ES440-15 Computational Fluid Dynamics

20/21

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 web page

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.
- 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.
- Critique developing technologies being used to solve problems in greater detail.
- Apply numerical PDE (partial differential equation) theories to fluid problems and in so doing demonstrate a practical ability to validate solutions.
- Use a commercial CFD software (such as STAR-CCM+) to interpret and solve complex problems in fluid engineering and to optimise design parameters.
- 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.

Indicative reading list

J. H. Ferziger & M. Peric 2004 Computational Methods for Fluid Dynamics. 3rd Edition, Springer.
T. J. Chung 2010 Computational Fluid Dynamics. 2nd Edition, Cambridge University Press.

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	1 session of 1 hour (1%)
Supervised practical classes	10 sessions of 2 hours (13%)
Private study	111 hours (74%)
Total	150 hours

Private study description

111 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 A

	Weighting	Study time
computer simulation and discussion.	50%	
1 Assignments combining computer simulation and discussion. (Equivalent to 3000 words / nominally 12 pages.)		
Numerical methods for computational fluid dynamics	50%	

Feedback on assessment

- Students receive both generic feedback and individual mark-up on their assignments;
- Student support through advice and feedback hours;
- Worked examples in revision classes;
- Model solutions to some past paper questions;
- Cohort level feedback on examination.

Availability

Courses

This module is Core for:

- Year 1 of TESA-H341 Postgraduate Taught Advanced Mechanical Engineering

This module is Core optional for:

- Year 4 of UESA-H311 MEng Mechanical Engineering

This module is Optional for:

- Year 1 of TESA-H800 Postgraduate Taught Biomedical Engineering

This module is Option list A for:

- Year 4 of UESA-H163 MEng Biomedical Systems Engineering
- Year 4 of UESA-H114 MEng Engineering
- UESA-H311 MEng Mechanical Engineering
    - Year 4 of H311 Mechanical Engineering
    - Year 4 of H30J Mechanical Engineering with Appropriate Technology
    - Year 4 of H30L Mechanical Engineering with Automotive Engineering
    - Year 4 of H30G Mechanical Engineering with Business Management
    - Year 4 of H30K Mechanical Engineering with Instrumentation
    - Year 4 of H30M Mechanical Engineering with Robotics
    - Year 4 of H30H Mechanical Engineering with Sustainability
    - Year 4 of H30N Mechanical Engineering with Systems Engineering
- Year 4 of UESA-H316 MEng Mechanical Engineering
- Year 4 of UESA-H318 MEng Mechanical Engineering with Exchange Year
- Year 5 of UESA-H317 MEng Mechanical Engineering with Intercalated Year

This module is Option list B for:

- Year 4 of UESA-HH31 MEng Systems Engineering