Module Descriptor

Title	Applied Finite Element Analysis		
Session	2025/26	**Status**	Published
Code	ENGG11022	**SCQF Level**	11
Credit Points	20	**ECTS (European Credit Transfer Scheme)**	10
School	**Computing, Engineering and Physical Sciences**		
Module Co-ordinator	O Obeid		

Summary of Module

The role of computational based analysis and simulation techniques are proving to be ever more critical as enabling technologies in the engineering and design environment Finite Element Analysis (FEA) is a major analysis tool for the simulation and assessment of components and systems.

This module will introduce students to advantages, disadvantages and limitations of different FE methodologies, exemplifying these by application of the methods to practical engineering and design problems.

An introduction to traditional H-type element formulation will be presented for beam, 2D planar, 3D shell and solid elements. Solution methods and routines will be discussed as applicable to the analysis type.

Module content will focus on modeling strategies and techniques. Types of modeling such as solid, shell, plane stress and strain techniques, axisymmetric and beam modeling will be discussed and demonstrated. Modeling issues will be highlighted such as the use of symmetry, error issues and convergence checking. Sensitivity studies will be dealt with in a practical manner. Effects of element formulation, equivalent nodal loading, solution schemes, element results, nodal averaging, and constraints will be discussed and assessed. Combination of element types within an analysis will be explored, with various modeling approaches demonstrated.

During the course of this module students will develop their UWS Graduate Attributes (https://www.uws.ac.uk/current-students/your-graduate-attributes/). Universal: Academic attributes - critical thinking and analytical & inquiring mind; Work-Ready: Academic attributes - knowledge of FEA and relevant ICT skills; Successful : autonomous, driven and resilient.

This module will start with a small displacement linear elastic FE analysis and progress to advanced modelling with geometric and material nonlinearities with applications. Assessment will be by means of a major coursework/case study submission. During the course of this module students will gain knowledge and understanding of this important discipline as well as having the opportunity to develop a broad range of ICT, technical and transferable skills. Subject matter will be delivered mainly by an innovative programme of laboratory demonstrations and class assignments where the practical nature of the module will be emphasised and students will gain experience in using state of the art FEA systems. A complementary series of lectures and presentations will also be used to reinforce the subject matter.

This module has been reviewed and updated, taking cognisance of the University's Curriculum Framework principles. Examples of this are found within the module such as

active and engaging laboratory and digital tutorial activity, module assessment which reflects industry Computer Aided Engineering activities, learning synergies across modules and levels of study, recorded lecture content supporting students to organise their own study time and the use of real-world practical problems with experimental data to validate simulation activity developing digital intelligence meta-skills.

Module Delivery Method	**On-Campus**[1] ☒	**Hybrid**[2] ☐	**Online**[3] ☐	**Work -Based Learning**[4] ☐
Campuses for Module Delivery	☐ Ayr ☐ Dumfries	☐ Lanarkshire ☐ London ☒ Paisley	☐ Online / Distance Learning ☐ Other (specify)	

Terms for Module Delivery	Term 1	☐	Term 2	☒	Term 3	☐
Long-thin Delivery over more than one Term	Term 1 – Term 2	☐	Term 2 – Term 3	☐	Term 3 – Term 1	☐

Learning Outcomes	
L1	Develop an in-depth comprehensive knowledge and critical understanding of the theory and application of analysis and simulation systems currently used in a design and analysis engineering environment.
L2	Apply advanced skills and techniques, in the application of Finite Element Analysis, to solve practical case studies and complex design problems, reaching substantiated solutions.
L3	Demonstrate a critical analysis and assessment of a Finite Element Analysis.
L4	Design solutions for complex problems that evidence originality using advanced FEA for problems involving linear elastic small displacement, eigenvalue and eigenvector vibration and buckling, nonlinearity and time dependencies.
L5	Adopt a holistic and proportionate approach to the mitigation of security risks.

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	**During completion of this module, there will be an opportunity to**

[1] Where contact hours are synchronous/ live and take place fully on campus. Campus-based learning is focused on providing an interactive learning experience supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus contact hours will be clearly articulated to students.

[2] The module includes a combination of synchronous/ live on-campus and online learning events. These will be supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus and online contact hours will be clearly articulated to students.

[3] Where all learning is solely delivered by web-based or internet-based technologies and the participants can engage in all learning activities through these means. All required contact hours will be clearly articulated to students.

[4] Learning activities where the main location for the learning experience is in the workplace. All required contact hours, whether online or on campus, will be clearly articulated to students

