ES440-15 Computational Fluid Dynamics

24/25

Department
School of Engineering
Level
Undergraduate Level 4
Module leader
Yongmann Chung
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES440-15 Computational Fluid Dynamics

Module aims

The aim of this module is to provide the student with a fundamental understanding of important numerical techniques in computational fluid dynamics and to establish a critical view on the use of CFD as part of the design process. This module offers an increased depth and range of specialist knowledge in computational fluid dynamics required by IMechE.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Concepts of CFD : • Discretisation; • Accuracy; • Finite Difference Methods; • Finite Volume Methods; • Solution of Linear Equation Systems; • Methods for Unsteady Problems; • Solution of the Navier-Stokes Equations; • Complex Geometries; • Turbulent Flows.

Learning outcomes

By the end of the module, students should be able to:

- Evaluate and interpret advanced numerical algorithms used in current commercial CFD programs. [M1, M2]
- Discriminate and interpret the effects of algorithm assumptions on solution speed and accuracy, and so demonstrate a solid understanding of the capabilities and limitations of CFD in engineering design process. [M2, M3]
- Apply numerical PDE (partial differential equation) theories to fluid problems and in so doing demonstrate a practical ability to validate solutions. [M3, M6]
- Use a commercial CFD software (such as STAR-CCM+) to interpret and solve complex problems in fluid engineering and to optimise design parameters. [M3, M6]
- Apply practical computational techniques and hand calculations in the analysis of CFD results and show how the information generation may be applied to the design process. [M3, M13]

Indicative reading list

J. H. Ferziger, M. Peric, R. L. Street 2020 Computational Methods for Fluid Dynamics. 4thd Edition, Springer.
P. Moin 2010 Fundamentals of engineering numerical analysis, Cambridge University Press.

View reading list on Talis Aspire

Subject specific skills

1. Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality
2. Ability to seek to achieve sustainable solutions to problems and have strategies for being creative and innovative

Transferable skills

1. Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions
2. Apply problem solving skills, information retrieval, and the effective use of general IT facilities
3. Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

Study

Study time

Type	Required
Lectures	18 sessions of 1 hour (12%)
Seminars	2 sessions of 1 hour (1%)
Supervised practical classes	10 sessions of 2 hours (13%)
Private study	110 hours (73%)
Total	150 hours

Private study description

110 hours guided independent learning

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group A3

	Weighting	Study time
CFD simulation and discussion.	50%	
Pre-recorded video presentation of individual CFD simulation results and discussion (Equivalent to 2000 words / nominally 10 pages.)		
Numerical methods for computational fluid dynamics	50%	
Assignment on understanding of basic CFD methods. (Equivalent to 2000 words / nominally 10 pages.)		

Feedback on assessment

Individual feedback as well as generic feedback will be provided.

Availability

Pre-requisites

To take this module, you must have passed:

- All of

- All of
  - ES193-15 Engineering Mathematics
  - ES3D6-15 Fluid Mechanics for Mechanical Engineers

Courses

This module is Core for:

- Year 4 of UESA-H114 MEng Engineering
- UESA-H109 MEng Engineering with Intercalated Year
  - Year 5 of H109 Engineering with Intercalated Year MEng
  - Year 5 of H10Q Engineering with Intercalated Year with Appropriate Technology MEng
  - Year 5 of H10U Engineering with Intercalated Year with Automotive Engineering MEng
  - Year 5 of H10N Engineering with Intercalated Year with Business Management MEng
  - Year 5 of H10S Engineering with Intercalated Year with Communications MEng
  - Year 5 of H10T Engineering with Intercalated Year with Computer Engineering MEng
  - Year 5 of H10X Engineering with Intercalated Year with Fluid Dynamics MEng
  - Year 5 of H10R Engineering with Intercalated Year with Instrumentation MEng
  - Year 5 of H10V Engineering with Intercalated Year with Robotics MEng
  - Year 5 of H10P Engineering with Intercalated Year with Sustainability MEng
  - Year 5 of H10W Engineering with Intercalated Year with Systems Engineering MEng
- Year 4 of UESA-H316 MEng Mechanical Engineering
- Year 5 of UESA-H317 MEng Mechanical Engineering with Intercalated Year
- Year 1 of TESA-H341 Postgraduate Taught Advanced Mechanical Engineering