Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

POSTGRADUATE TAUGHT STUDENT HANDBOOK

MSc (FHEQ LEVEL 7)

MSc COMPUTATIONAL MECHANICS DEGREE PROGRAMME

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

DISCLAIMER

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

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

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

The 23-24 academic year begins on 25 September 2023

Full term dates can be found here

DATES OF 23-24 TERMS

25 September 2023 – 15 December 2023

8 January 2024 – 22 March 2024

15 April 2024 – 07 June 2024

SEMESTER 1

25 September 2023 – 29 January 2024

SEMESTER 2

29 January 2024 – 07 June 2024

SUMMER

10 June 2024 – 20 September 2024

IMPORTANT

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

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

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

Welcome to the Faculty of Science and Engineering!

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

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

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

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

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

Faculty of Science and Engineering	
Pro-Vice-Chancellor and Executive Dean	Professor David Smith
Director of Faculty Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Laura Roberts
School of Aerospace, Civil, Electrical, General and Mechanical Engineering	
Head of School	Professor Antonio Gil
School Education Lead	Professor Cris Arnold
Head of Civil Engineering	Professor Eduardo De Souza Neto
Civil Engineering Programme Director	Dr Clare Wood
Year Coordinators	Professor Rubén Sevilla

STUDENT SUPPORT

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

Standard Reception opening hours are Monday-Friday 8.30am-4pm.

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

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

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

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

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

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

READING LISTS

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

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

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

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

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

MSc (FHEQ Level 7) 2023-24
MSc Computational Mechanics

YEAR 2 – Commencing at Swansea

Semester 1 Modules	Semester 2 Modules
EGIM16 **Communication Skills for Research Engineers** **10 Credits** **CORE**	
EGIM07 **Dynamics and Earthquake Analysis of Structures** **10 Credits** **CORE**	
Research Project	
EG-M100 **Case Study** **20 Credits** **CORE**	
EG-M101 **60 Credits** **Prof R Sevilla** **CORE**	
Total 120 Credits	

Optional Modules

Choose exactly 20 credits

EG-M07	Optimisation	TB2	CORE	10
EG-M25	Advanced Structural Analysis	TB1	CORE	10
EGIM08	Plasticity in Structural and Geotechnical Engineering	TB2	CORE	10
EGIM06	Computational Fluid Dynamics	TB2	TB2	10
EGEM07	Fluid Structure Interaction	TB2	TB2	10

EG-M100 Case Study

Credits: 20 Session: 2023/24 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof R Sevilla, Refer To Dept

Format: Typically 1h weekly meeting with the supervisor.

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 computational mechanics.

A detailed literature survey and state of the art examination in a given topic of specialisation will be carried out. This might include revising or developing basic computational engineering codes in a given topic.

The topic of the case study will be in line with the research dissertation to be carried out in the second semester.

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

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;
• produce a report, with the findings presented in a well organised and reasoned manner.

Accreditation 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
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.

Assessment: Other (100%)

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

The report should contain around 5,000 words depending on the chosen MSc research topic, and the format and layout should follow the general guide provided by the module coordinator. 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 be arranged by the supervisor. During the oral examination, the student is requested to give a PPT 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 Double Blind Marking of the whole cohort
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: 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-M101 Research Dissertation

Credits: 60 Session: 2023/24 June-September

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof R Sevilla

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.

Accreditation 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
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: Oral Examination (100%)

Assessment Description: The research project and dissertation forms Part Two of the Masters degree. Information about dissertation preparation and submission can be found at:
http://www.swan.ac.uk/registry/academicguide/assessmentandprogress/dissertationpreparationsubmission/

Additionally, students should refer to:
http://www.swan.ac.uk/registry/academicguide/postgraduatetaughtawardsregulations/postgraduatetaughtmastersdegrees/17submissionofdissertation/

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 two soft bound copies and an electronic copy of the dissertation (CD with dissertation in Pdf format) to the Faculty Postgraduate Administration Team by the deadline of 30th September. Each copy 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.

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

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 failure. 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 Faculty of Science and 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:

- 31 August – deadline for Part Two students (non-resit students)
- 8 November – deadline for Part Two Students (students who had resits)

EG-M07 Optimisation

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof C Giannetti

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%)

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: Moderation of the entire cohort as Check or Audit

Assessment Feedback:
Examination - Standard Faculty of Science and 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.

This module operates with 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-M25 Advanced Structural Analysis

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-320

Co-requisite Modules:

Lecturer(s): Prof EA De Souza Neto

Format: Lectures 20 (h); Example classes 10 (h); Directed private study 70 (h)

Delivery Method: The course is delivered by means of lectures and example classes, including a number of synchronous and asynchronous online learning activities.
Course announcements, including office hours details, etc, are made via CANVAS.
Course material, including the course notes and assignment description, lecture and exercise class recordings, will be available for download from CANVAS.

