University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Analysis & Simulation 1			
Code: ENGG09011	**SCQF Level: 9 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: 10 (European Credit Transfer Scheme)**
School:	School of Computing Engineering and Physical Sciences		
Module Co-ordinator:	Dr Obeid Obeid		

Summary of Module

The role of computer based analysis and simulation techniques are proving to be ever more critical as enabling technologies in the engineering and design environment. Technologies which are now considered as a critical component to any competitive design strategy are Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD).

This module will introduce students to FEA and CFD focusing strongly on the application of the method to practical engineering and design problems.

An introduction to the FEA and CFD will be given and its role as an enabling technology in a competitive 'time to market' strategy will be discussed and described. The main techniques used for computational analysis of engineering and design problems will be outlined and examples given of typical situations identified.

Subject matter will be delivered mainly by an innovative programme of laboratory demonstrations where the practical nature of the module will be emphasised and students will gain experience in using state of the art Computer Aided Engineering systems. A complementary series of lectures and presentations will also be used to reinforce the subject matter.

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/CFD and relevant ICT skills; Successful : autonomous, driven and resilient.

FEA Module content will focus on modelling strategies and techniques. Types of modelling such as solid, plane stress and strain techniques, axisymmetric, beam and shell modelling will be discussed and demonstrated.

Modelling issues will be highlighted such as the use of symmetry. Error issues and convergence checking will be dealt with in a practical manner. Comparison will be made of the different formulations used such as p/h methods. Mesh generation and refinement issues will also be dealt with.

CFD Module content will include geometry creation, meshing techniques, solution approaches and post processing of results data. Strategies to demonstrate the

importance of mesh independence and turbulence modelling will also be explored.

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					
Face-To-Face	**Blended**	**Fully Online**	**HybridC**	**Hybrid 0**	**Work-Based Learning**
☒	☐	☐	☐	☐	☐
See Guidance Note for details.					

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit) (tick as appropriate)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
☒	☐	☐	☐	☐	☐	

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	☐	Term 2	☒	Term 3	☐

Learning Outcomes: (maximum of 5 statements) At the end of this module the student will be able to:	
L1	Identify and describe the main techniques utilised for computational analysis and the key stages associated with a basic Finite Element and CFD analysis.
L2	Select and plan suitable modelling and analysis strategies for a typical Finite Element Analysis and CFD analysis.
L3	Define modelling requirements and apply simulation methods to various design problems.
L4	Evaluate the accuracy of a typical analysis and understand and be able to discuss potential sources of errors associated with a simulation.

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:
Knowledge and Understanding (K and U)	SCQF Level **9** Knowledge and understanding of FEA/CFD and techniques and how it fits into engineering and design strategies. Specific knowledge and understanding of the application and practices associated with FEA/CFD of engineering and design problems. Knowledge of the appropriateness of methods and techniques to different problems/scenarios. Knowledge of holistic and proportionate approach to the mitigation of security risks.
Practice: Applied Knowledge and Understanding	SCQF Level **9** Select and apply appropriate computational and analytical techniques to model complex problems, discussing the limitations of the techniques employed. Applying knowledge and understanding to develop modelling and analysis strategies for a wide range of engineering and design problems, using FEA/CFD. Select and critically evaluate technical literature and other sources of information to solve complex problems. Assessing different strategies with respect to obtaining appropriate efficient solutions to engineering and design problems. Making use of specialised FEA/CFD techniques to solve engineering and design problems such as optimisation methods. Select and apply appropriate materials, equipment, engineering technologies and processes, recognising their limitations. Use practical laboratory and workshop skills to investigate complex problems. mitigations of the techniques employed.
Generic Cognitive skills	SCQF Level **9** Undertaking and assessing critical analysis data. Making judgements on analytical data and results.

	Dealing with unpredictability in results and making comparative assessments between theoretical, simulation, and experimental predictions. Bringing information together from a variety of sources during problem solving.	
Communication, ICT and Numeracy Skills	SCQF Level **9** Ability to perform, interpret and evaluate numerical and graphical data to solve problems. Ability to use variables and equations. Using communications skills to write technical reports, including text and illustration. Using FEA/CFD hardware and software and associated ICT equipment such as networks to support and perform a wide range of problem solving tasks. Adopt a holistic and proportionate approach to the mitigation of security risks. Communicate effectively on complex engineering matters with technical and non- technical audiences, evaluating the effectiveness of the methods used.	
Autonomy, Accountability and Working with others	SCQF Level **9** Identifying and addressing their own learning needs both during and outwith class time. Identifying solution routes and strategies using their own initiative.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code:	**Module Title:**
	Other:	
Co-requisites	**Module Code:**	**Module Title:**

*Indicates that module descriptor is not published.

Learning and Teaching

The learning and teaching activity for this module include lectures, tutorials and problem based learning.

Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	12
Tutorial/Synchronous Support Activity	24
Independent Study	164
	Hours Total 200

****Indicative Resources: (eg. Core text, journals, internet access)**

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

Computer Aided Engineering Analysis System + 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:

R. H. Shih, Introduction to Finite Element Analysis Using Creo Simulate 4.0, SDC Publications, 2018

R. Toogood, Creo Simulate 4.0 Tutorial Structure and Thermal, SDC Publications, 2017

T.K. Hellen and A.A. Becker, Finite Element Analysis for Engineers - A Primer (R0110), NAFEMS, 2013

An Introduction To Computational Fluid Dynamics, H K Versteeg & W Malalasekera, 1995, Longman, ISBN 0-582- 21884-5*

Computational Fluid Dynamics - An Introduction for Engineers, M B Abbott & D R Basco, 1989*

Chen, X. and Liu, Y., 2018. Finite element modelling and simulation with ANSYS Workbench. CRC press.

(**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.

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.
(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 and Physical Sciences
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Engineering
Moderator	Tony Leslie
External Examiner	M Ghaleeh
Accreditation Details	This module is part of the IMechE accredited programmes BEng/Meng (Hons) Aircraft and BEng/Meng (Hons) Mechanical Engineering.
Changes/Version Number	2.15 (was 2.14) Module Delivery Changed to Face-To-Face from Hybrid C. Typographical errors corrected throughout.

Assessment: (also refer to Assessment Outcomes Grids below)
Coursework 1 - written coursework submission - 50%. (FEA) A minimum of 30% must be achieved for each coursework. A minimum of 40% is required to achieve a pass in this module
Coursework 2 - written coursework submission - 50%. (CFD) A minimum of 30% must be achieved for each coursework. A minimum of 40% is required to achieve a pass in this module
(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.)

Assessment Outcome Grids (See Guidance Note)

Component 1						
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Essay (FEA)	✓	✓	✓	✓	50	0

Component 2						
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Essay (CFD)	✓	✓	✓	✓	50	0
Combined Total for All Components					**100%**	**0 hours**