systems (LO2)
- Understand and be able to set up and carry out the necessary calculations for Linear Programming problems (LO3)

Accreditation Outcomes (AHEP)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Understanding of concepts from a range of areas, including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects (SM6m)
- Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods (EA7M)
- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D10M)

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

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

Assessment Description: Exam - 80%
Coursework - 2 separate pieces which involve a selection of problems which utilise the optimisation methods taught. 20%

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

Assessment Feedback:
Examination - Standard College of Engineering exam feedback form.

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

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

This module assumes good mathematical skills and students will be expected to demonstrate a good understanding of partial differentiation, Taylor series expansion and matrices.

Failure to sit an examination or submit work by the specified date will result in a mark of 0% being recorded. The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

Additional notes: Office hours, lecture notes and other teaching materials will be posted on Canvas.

EG-M190 Social, environmental and economic context of research

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr N Wint

Format: 30 formal contact hours
10 x 1 hour lectures
10 x 2 hour interactive workshops

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

Lecture and workshops

Module Aims: There is an increasing need for engineers to work towards complex, so called 'wicked problems', for example the secure supply of energy. This necessitates a holistic approach and involves making decisions based on a range of different factors, and consideration for economic, ethical, social, political and environmental, as well as technical limitations.

Obtaining and making sense of such information involves types of knowledge and the use of tools and techniques that have not always been traditionally used within engineering disciplines. For example, ethical issues concerning negative impacts on environment or society may raise questions of value, duty or morality and requires the application of moral reasoning rather than scientific reasoning.

During this module we will make use of a variety of engineering case studies which exemplify the need to consider non-technical aspects of engineering projects. We will use qualitative research approaches and ethical frameworks to help in our engineering decision making. We will also consider the role of the engineer in policy making.

Module Content: Different types of knowledge and research approaches used to obtain different types of knowledge and information
The use of moral reasoning and ethical frameworks
Policy process and the role of the engineer in informing policy

Intended Learning Outcomes: Technical Outcomes
By the end of this module students should be able to:
Knowledge of the stages of a research project and how to select appropriate research methods.

Accreditation Outcomes (AHEP)
Awareness of the need for a high level of professional and ethical conduct in engineering (EL8M / ET1fl)
Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9M/ ET2fl)
Awareness that engineering activities should promote sustainable development (EL11M / ET4fl)

Assessment: Coursework 1 (60%)
Coursework 2 (40%)
Participation Exercise (0%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Assessment One: Selection of a contemporary engineering topic/project. Outline of the role of different types of knowledge and information needed to inform project. Ethical, economic, social and environmental evaluations of the engineering issues involved.
Assessment Two: A policy brief (choice of contemporary engineering topic)

PASS/FAIL COMPONENT Minimum attendance and contribution to workshop sessions
Note, that this module cannot be passed if this pass/fail element is not passed. If you do not meet the requirements of the Pass/Fail component, you will receive a QF outcome. This means that you will be required to repeat the failed component(s), even if your module mark is above 50%

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

Assessment Feedback: Formative and peer feedback will be given in group/workshop sessions Feedback during Q&As in lecture and example classes. Lecturer available for ad-hoc feedback during office hours. Written feedback on all coursework submitted
Failure Redemption: Students will be provided with the opportunity to resubmit failed components. If engagement in group project activities is below required level, no supplementary will be possible and module will have to be resat in the following year.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. .

EG-M192 Research Case Study

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof HU Karunarathna

Format: No formal lectures involved. Tutorials given by individual MSc research project supervisors (10h)
Directed private study (190h)
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

No formal lectures are involved. Student will meet their individual supervisors regularly (at least weekly) and will be guided the whole course of the module.

Module Aims: The aim of the module is to undertake an in-depth study into the use of research methods in engineering practice by carrying out a detailed literature survey and state of the art examination in a given topic of specialization.

Module Content:

• Literature review on chosen research topic.
• Familiarisation with chosen research topic.
• Planning of MSc thesis.

Intended Learning Outcomes: The student should be able to:

• Investigate a research topic;
• Identify the state-of-the-art and critically evaluate the main problems and necessary steps to move forward with their research topic;
• Formulate research aims;
• Sketch a research plan;
• Undertake a literature review;
• Gather, organize and use evidence, data and information from a variety of primary and secondary sources;
• Critically analyse information;
• Make conclusions supported by the work and identify their relevance to the research topic;
• Produce a report, with the findings presented in a well organised and reasoned manner.

