University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Analysis & Simulation 2			
Code: ENGG10019	**SCQF Level: 10 (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

Computer based analysis and simulation techniques are proving to be ever more critical in their role as enabling technologies in the engineering and design environment. Two particular technologies which are now considered as critical components to any competitive design strategy are Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD).

This module develops and enhances the students existing knowledge in the FEA and CFD areas. The subject matter focuses strongly on the application of the methods to practical engineering and design problems. The subject content is split to 50% FEA, 50% CFD in terms of time and assessment.

An introduction to more advanced FEA and CFD topics will be provided for the students. The role of these techniques as enabling technologies 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. The FEA will build on and reinforce knowledge already obtained in previous FEA modules and the CFD will offer an introduction to the topic.

FEA content will include practical applications. More advanced FEA problems such as heat transfer, dynamic analysis, buckling and simple contact modelling will also be considered.

Practical application of sensitivity studies and a background to optimisation studies are considered. Practical use of optimisation methods, modelling for sensitivity and optimisation (including geometrical) studies and practical selection of design variables will be dealt with and a series of detailed design based finite element case studies presented.

The role of CFD as an enabling technology in a ‘time to market strategy’ is discussed as well as practical applications for CFD. Theoretical concepts applicable to CFD, boundary conditions, laminar flow modelling and turbulence simulation will all be considered.

An overview of Advanced CFD Applications such as casting simulation, injection moulding/plastic flow simulation will also be outlined.

Quality issues will also be dealt with such as professional organisations associated with finite element practice and other topics such as benchmarking.

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

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	Apply a comprehensive knowledge about the role which analysis and simulation systems play in a design and engineering environment to solve complex problems.

L2	To introduce and develop an understanding of the capabilities of analysis and simulation systems with respect to engineering design, particularly finite element analysis and computational fluid dynamics. Recognising the limitations.
L3	Select and apply appropriate computational techniques to model and analyse advanced practical engineering problems
L4	Formulate and analyse complex analytical solutions to more advanced problems using advanced analysis and simulation systems, and to evaluate complex results to reach a substantial conclusion.

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 **10** A critical knowledge and understanding of finite element / computational fluid dynamics 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 and computational fluid dynamics analysis of engineering and design problems. Detailed knowledge of the appropriateness of methods and techniques to different problems/scenarios.
Practice: Applied Knowledge and Understanding	SCQF Level **10** Applying knowledge and understanding to develop modelling and analysis strategies for a wide range of engineering and design problems, using finite element methods and computational fluid dynamics techniques. Assessing different strategies with respect to obtaining appropriate efficient solutions to engineering and design problems. Making use of specialised finite element and computational fluid dynamic techniques to solve engineering and design problems such as optimisation methods or open ended problems. Select and critically evaluate technical literature and other sources of information to solve complex problems Adopt a holistic and proportionate approach to the mitigation of security risks

Generic Cognitive skills	SCQF Level **10** Undertaking, evaluating and assessing critical FE/CFD analysis data. Making judgements on analytical data and results. Being able to develop conceptual solutions and strategies to FE/CFD 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 Level **10** 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 Level **10** 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.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code: ENGG09020 ENGG09011	**Module Title:** Design Analysis 2 Analysis & Simulation 1
	Other:	or completion of equivalent HN qualification
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	24
Tutorial/Synchronous Support Activity	12
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:

Finite Element and Computational Fluid Dynamics Analysis Systems (such as PTC Creo Parametric/Simulate, ANSYS & FLUENT) + 40 seat PC Lab with corresponding network facilities and suitable PCs. Software site licences are required.

Course notes, presentations and case studies will be provided. Software user's manuals will be available. Text

Designing better products with Finite Element Analysis, Vince Adams, Delmar Learning*

NAFEMS, An Explicit Finite Element Primer, Paul Jacob & Lee Goulding, NAFEMS Publications, ISBN 187437645X.* NAFEMS, Why Do / How To/ Introduction to series, Various, NAFEMS Publications.*

NAFEMS Benchmarking Series, Various, NAFEMS Publications.*

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* Longman Scientific & Technical, Harlow, England. ISBN 0-582-01365-8*

(**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. Module moderator changed to Tony Leslie from Stephanie Docherty 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.
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**
Case Study (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**
Case Study (CFD)	✓	✓	✓	✓	50	0
Combined Total for All Components					**100%**	**0 hours**