Module Aims: The module develops theory and associated solution techniques relevant to structural problems related to plates, shells and solid applications. The basic theoretical concepts are firstly introduced and the underlying governing equations then developed. The first topic considered is the elastic theory of plate bending, which is of fundamental importance in the design and analysis of a large class of engineering structures. This is followed by the limit analysis of plate structures, which is of prominence in reinforced concrete design. A central aspect of the course is the treatment of the membrane analysis of shell structures. Most shell structures operate by their resistance to membrane action, rather than bending, and the course develops solution procedures for a range of practical shell structure applications encountered in both civil and mechanical engineering environments. The course concludes by developing solution strategies for structures subjected to torsion, with particular emphasis placed on the analysis of thin walled structures, such as those encountered in bridge deck construction and aerospace applications.

Module Content: • Introduction. Equilibrium conditions and the development of the governing equations for plate bending in terms of bending moments. [3]
• Constitutive law and the moment-curvature relations. Governing equations in terms of displacements. [2]
• Boundary conditions for rectangular plates. Navier's solution for simply supported rectangular plates. [2]
• Point loaded simply supported rectangular plates. Development of the governing equations for axisymmetrically loaded circular plates. [2]
• Solution of axisymmetrically loaded circular plate problems. Introduction to the limit analysis of reinforced concrete slabs. [2]
• Virtual work method and equilibrium method for the evaluation of limit loads of slabs. Orthotropically reinforced slabs. [2]
• Introduction to shell behaviour. The theory of shell action under membrane behaviour. Axisymmetrically loaded shells of revolution. [4]
• Introduction to the Linear Theory of Elasticity. [2]
• Torsion of prismatic bars. Thin-walled sections [2]
• Plane stress and plane strain linear elasticity [2]
• Axisymmetric problems. Thermal stresses [2]
• Solution of various elasticity problems [2]

Intended Learning Outcomes: Upon completion of this module students should be able to:
• Use the principles of equilibrium and compatibility, linear elastic law and the concept of generalised strains and stresses to pose well-defined boundary value problems of advanced structural analysis involving plates, shells and solids under plane strain and plane stress conditions.
• Distinguish between axial, bending, shear and torsional load carrying actions and understand how they are transferred within a structure.
• Identify and make use of appropriate methods of analysis for plates, shells and solids and compute relevant stresses and deformations in realistic structures.
• Distinguish between statically determinate and indeterminate structures.
• Identify plastic collapse mechanisms in plain/reinforced plates and compute the corresponding plastic collapse loads.
• Compute the torsional stiffness, stresses and rotations for thin-walled structures subjected to torsional loads.

AHEP3 Learning Outcomes

MEng
SM2m 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.
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.

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.

Assessment: Examination 1 (75%)
Coursework 1 (25%)

Assessment Description: Coursework 1: 1 piece of written coursework to be handed in in December..
Examination: Covering all aspects of the module.
Failure to sit an examination or submit coursework by the specified date will result in a mark of 0% being recorded.

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

Assessment Feedback: Exam: Standard College of Engineering exam feedback
Coursework: A copy of the marked/commented coursework will be returned to students for feedback.

Failure Redemption: Exam re-sits according to University regulations. 100% supplementary examination.

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

This module particularly builds on the work you have done in the Year 2 Structural Mechanics 2 (a) and (b) modules as well as Year 3 Structural Mechanics 3. You should revise the topics learnt in these modules. This module also assumes that you are familiar with the basic mathematical concepts learnt in Years 1 and 2 mathematics modules.

EGEM07 Fluid-Structure Interaction

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof WG Dettmer

Format: Lectures and example classes: 30 hours

Directed private study and revision: 70 hours

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

EGIM06 Computational Fluid Dynamics

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

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%)
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: Moderation of the entire cohort 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: 2023/24 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%)

Assessment Description: Exam - 40%

Project - 60%

Moderation approach to main assessment: Moderation of the entire cohort 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: 2023/24 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%)

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: Moderation of the entire cohort 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: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

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

Format: Lectures (15h), Exercises (15h), 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 and visual communication will be explored through a series of lectures and formative exercises.

Module Content: Background to Communication:
• Academic misconduct and research publication ethics.
• Fundamentals of communication.
• Critical thinking in research.

Written Communication:
• 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:
• The usual layout of a research presentation
• Slide design for a research presentation
• Delivery of a presentation
• Audience engagement.

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)

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)
- 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 3 assignments.

The first assessment component will be a written piece, which will test the students' understanding of the literature-based research process, test their ability to articulate the findings, and draw relevant, well-supported conclusions. This is an individual piece of coursework. This assignment is a precursor to assignment 3 (article).

The oral examination will involve the students presenting the outcome of their chosen research topic (literature-based only, no original research requirement in the module), 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, third, component will require the student to write a technical article 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, detailed in a further section.

Moderation approach to main assessment: Moderation by sampling of the cohort

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.

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.

All components are redeemable individually in the event of failure across the module. Students may be required to take supplementary examination of examined components they have already passed if the combination of marks is such that the module may be failed.

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