AHEP3 Learning Outcomes
SM1m A comprehensive knowledge and understanding of the scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies
SM2m Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems
EA1m Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes
G1 Apply their skills in problem solving, communication, information retrieval, working with others and the effective use of general IT facilities
G2 Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

Assessment: Report (70%)
Oral Examination (30%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Written report (70%)
Oral presentation (30%)

The report should be approximately 20-30 pages depending on the chosen MSc research topic, and the format and layout should follow the general guide provided by the module coordinator.

Page count is preferred to word count due to the nature of the content, i.e.figures, equations, etc.

The report will be electronically submitted to Canvas via Turnitin, and the online system will automatically perform similarity check.

Arranged by the supervisor, an oral examination will take place before 30th May. During the oral examination, the student is requested to give a PowerPoint presentation (no longer than 15 mins) to summarize his/her case study, followed by questions.

The written report (70%) and the oral presentation (30%) will be marked by the supervisor and another faculty member appointed by the supervisor. At the end of the oral examination, the examiners will provide technical feedback (not the final mark) on the case study.

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

Assessment Feedback: Student will be closely guided and supervised by his/her supervisor, through one-to-one tutorial meetings. In addition, technical feedback (not the final mark) will be provided to students during the oral exam.

Failure Redemption: Failure redemption is possible by the resubmission of the research case study.

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

Around 5,000 word report on the chosen MSc research topic.

Recommended Texts to be defined by supervisor according to the chosen research topic.

EG-M23 Finite Element Computational Analysis

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-323

Co-requisite Modules:

Lecturer(s): Prof R Sevilla

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

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

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

The module is delivered by lectures and example classes.

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

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

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

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

Module Content:

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

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

Accreditation Outcomes (AHEP)

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

MSc
SM1m A comprehensive understanding of the relevant scientific principles of the specialisation.
SM2m A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation.
SM3m Understanding of concepts relevant to the discipline, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects.
EA1m Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations
EA3m Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods.
D1m Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the

effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies
P2m A thorough understanding of current practice and its limitations, and some appreciation of likely new developments.
P4m Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader.
G1 Ability to apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities
G2 Plan self-learning and improve performance, as the foundation for lifelong learning/CPD.
G3 Monitor and adjust a personal programme of work on an on-going basis.

Assessment: Examination 1 (60%)
Assignment 1 (40%)
Resit Assessment: Examination (Resit instrument) (100%)

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

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

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

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

Assessment Feedback:
Examination - Standard university exam feedback form.

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

Failure Redemption: Exam re-sits according to University regulations. A supplementary exam will form 100% of the module marks.

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

Penalty for late submission of continual assessment assignment: No marks awarded for late submissions.

Available to visiting and exchange students.

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

EGEM07 Fluid-Structure Interaction

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof WG Dettmer

Format: Lectures and example classes: 30 hours

Directed private study and revision: 70 hours

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

EGIM02 Advanced Computational Methods for Engineers

Credits: 10 Session: 2022/23 September-January

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

Co-requisite Modules:

Lecturer(s): Dr F Zhao

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

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

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

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

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

Module Content:

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

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

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

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

Assessment: Examination (70%)
Assignment 1 (30%)
Resit Assessment: Examination (Resit instrument) (100%)

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

Assignment 1. Questions on key components and concepts of the course material covered during the semester.

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

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

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

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

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

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

Lecture notes provided.

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

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

EGIM03 Solid Mechanics

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof D Peric

Format: 2 Lectures and 1 Example Class per week. Directed private study 3h per week.

Delivery Method: Two lectures and one example class per week.
Assessment: 70% from end of teaching block 2 hour examination; 30% from 3 small assignments.

Module Aims: This module is concerned with the fundamentals of solid mechanics with particular attention given to elastic solids. Generic continuum mechanics concepts are introduced including basic geometric relations, balance principles and constitutive theory. This provides a basis for approximation methods and finite element method, in particular. Solution techniques of classical elasticity are employed in the solution of several engineering problems, including torsion of cylindrical bars and two-dimensional problems of elasticity.

