MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME945 Introduction to Open Source Computational Fluid Dynamics- Online

Module Registrar: Dr P Capobianchi paolo.capobianchi@strath.ac.uk	**Taught To (Course): MSc AME by Distance Learning**	
Other Lecturers Involved:	**Credit Weighting: 10**	**Semester: 2 (Online Learning)**
Optional class	**Academic Level: 5**	**Suitable for Exchange: N**

Required prerequisites

Note: It is the responsibility of ALL students to ensure that they satisfy the prerequisite knowledge for this module BEFORE adding as part of curriculum selection. If unsure, please contact the Module Registrar or discuss with your Programme/Year Adviser of Studies.

Mathematical methods:
Linear algebra, vectors & matrices.

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
					36		24	40	100

Educational Aim

This module is intended for MSc students who have either no prior experience of computational fluid dynamics (CFD) or students who only have experience of using commercial CFD codes and would like to investigate an open source CFD code that is used predominantly for research. It aims to introduce the principles and application of numerical simulation of fluid flows and to underpin the theoretical foundations by applying a CFD code to realistic flow problems.

Learning Outcomes

On completion of the module the student is expected to be able to:

LO1 Understand the governing flow equations for common flow problems and to understand why discretisation of a domain into a mesh is required.

LO2 Understand why boundary conditions need to be applied

LO3 Understand numerical solution methods and their limitations and to understand the role of turbulence, its influence on fluid flows and how it is modelled in RANS codes

LO4 Construct a case for the simulation of an incompressible, steady state, fluid flow.

Syllabus

The module will teach the following:

What the terms in the Navier Stokes equations represent and how they are discretised in order to allow them to be solved by the finite volume technique. Why boundary conditions are required and how they are applied in the FV solution. The necessity to use closure schemes in the form of turbulence models to allow the RANS to be solved. When the fundamentals of CFD analysis are understood the students will be required to undertake the simulation of a limited number of steady-state, incompressible, flow processes. At the end of the course the student should be able to analyse simple flow problems using on open source CFD code.

Assessment of Learning Outcomes

Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1-4
C1 The student should be able to mesh a domain
C2 The student should be able to apply the correct boundary conditions
C3 The student should be able to select and apply a suitable turbulence model
C4 The student should be able to simulate a flow and analyse the results

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

Principles of Assessment and Feedback
(within Assessment and Feedback Policy at: https://www.strath.ac.uk/professionalservices/staff/policies/academic/)

Assessment will be by on-line class tests to assess progress, and submission of two courseworks containing the results of the CFD simulation and verification.

Regular feedback and discussion will be available in online tutorial sessions using a MyPlace online discussion forum. Feedback from the report will enable students to reflect on their understanding of the subject material. Individual feedback will be available by appointment with the course lecturers. Report submissions will be returned with marks and detailed written feedback to allow students to reflect on their performance.

Discussion of the course material between teacher-student and amongst peers will be encouraged by participation in online forums.

Summative feedback: The summative feedback will be provided by the assessment results of the online tests and the report.

Formative feedback: Online forums will provide opportunities for students to discuss their work and course material with staff and other students.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams *(individual weightings)*

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
6 online	see below		40% equally weighted	2	60% (30% each)				
* LO1-3				* LO4		*		*	

* ***L/Os:*** *Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

Coursework / Submission deadlines (*academic weeks*):

All online quizzes must be completed by the end of week 11 semester 2. Coursework 1 to be submitted by 12 noon on the Thursday of week 7 semester 2 and coursework 2 by 12 noon on the Thursday of the last week of the semester 2 exam diet (dates confirmed in the University Calendar).

Resit Assessment Procedures:
New set of ^^quizzes and alternate ^^courseworks to be submitted prior to commencement of the August exam diet (date confirmed in the University Calendar).

^^Students must contact the module Registrar for full details as soon as results confirm that they are required to resit this class.

PLEASE NOTE:
Students must gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-assessed before the August diet. This re-assessment will consist of additional submission as outlined above. No marks from any previous attempts will be transferred to a new resit attempt.

Recommended Reading

***Purchase recommended **Highly recommended reading *For reference
Computational Fluid Dynamics for Engineers, Anderson et al, Cambridge. ISBN 978110701895-2*** Computation Fluid Dynamics – A practical approach, Tu et al Butterworth Heinemann ISBN 978008098243-4***

Additional Student Feedback
(Please specify details of when additional feedback will be provided)

Date	Time	Room No
		Check timetable webpages for details

Session: 2021/22

Approved:

Course Director Signature:	**E Henderson**
Date of Last Modifications:	**02/09/2021**

(Updated July 2021-MAE)

MODULE TIMETABLE

Module Code: **ME945**

Module Title: **Introduction to Open Source Computational Fluid Dynamics**

Brief Description of Assessment:

Online class tests each of approximately 20 minutes duration which may be taken at any time plus 2 courseworks

Assessment Timing

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment. Dropdowns may be left blank. Add extra notes below the dropdowns where relevant.

Please note: Timings can and will change, this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item.

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Course work Submit CW 1 by 12:00 Thursday	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item.	Online Test: Coursework Submit All tests to be completed	