UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title:	Computational Fluid Dynamics and Finite Element Methods
Module Code:	CSE7012-B
Academic Year:	2019-20
Credit Rating:	20
School:	Department of Civil and Structural Engineering
Subject Area:	Civil and Structural Engineering
FHEQ Level:	FHEQ Level 7 (Masters)
Pre-requisites:	
Co-requisites:	

Contact Hours	
Type	**Hours**
Lectures	30
Practical classes and workshops	6
Directed Study	164

Availability	
Occurrence	**Location / Period**
BDA	University of Bradford / Semester 2 (Feb - May)

Module Aims

To provide stduents with a deep understanding to the fundamental principles of the numerical simulations of Computational Fluid Dynamics (CFD). There will be an emphasis on developing practical skills to build numerical models in practical contexts. To critically evaluate the application of the Finite Element (FE) method as a tool for engineering analysis.

Outline Syllabus

Computational Fluid Dynamics part includes: (1) Understand fundamental Navier-Stokes-type equations, such as Reynolds-Averaged Navier-Stokes equations and shallow-water equations. (2) Understand basic numerical schemes, such as finite difference method, finite volume method and particle method. (3) Understand numerical methods/solutions. (4) Understand three widely

used engineering models such as RANS model, SWE model and SPH model. (5) Understand turbulent closure equations and turbulence modelling concepts. (6) Learn how to carry out numerical simulation and analyse/interpret numerical results. (5) Learn how to use CFD model to solve practical flow problems.
Finite Element Methods part include: (1) Overview of applications of FE analysis to a variety of engineering problems; main steps in the FE analysis, element stiffness matrix, global stiffness matrix, boundary conditions; primary and derived variables. (2) Domain definition; techniques for building and utilising the geometry; meshing; properties and selection of elements, materials, loads and boundary conditions; solver output; data post-processing. (3) Applications: linear static, non-linear static (elastic-plastic and contact analysis), thermal stress analysis and dynamic analysis; practical case studies and interpretation of results. (4) FE modelling tips; errors in FE solutions.

Learning Outcomes

1	Understand and use different Navier-Stokes type equations and numerical models
2	Gain critical awareness of the fundamental concepts of relative numerical schemes
3	Demonstrate originality in building and using numerical models
4	Interpret and analyse numerical data for practical engineering problems
5	Critically evaluate the suitability of the FE method for solving engineering problems
6	Apply the FE method to solving engineering problems and apply a critical evaluation to interpretation of the results

Learning, Teaching and Assessment Strategy

Involving lecture and computer laboratory methods to maximise students' understanding and encourage deep-learning from multiple angles for the subject matters, in order to deliver all learning outcomes.

Assessments of this module are conducted by two coursework (one on Computational Fluid Dynamics and one on Finite Element Methods), an exam (on Finite Element Methods) and a formative computer-based calculative assessment. These assessments both formative and summative will cover all LOs 1-6, and they will thoroughly assess students' understanding of this module.

Mode of Assessment

Type	Method	Description	Length	Weighting
Summative	Examination - closed book	Finite Elements Methods: Exam	1.5 hours	35%
Summative	Coursework	CFD Coursework 1: Build, simulate and demonstrate understanding of numerical models by in depth/critical interpretations and analyses		50%

Summative	Coursework	Finite Element Methods coursework: Solution and analyses to problems using finite element software		15%
Formative	Computer-based assessment	Computational Fluid Dynamics: Computation modelling	1 hour	%

Reading List
To access the reading list for this module, please visit https://bradford.rl.talis.com/index.html.

Please note:

This module descriptor has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but minor changes may occur given the interval between publishing and commencement of teaching. Upon commencement of the module, students will receive a handbook with further detail about the module and any changes will be discussed and/or communicated at this point.