Module Content: • Elements of Tensor Algebra: Points. Vectors. Tensors: Definitions and Notation. Spectral Theorem; Principal Invariants; Cayley-Hamilton Theorem. [3]
• Elements of Tensor Analysis: Differentiaton; Gradient. Divergence. Curl; Green's Formulae; Divergence Theorem. Stoke's Theorem. [3]
• Geometry and Kinematics of Bodies: Deformation of Bodies: Displacement. Green-Lagrange Strain Tensor; Infinitesimal Strain and Rotation. Properties of the Strain Tensor. Normal and Shear Strains. [3]
• Balance Principles: Linear and Angular Momentum Balance. The Stress Tensor. Local Equations of Equilibrium. Symmetry of the Stress Tensor; Properties of the Stress Tensor. Principal and Deviatoric Stresses; The Principle of Virtual Work. [3]
• Constitutive Theory: The Principle of Energy Balance - The First Law of Thermodynamics; Strain Energy Function; Generalised Hooke's Law. The Elasticity Tensor; Isotropic Linear Elasticity: Constitutive Equations. Lame Coefficients. The Matrix Formulation. [3]
• The Boundary Value Problems of Linear Elasticity: Summary of Field Equations; Navier's Equations; Beltrami-Mitchells Compatibility Conditions; Formulation of the BVP; Uniqueness of Solution. [4]
• Solution of Selected Problems I: Torsion of a Cylindrical Bar. [5]
• Solution of Selected Problems II: The Plane Problem of Elasticity: Problem Description. State of Plane Strain. State of Plane Stress. Characterisation of the Stress Field. Airy's Solution. Formulation in Polar Coordinates. [6]

Intended Learning Outcomes: Students should be able to:
• Apply the fundamentals of solid mechanics to problems of elasticity.
• Formulate engineering problems in solid mechanics by considering geometry, equilibrium and constitutive theory.
• Use tensor calculus in the formulation and solution of solid mechanic problems.
• Perform analysis of torsion of arbitrary cross-section.
• Perform analysis of 2-D plane strain and plane stress engineering problems.
• Recognise situations in which closed form solutions are not feasible in solid mechanics, and approximation techniques are necessary.

Accreditation Learning Outcomes (AHEP)
SM1m A comprehensive understanding of the relevant scientific principles of the specialisation.
SM2m A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation.
EA1m Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations
P1 Advanced level knowledge and understanding of a wide range of engineering materials and components.

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

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

Assessment Description: Examination 1 - Standard 2 hour university examination worth 70% of the final mark. Exam question related to the solution of a boundary value problem is a closed book question. For the remainder of the exam the use of lecture notes and worked exercises is permitted. Coursework 1, 2 and 3 - Each students will need to complete three individual assignments that will require hand calculation. Each assignment will contribute 10% of the final mark, making assignments worth 30% of the final mark.
Moderation approach to main assessment: Universal second marking as check or audit
Assessment Feedback: Examination 1 - Standard university exam feedback form. Coursework 1, 2 and 3 - Marked assignments with comments will be provided to students for inspection.
Failure Redemption: Exam re-sits according to university regulations. Normally, supplementary examination will form 100% of the module mark.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. Zero tolerance will apply for late submissions of the assignments. Failure to sit an examination or submit work by the specified date will result in a mark of 0% being recorded.

EGIM04 Advanced Fluid Mechanics

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof K Morgan

Format: Synchronous Learning 20hr
Blended learning 10hr
Continuous assessment 15h
Directed private study 35h
Preparation for assessment 20h

Delivery Method: Standard lectures

Module Aims: This module provides an introduction to the development of basic mathematical models for describing the flow of fluids. The techniques that are available for developing analytical and simple numerical solutions will be presented and the solutions obtained will be used to gain an understanding of flows of different types.

Module Content: • Introduction. Vectors and tensors (2hr)

• Basic concepts and integral theorems (2hr)

• Governing equations (2hr)

• Ideal fluid flow (4hr)

• Inviscid compressible flow: method of characteristics (2hr)

• Inviscid compressible flow: shock waves (2hr)

• Incompressible viscous flow (2hr)

• Incompressible boundary layer theory (2hr)

• Compressible boundary layer theory (2hr)

Intended Learning Outcomes: By the end of the module, the student will be able to:

• Demonstrate an understanding of the fundamentals of theoretical fluid mechanics, including the nature of ideal and compressible and viscous fluid flow (assessed by assignment and written examination).

• Demonstrate the ability to formulate problems involving different classes of flows and a knowledge of the analytical tools that can produce solutions to basic models (assessed by assignment and written examination).

• Demonstrate the ability to use classical and simple numerical techniques to solve problems in fluid mechanics (assessed by assignment and written examination).

Learning Outcomes (AHEP)
SM1m A comprehensive understanding of the relevant scientific principles of the specialisation.
SM2m A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation.
SM3m Understanding of concepts relevant to the discipline, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects.
EA1m Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations
EA3m Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods.
EL1m Awareness of the need for a high level of professional and ethical conduct in engineering
G1 Ability to apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities
G3m Monitor and adjust a personal programme of work on an on-going basis

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

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

Assessment Description: Coursework 1. This will require the solution to questions on the material covered during weeks 1 to 3 of lectures (6 hours of the syllabus).

Coursework 2. This will require the solution to questions on the material covered during weeks 4 to 6 of lectures (6 hours of the syllabus).