	achieve core skills in:
Knowledge and Understanding (K and U)	**SCQF 11** A critical knowledge and understanding of finite element methods and techniques and how these fit into engineering and design strategies. Specific and detailed knowledge and understanding of the application, techniques and practices associated with finite element analysis of engineering and design problems. Detailed knowledge of appropriateness of methods and techniques to different problems/scenarios.
Practice: Applied Knowledge and Understanding	**SCQF 11** Select and critically evaluate technical literature and other sources of information to solve complex problems Applying knowledge and understanding to develop modelling and analysis strategies for a wide range of engineering and design problems, using finite element method techniques. Assessing different strategies with respect to obtaining appropriate efficient solutions to engineering and design problems. Making use of specialised finite element techniques to solve engineering and design problems such as optimisation methods or open ended problems.
Generic Cognitive skills	**SCQF 11** Undertaking, evaluating and assessing critical FE analysis data. Making judgements on analytical data and results. Being able to develop conceptual solutions and strategies to FE problems. Dealing with unpredictability in results and making critical comparative assessments between theoretical, simulation, and experimental predictions. Bringing information together from a variety of sources during problem solving and being able to perceive potential problems with methods and strategies.
Communication, ICT and Numeracy Skills	**SCQF 11** Ability to perform, interpret and evaluate complex numerical, geometrical and graphical data and using it to solve problems. Ability to use variables and equations. Ability to integrate existing software with other applications such as spread sheets. Make use of multi-purpose integrated software systems to solve complex problems. Using communications skills to write detailed, critical technical reports, including text and illustration. Using finite element hardware and software and associated ICT equipment and systems such as networks to support and perform a wide range of problem solving tasks.
Autonomy, Accountability and Working with Others	**SCQF 11** Identifying and addressing their own learning needs both during and outwith class time. Identifying solution routes and strategies using their own initiative and informed judgements.

Prerequisites	Module Code	Module Title
	Other	
Co-requisites	Module Code	Module Title

Learning and Teaching	
In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours. The learning and teaching for this module comprises a series of lectures and tutorials.	
Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture / Core Content Delivery	24
Tutorial / Synchronous Support Activity	12
Independent Study	164
n/a	0
n/a	0
n/a	0
TOTAL	200

Indicative Resources
The following materials form essential underpinning for the module content and ultimately for the learning outcomes: Finite Element Analysis System (such as ANSYS, PTC Creo Parametric/Simulate) + 40 seat PC Lab with corresponding network facilities and suitable PCs. Software site licences required. Course notes, presentations and case studies will be provided Textbooks: Chen, X. & Liu, Y. (2019) Finite Element Modeling and Simulation with ANSYS Workbench. Boca Raton: CRC PRESS. Lee, H.H., (2020) Finite element simulations with ANSYS workbench 2020. Mission: SDC publications. Lee, H.H. (2022) Finite element simulations with ANSYS Workbench 2022: theory, applications, case studies. Mission: SDC publications. Versteeg, H.K. (2007) An introduction to computational fluid dynamics the finite volume method, 2/E. Chennai: Pearson Education India.
(N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements
In line with the Student Attendance and Engagement Procedure, Students are academically engaged if they are regularly attending and participating in timetabled on-

campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

For the purposes of this module, academic engagement equates to the following:

The School of Computing, Engineering and Physical Sciences considers attendance and engagement to mean a commitment to attending, and engaging in, timetabled sessions. Students will scan their attendance, via the attendance scanners, each time they are on-campus, they will have their attendance recorded in class and they will be expected to login to the VLE several times per week. Students who are unable to attend a timetabled session, due to illness or other circumstance, should notify their Programme Leader. Across the School an 80% attendance threshold is set. Students who fall below this, will be referred to the Student Success Team to see how they can be best supported in their studies.

Equality and Diversity
The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code. Aligned with the University's commitment to equality and diversity, this module supports equality of opportunity for students from all backgrounds and learning needs. Using the VLE, material will be presented electronically in formats that allow flexible access and manipulation of content. This module complies with University regulations and guidance on inclusive learning and teaching practice. Specialist assistive equipment, support provision and adjustment to assessment practice in accordance with the University's policies and regulations.
(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	**Engineering Physical Sciences**
Overall Assessment Results	☐ **Pass / Fail** ☒ **Graded**
Module Eligible for Compensation	☐ **Yes** ☒ **No** **If this module is eligible for compensation, there may be cases where compensation is not permitted due to programme accreditation requirements. Please check the associated programme specification for details.**
School Assessment Board	Engineering
Moderator	T Leslie
External Examiner	B Bryant
Accreditation Details	This module is part of the IMechE accredited programmes BEng/MEng (Hons) Aircraft and BEng/MEng (Hons) Mechanical Engineering.
Module Appears in CPD catalogue	☐ **Yes** ☒ **No**
Changes / Version Number	1.10 (was 1.09) Module Descriptor copied to 2025/26 template, resources list updated to reflect ILR feedback, Attendance and Engagement and EDI statements updated.

Assessment (also refer to Assessment Outcomes Grids below)

Assessment 1
Assessment Category 1: Case study on Linear FEA Modelling & Analysis, Weight-50%
Assessment 2
Assessment Category 2: Case study on Non-linear Modelling & Analysis, Weight-50%
Assessment 3
N/A
(N.B. (i) Assessment Outcomes Grids for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An indicative schedule listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Component 1							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Case Study	☒	☒	☒	☒	☐	50	0

Component 2							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Case Study	☐	☒	☒	☐	☒	50	0

Component 3							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
N/A	☐	☐	☐	☐	☐		
Combined total for all components						100%	0 hours

Change Control

What	**When**	**Who**
Module Descriptor copied to 2025/26 template, resources list updated to reflect ILR feedback, Attendance and Engagement and EDI statements updated.	March 2025	Obeid Obeid