Coursework 3. This will require the solution to questions on the material covered during weeks 7 to 8 of lectures (4 hours of the syllabus).

Examination 1. This will take the form of a take-home examination testing your understanding of all the material presented in the course.

If the Coursework is not submitted by the prescribed date, a mark of zero will be recorded. If an extenuating circumstances request is granted for coursework not submitted by the prescribed date, an extension cannot be put in place,. However, in this case, the marks available for the written Examination will be appropriately scaled.

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

Assessment Feedback: Individual feedback on your submitted coursework within 1 week of the submission deadline.

Electronic feedback on the class examination performance during the scheduled feedback weeks.

Failure Redemption: A supplementary 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.

Some previous knowledge of MATLAB can prove useful

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

EGIM06 Computational Fluid Dynamics

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: EGIM02; EGIM04

Lecturer(s): Prof P Nithiarasu

Format: Lectures and examples 30 hours.

Delivery Method: A total of 30 hours of lectures and examples. Two individual mini-projects on the implementation of computational fluid dynamics algorithms.
Assessment: Written closed-book examination (70%), projects (30%).
Penalty for late submission of continuous assessment assignment:
No marks awarded for late submissions.
Directed private study: 30 hours
Private laboratory work: 12 hours

Module Aims: This module provides a concise overview on the basic principles of computational fluid mechanics. The topics include finite difference and finite element methods, compressible and incompressible flows. Training will also be provided on the implementation of computational fluid dynamics algorithms.

Module Content: Introduction to CFD [1]
CFD model and applications [1]
Navier-Stokes equations [2]
Mathematical nature of equations [3]
Examples [2]
Spatial and temporal discretizations and examples [4]
Mini-project briefs [1]
Finite difference and finite volume schemes and examples [4]
Finite element schemes and examples [4]
Stabilized solution algorithms and examples [4]
Advanced topics [2]
Review and assessment [2]

Computer laboratory work: associated with mini-projects.
Project work: Mini-projects on computer implementation.

Intended Learning Outcomes: At the end of the module the student should be able to;
• Apply the knowledge of fluid dynamics equations, including initial and boundary condition, spatial and temporal discretizations and relevant mathematical aspects to the solution of practical fluid dynamic problems.
• To identify and evaluate the key issues relevant to discretization both in space and time.
• Create a computer code using any one programming language to solve fluid dynamic problems.
• Use computer codes to produce correct solutions.

Learning Outcomes (AHEP)
SM1m A comprehensive understanding of the relevant scientific principles of the specialisation.
SM2m A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation.
SM3m Understanding of concepts relevant to the discipline, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects.
EA1m Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations
EA2m Ability to use fundamental knowledge to investigate new and emerging technologies.
EA3m Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods.
D1m Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies
G1 Ability to apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities
G2 Plan self-learning and improve performance, as the foundation for lifelong learning/CPD.
G3m Monitor and adjust a personal programme of work on an on-going basis.

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

Assessment Description: (i) Mini-project 1: Computer implementation of finite difference schemes (15%).
(ii) Mini-project 2: Computer implementation of a finite element scheme (15%).
(iii) Final examination: Closed book exam (70%).

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

Assessment Feedback: Feedback given on mini-projects 1 and 2. A overall feedback on the final examination will be posted online.

Failure Redemption: Resit may be allowed in exceptional circumstances - subject to university regulations. Assessment - 100% examination.

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

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

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

EGIM07 Dynamics and Earthquake Analysis of Structures

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules: EG-260

Co-requisite Modules:

Lecturer(s): Prof Y Feng

Format: Lectures & Example classes (30h); Directed private study (30h)

Delivery Method: Mixture of online lectures (live + recorded), face-to-face activities and unscheduled one-to-one (online) tutorials

Module Aims: This module aims to develop the understanding and skills necessary to analyse linear structures under general dynamic, including earthquake loading, and to understand the use of time stepping schemes for linear dynamic and transient problems.

Module Content:

• Introduction: Dynamic effects on structures, Engineering disasters, design issues. [1]

• Single Degree of Freedom Problems (SDOF): the SDOF spring-mass system, equivalent SDOF structures - energy method, analytical solution of SDOF problems, step by step solution methods, earthquake loading, response and design spectra, Eurocode- 8 elastic spectrum. [15]

• Multiple Degree of Freedom Problems: natural modes and frequencies of vibration, modal decomposition, reduction methods, earthquake loading, shear building model, design considerations. [9]

• Distributed Mass Systems: finite element discretisation and formulations. [4]

• Revision [1]

Intended Learning Outcomes: On the completion of the module, students are expected to be able to:

• Evaluate potential disastrous consequences of structural failures under dynamic loadings, such as strong wind, wave and particularly earthquakes.
• Apply the Rayleigh method to simplify a complex structure to a SDOF system; perform earthquake analysis of SDOF systems and apply knowledge of basic dynamic concepts of SDOF systems such as dynamic magnification, resonance and damping.
• Follow Eurocode-8 to conduct elastic earthquake analysis of a regular-shaped multi-story frame structure.
• Use a computer language to analyse the accuracy and stability of the Newmark integration method, and generate an earthquake spectra, based on which to conduct an earthquake analysis of a multi-story building.
• Determine Rayleigh vibration shape functions for simple structures.
• Distinguish between stiffness/mass/damping-dominated problems.
• Identify dynamic loading on bridges, footbridges, floors, etc. resulting from moving loads or rhythmic activities.

AHEP3 Learning Outcomes

MEng
EA1m Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes
EA2 Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques
EA4 Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems.
D6 Communicate their work to technical and non-technical audiences.
EL4 Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate.
P4 Understanding of the use of technical literature and other information sources.
P6 Understanding of appropriate codes of practice and industry standards.
G1 Ability to apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities.
G2 Plan self-learning and improve performance, as the foundation for lifelong learning/CPD.

MSc
SM1m A comprehensive knowledge and understanding of the scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies
SM2m Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems
SM3m Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively
EA1m Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes
EA2 Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques
P2m Knowledge of characteristics of particular equipment, processes or products, with extensive knowledge and understanding of a wide range of engineering materials and components
G1 Apply their skills in problem solving, communication, information retrieval, working with others and the effective use of general IT facilities
G2 Plan self-learning and improve performance, as the foundation for lifelong learning/CPD
G3m Monitor and adjust a personal programme of work on an on-going basis

Assessment: Examination 1 (40%)
Project (60%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Exam - 40%

Project - 60%

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

Assessment Feedback: Offer one-to-one sessions to discuss the student's individual project; and use the College's standard module feedback procedure to provide the students with issues associated with the final examination.
Failure Redemption: 1. Students can redeem their failure by taking a supplement exam in August. 2. If students passed the exam component, but failed the individual project, the students have an option to redo the project without taking the supplementary exam.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. Assessment: Written, open book, examination (2 hrs) at the end of Semester 1 accounts for 60% of the marks, the remaining 40% are awarded to an individual project, for which students are expected to solve a dynamical problem using Excel/Matlab etc and write a technical report on their findings. Penalty for late submission of course work is zero mark in the course work. The detail of the individual project will be provided at the beginning of the course.

EGIM08 Plasticity in Structural and Geotechnical Engineering

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof D Peric

Format: Lectures (20h); Example classes and Laboratory work (10h). Directed private study 3h per week.

Delivery Method: Two lectures and one example or laboratory class per week.
Assessment: 50% from end of teaching block 2 hour examination; 50% from 2 projects.

Module Aims: This module is concerned with basic concepts and methods of computational plasticity. Essential steps required in numerical integration of elasto-plastic constitutive models are first discussed in a one-dimensional setting. Concepts of plasticity under multiaxial stress states are introduced and several yield criteria are described including von Mises, Tresca, Mohr-Coulomb and Drucker-Prager yield criteria. Details of numerical integration are provided for the von Mises yield criterion. Understanding of basic concepts and practical applications are strengthened through the programming exercises focusing on one-dimensional problems, and use of computational codes under multiaxial state of stress. Computer simulations of structural and geotechnical problems are performed, with the objective of understanding the concepts of engineering failure and limit state.

Module Content:

• Introduction: Historical Perspective. Physical Motivation. Rate Independent Plasticity. Rate Dependence. Creep. Rheological Models. [2]
• 1-D Mathematical Model: Yield Criterion. Flow Rule. Loading / Unloading Conditions. Isotropic and Kinematic Hardening Models. 1-D Elasto-Plastic Boundary Value Problem. [1]
• Computational Aspects of 1-D Elasto-Plasticity: Integration Algorithms for 1-D Elasto-Plasticity. Operator Split. Return Mapping. Incremental Elasto-Plastic BVP. Consistent Tangent Modulus. [5]
• Classical Model of Elasto-Plasticity: Physical Motivation. Classical Mathematical Model of Rate-Independent. Elasto- Plasticity: Yield Criterion. Flow Rule. Loading / Unloading Conditions. [6]
• Computational Aspects of Elasto-Plasticity: Integration Algorithms for Elasto-Plasticity. Operator Split. The Trial Elastic State. Return Mapping. Incremental Elasto-Plastic BVP. Consistent Tangent Modulus. [3]
• Plane Strain Von Mises Elasto-Plastic Model: Continuum. Integration Algorithm. Operator Split. The Trial Elastic State. Return Mapping; Incremental Elasto-Plastic BVP: Consistent Tangent Modulus. [4]
• Integration Algorithms for Generalised Elasto-Plasticity. [1]
• Generalisations and Applications of Plasticity: Plasticity in Engineering Practice: Geomechanics. Structural Mechanics. Impact Dynamics and Crashworthiness. [8]

Intended Learning Outcomes: Students should be able:
• Identify and select different constitutive models for describing material behaviour including von Mises, Tresca, Mohr-Coulomb and Drucker-Prager elasto-plastic models.
• Apply fundamentals of computational modelling of inelastic materials with emphasis on rate independent plasticity.
• Identify and apply different methodologies for discretisation of different time evolution problems, and rate-independent elasto-plasticity in particular.
• Formulate and implement a computational procedure for integration of rate-independent elasto-plasticity in 1-D.
• Perform analysis of engineering problems in elasto-plasticity by employing a commercial finite element package.
• Determine failure modes in engineering structures and geomechanics.

AHEP 3 Learning Outcomes

MEng
SM1m A comprehensive knowledge and understanding of the scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies
SM2m Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems
SM3m Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively
SM4m Awareness of developing technologies related to own specialisation
SM5m A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations.
EA1m Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes
EA2 Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques
EA3m Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and to implement appropriate action.
P2m Knowledge of characteristics of particular equipment, processes or products, with extensive knowledge and understanding of a wide range of engineering materials and components
P4 Understanding of the use of technical literature and other information sources
G1 Apply their skills in problem solving, communication, information retrieval, working with others and the effective use of general IT facilities

MSc
SM1m A comprehensive understanding of the relevant scientific principles of the specialisation.
Sm2m A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation.
EA1m Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations.
P1m Advanced level knowledge and understanding of a wide range of engineering materials and components.
P2m A thorough understanding of current practice and its limitations, and some appreciation of likely new developments.
G1 Ability to apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities.

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

Assessment Description:
Examination 1 - Standard 2 hour university examination worth 50% of the final mark. This is a closed book examination.
The coursework will consist of two individual projects that will require both hand calculation and computer simulations. Computer simulation will require certain amount of programming and use of the existing finite element software package Elfen. The project reports should consist of two parts: (i) a discussion related to general aspects of formulation and computational treatment of the problem under consideration, (ii) description of numerical solution of an individual problem.
Coursework 1 - Hand calculation and numerical solution in MATLAB will be used to obtain solution of simple 1-D elasto-plastic problem. Coursework 1 will contribute 20% of the final mark.
Coursework 2 - Short hand calculation and computer simulation in commercial code will be used to obtain solution of a 2-D engineering problem. Coursework 2 will contribute 30% of the final mark.

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

Assessment Feedback: Examination 1 - Standard university exam feedback form.
Coursework 1 and 2 - Marked assignments with comments will be provided to students for inspection.

Failure Redemption: Exam re-sits according to university regulations.
Normally, a supplementary examination will form 100% of the module mark.

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

Zero tolerance will apply for late submissions of the assignments.
Failure to sit an examination or submit work by the specified date will result in a mark of 0% being recorded.

EGIM16 Communication Skills for Research Engineers

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

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

Format: Lectures (10h), Exercises (20h), Reading / Private Study (30h), Preparation for Assessment (40h)

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

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

Module Content:

Written Communication: [6 hours]
• The usual layout of reports, theses, journal & conference papers.
• How to write a good abstract for a research output.
• What should be in the introduction
• Contents of the main body of a research output.
• Effective conclusions
• Writing style
• Cross-referencing, captions, references
• Critical review of self and others
• Design concepts for research posters

Oral Communication: [6 hours]
• The usual layout of a research presentation
• Slide design for a research presentation
• Delivery of a presentation, do's and don'ts
• Maintaining the audience's interest.

Other topics: [3 hours]
• Attending & chairing meetings
• Conferences – submissions and attendance
• Submission of papers and peer review.

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

Accreditation Outcomes (AHEP)
- Awareness of the need for a high level of professional and ethical conduct in engineering (EL8M / ET1fl)
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9M / ET2fl)
- Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate (EL11M / ET4fl)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9M / EP2fl)

Assessment:	Assignment 1 (10%) Assignment 2 (10%) Oral Examination (40%) Writing (40%)

Assessment Description:
The first sit assessment will consist of 4 assignments.

The first assessment component will be a short written piece, up to two pages long, which will test the students understanding of the concepts with respect to the written work and to allow feedback to the participants in the module prior to the final assessment. This is an individual piece of coursework.

The second component will feature a small number of tasks which are aimed to evaluate the students understanding of the other ideas, beyond the written word and oral presentations, which are covered in the module. This will include the critical review of a written output. Other possible tasks include group meetings and the creation of a poster. The coursework may be done individually or in groups, this will be confirmed at the time of setting the work.

The oral examination will involve the students presenting an example of the work they have undertaken in the past, typically a project, through an oral presentation. The target duration of the oral presentation will usually be between 8 to 10 minutes. The exact duration will be specified in the assignment descriptor. This is an individual piece of coursework.

The final, fourth, component will require the student to write a paper or equivalent. This paper will be between four to five pages in length and will be written to a format described in the assignment descriptor. This is an individual piece of coursework.

The pass mark for a module at Level 4/M is 50%. In addition to this Students must achieve at least 40% in the Oral Examination AND 40% in the Writing assessment to pass the module.

The reassessment will consist of 2 assignments, details of which are provided in a later section.

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

Assessment Feedback: CANVAS will be used to provide individual feedback to the students on all the components that contribute to the final mark. For the first assessment component a class feedback document is also generally included on CANVAS.

As part of the practical sessions the students will receive verbal feedback on their performance. These sessions do not contribute to the final mark.

Failure Redemption: Candidates shall be given one opportunity to redeem a failure in the module during the summer supplementary period.
All components are redeemable individually in the event of failure across the module.

In addition, the 40 % oral and written assignments of the first must be passed individually to pass the module, and will have to be redeemed even if a pass mark is achieved for the module overall on first sit. A pass mark on both main assessment components will be required to pass the module.

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

All lectures and course material will be provided on CANVAS.

The pass mark for a module at Level 4/M is 50%. In addition to this Students must achieve at least 40% in the Oral Examination AND 40% in the Writing assessment to pass the module.

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

2-year MScs with Industry - Student FAQs

<table>
<tr><td>1.Which courses will be offering 2-year MSc with Industry</td><td>a. MSc Electronic and Electrical Engineering with Industry
b. MSc Materials Engineering with Industry
c. MSc Mechanical Engineering with Industry
d. MSc Computational Engineering with Industry
e. MSc Civil Engineering with Industry
f. MSc Structural Engineering with Industry</td></tr>
<tr><td>2. What is the Course break down:</td><td>
<table>
<tr><th>Year</th><th></th><th>Credits</th><th>Description</th></tr>
<tr><td>1</td><td>Taught Modules</td><td>120</td><td>As per existing MSc</td></tr>
<tr><td>1</td><td>EG-M194 Preparatory Module</td><td>0</td><td>EG-M194 MSc Industrial Preparation - A pre-placement module providing support and guidance.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>2</td><td>Module dissertation

EG-D05
EG-D06
EG-D03
EG-D04
EG-D12</td><td>60</td><td>Same as existing 1-year MSc dissertation. Deadline is September 30th, or if a student resit examinations then the deadline extended to December 15th.
Dissertation projects can be assigned before placements are secured so students may complete the two elements separately.
If a placement is secured in time to undertake the dissertation and the industrial experience within the same placement then this will be possible.</td></tr>
<tr><td>2</td><td>EG-M39 Industrial experience module</td><td>60</td><td>32 weeks of industrial experience. This can either be with a paid industrial placement, or via an internal placement at the University.

In some cases, the entire 32 weeks will be based at the University and in others it could be based entirely in Industry. All students placed in Industry will be under close guidance of academic staff at Swansea.

The industrial experience module (EG-M39) will be assessed with three components on a pass / fail basis, and the learning outcomes and assessment will be closely linked to the requirements of professional engineering accreditation.</td></tr>
<tr><td colspan="4">Total Credits 240</td></tr>
</table>
</td></tr>
<tr><td>3. Who will be providing support to me during my placement?</td><td>The academic coordinator of the ‘with Industry’ programme will oversee the support and monitoring. They will also act as supervisor for the industrial experience module and they guide students via weekly interactions. Attendance will be monitored by the academic supervisor, in conjunction with the placement company as relevant. UKVI requirements will be met with regular meetings with the supervisor (face to face). There will also be resource within Academic Registry to monitor the students in Year 2 to ensure UKVI compliance.</td></tr>
</table>

<table>
<tr><td>4. Are there any conditions for progression to Year 2?:</td><td>To remain on the MSc with Industry, students will need to have successfully completed Part 1 and to have secured an appropriate placement(s). Any student who does not meet these criteria will be transferred to the normal one-year MSc.</td></tr>
<tr><td>5. What about my Visa?</td><td>Swansea University will support the application for a 2-year Visa.</td></tr>
<tr><td>6. What are the entry requirements</td><td>Entry requirements for the 2-year MSc schemes will be a 2:1 in a relevant degree (higher than the 1-year MSc entry requirement).</td></tr>
<tr><td>7. What is the application process?</td><td>Intake will be capped at 10 students per MSc and we are anticipating high demand. If we cannot offer the 2-year MSc we may be able to offer the existing 1-year MSc courses.</td></tr>
<tr><td>8. Will I be able to work alongside my study?</td><td>You will be able to work for 20 hours per week on top of the MSc.</td></tr>
<tr><td>9. How will I secure a placement?</td><td>Where possible, placements will be secured in advance of recruitment.
Some placement opportunities will be available as students apply and competitive applications against these will take place. The remaining placement projects will need to be secured by students with support of University staff and this process will take place during October – June of the first year.</td></tr>
<tr><td>10. Is my placement guaranteed?</td><td>No.
It is the responsibility of the student to secure a suitable placement with the assistance of University staff. Any student who does not meet these criteria will be transferred to the normal one-year MSc working to the same dissertation deadline as the 1-year MSc.</td></tr>
<tr><td>11. What is the course timeline?</td><td>
<table>
<tr><td colspan="2">YEAR 1</td></tr>
<tr><td>Sept – June</td><td>Year 1 Taught Modules (120 credits) and also alongside this MSc Industrial Experience Preparation module (EG-M194). The pre-placement sessions will take place to prepare you ahead of the placement and will cover academic requirements that you will have to fulfil during your time in industry.</td></tr>
<tr><td>Oct – June</td><td>Process to apply for and secure placement/s (subject to successful completion of Part 1 in June)</td></tr>
<tr><td>June/August</td><td>Exams and check point for Part 1 completion.
- If you've passed all modules (no toleration allowed) - Board confirmation of completion of Part 1.
- Board confirmation of placement secured.
If both confirmed, then you can proceed to dissertation and placement year.

If placement has not been secured, then you will be transferred to standard 1-year MSc and submit the dissertation in line with the deadline.

If Part 1 is not completed due to academic failure, then you will fail the degree. You may be awarded a post-graduate certificate as an exit qualification.</td></tr>
<tr><td colspan="2">YEAR 2</td></tr>
</table>
</td></tr>
</table>

	Y2 June – September	Part A: Dissertation (60 credits): September submission: Learning outcomes and assessment as per 1-year MSc dissertation. Part B: Industrial experience - module EG-M39 (60 credits): 32 weeks of industrial experience Assessment points (Three pass/fail components): 1 - Placement Report: The student is expected within the first few months of the placement to complete a report which includes an overview health and safety as well as your main responsibilities in the placement (December 20%) 2 - Final Placement Report: This report summarises the students year in industry placement/ project experience. The report will include a reflective section covering the student's role in the engineering placement / project, highlighting their personal initiative and their role in the evaluation of new engineering concepts (May 60%) 3 - Recorded Presentation: Every student is expected to record and submit through Canvas a maximum 5-minutes PowerPoint presentation video summarising your MSc Year in Industry placement (May 20%)

12. What happens if I pass Part 1 but have not secured a suitable placement or project?	You will be transferred to the standard 1-year MSc Course and have until September to complete the dissertation. If you were required to undertake resit examinations the dissertation deadline will be moved on to December.
13. What happens if I fail to complete Part 1 by June?	You will be entered in for resit examinations for the taught modules will take place in August and you will have until December to complete your dissertation.
14. What happens if I fail to complete Part 1 following resits in August?	If you fail to pass all August resists, then you will fail the degree. You may be awarded a post-graduate certificate as an exit qualification.
14. What happens if I fail any of Year 2 assessments	You will have one opportunity to repeat or resubmit assessment (capped at 50%). These must be completed by August of Year 2, so within the UKVI time allowance. If you fail any repeat / resubmission, then you will fail the degree and may be awarded a post-graduate certificate as an exit qualification.
15. What happens if I drop out of Year 2 at any point in Year 2?	Drop out will result in failure of the degree. You may be awarded a post-graduate certificate as an exit qualification. If student has valid extenuating circumstances Extensions may be applied / deferred fairly and extensions to UKVI time allowance will be sought on an individual basis
16. What if I don't complete the Industrial Module (EG-M39)?	Failure to complete the industrial experience module (EG-M39) will lead to failure of the degree, even if the dissertation module has been passed. After June of Year 1, there will be no scope to transfer from the 2-year MSc to the 1-year MSc equivalent.