

WM3G1-15 CAE-Modelling and Simulation

27/28

Department

WMG

Level

Undergraduate Level 3

Module leader

Hesam Khajehsaeid

Credit value

15

Module duration

14 weeks

Assessment

100% coursework

Study location

University of Warwick main campus, Coventry

Description

Introductory description

Modelling and simulation are essential parts of many engineering problem solutions in industries as they reduce costs of design and product development. Computer Aided Engineering introduces numerical methods to simulate engineering problems using state-of-the-art tools and software packages.

Apprenticeship Standard ST0027.

This module is linked with C1, C2, C3, C4, C13 and C16 of the AHEP 4.

LO1 - C1, C2, C3, C13

LO2 - C1, C2, C3, C4

LO3 - C1, C2, C3, C4

LO4 - C3, C13

LO5- C3, C16

Module aims

This module aims to introduce the principles and applications of numerical methods in

engineering. It also enhances both the theoretical and practical appreciation of CAE, whilst introducing finite element analysis (FEA) and computational fluid dynamics (CFD) as the strongest numerical approaches to engineering design/analysis problems. The module also aims to introduce methods to validate simulation results using engineering judgement and/or test results.

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.

Introduction to the Numerical Methods in Engineering and Technology.

Engineering problem-solving using finite element method applied to a range of practical and industrially relevant stress analysis problems.

Simplifications, assumptions and idealisations during simulation for stress analysis, selection of boundary conditions, practical modelling, verification of models, post-processing and checking of results.

The Philosophy behind Computational Fluid Dynamics (CFD) and its influence on Engineering Analysis and Design, focusing on related industries.

Review of governing equations for fluid systems and how to utilise them to solve engineering problems computationally.

Principles and stages in a CFD simulation for solving complex engineering problems.

Simplification, mesh generation and mesh quality.

Different physics, numerical models and numerical methods for engineering applications.

Different boundary conditions and their applications.

Thermal distribution and heat transfer modelling.

Simulation of Turbulent flow using CFD software.

Learning outcomes

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

- Apply advanced numerical methods, including finite element method (FEM) and control volume method, to solve real-life engineering problems [AHEP:4-C1, C2, C3, C13]
- Evaluate effectiveness of analytical techniques and numerical simulations in a range of engineering problems, compare the methods and recognise limitations of the employed methods [AHEP:4-C1, C2, C3, C4]
- Provide simulation-based solutions for a range of applied engineering problems, verification of models, and post-processing and checking of results [AHEP:4-C1, C2, C3, C4]
- Employ appropriate loading/boundary conditions, assumptions, and idealisations during engineering simulations [AHEP:4-C3, C13]
- Demonstrate the ability to function effectively as an individual, and as a member or leader of a team in an engineering, modelling and simulation project [AHEP:4 - C3, C16]

Indicative reading list

[Reading lists can be found in Talis](#)

[Specific reading list for the module](#)

Subject specific skills

1. Observe, record and draw accurate and auditable conclusions from data or developmental or test evidence (S5 ST0027).
2. Identify resources, such as digital tools or technologies, human, equipment, materials or data, to complete design and development projects or programmes of work (S8 ST0027).
3. Identify and rectify faults, inaccuracies, discrepancies or unexpected results during the design or development process, which may impact the quality and reliability of the product, system or component (S11 ST0027).
4. Evaluate engineering designs, development or modification options (S13 ST0027).

Transferable skills

- Problem-solving: Use rational and logical reasoning to deduce appropriate and well-reasoned conclusions. Retain an open mind, optimistic of finding solutions, thinking laterally and creatively to look beyond the obvious. Knows how to learn from failure.
 - Teamwork: Operate within, and contribute to, a respectful, supportive and cooperative group climate. Sensitive to the impact of actions on others.
 - Critical Thinking: Recognise patterns, themes and key messages from sometimes confused and incomplete data. Make informed decisions on the value of a range of sources allowing an evidence based conclusion based on this analysis.
 - Information Literacy: Critical awareness of how information is gathered, used, managed and synthesised. Understanding of the relative value of different sources and the importance of provenance. The systematic collection, analysis and evaluation of information in the investigation of a topic.
 - Communication: Verbal: Communicate orally in a clear and sensitive manner which is appropriately varied according to different audiences. Written: Present arguments, knowledge and ideas, in a range of formats Active listening: questioning, reflecting, summarising.
 - Digital Literacy: Has the capabilities that enable living, learning and working in a digital society. Comfortable with using digital media to communicate, solve problems, manage information, collaborate, create and share content.
 - Professionalism: Prepared to operate autonomously. Aware of how to be efficient and resilient. Manages priorities and time. Self-motivated, setting and achieving goals, prioritising tasks.
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Study

Study time

Type	Required
Lectures	12 sessions of 1 hour (8%)
Seminars	5 sessions of 1 hour (3%)
Tutorials	7 sessions of 1 hour (5%)
Online learning (scheduled sessions)	6 sessions of 1 hour (4%)
Online learning (independent)	5 sessions of 1 hour (3%)
Other activity	3 hours (2%)
Private study	52 hours (35%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

Review of content and practice on provided codes, problems/solutions

Online forum and discussion (asynchronous)

Other activity description

Online support/consultancy for the assignments

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time	Eligible for self-certification
Assessment component			
Group Written Report	40%	24 hours	No
Computer lab to work with MATLAB and/or specialist software package (e.g., ANSYS), analysis and verification of results.			
A typical lab group will consist of 4 students. Peer marking will be applied in accordance with WMG policy.			

	Weighting	Study time	Eligible for self-certification
Reassessment component			
Individual Written report			No
Individual report on the computer lab simulation results			

Assessment component

Individual Written report	60%	36 hours	Yes (extension)
Report on detailed numerical solutions of engineering problems, simulation, post-processing and verification of results, and comparison with analytical solutions			

Reassessment component

Individual Written report			No
Report on detailed numerical solutions of engineering problems, simulation, post-processing and verification of results, and comparison with analytical solutions			

Feedback on assessment

Feedback will be given as appropriate to the assessment type:

Formative feedback:

- verbal formative feedback during the classroom, seminars and computer lab sessions
- formative feedback through online support and online activities

Summative feedback:

- written summative feedback on the group report (Assessment 1)
- written summative feedback on the individual report (Assessment 2)

Availability

Courses

This module is Core for:

- Year 4 of UWMS-H7C4 Undergraduate Applied Professional Engineering (Product Design and Development Engineer)
- Year 4 of DWMS-H7C8 Undergraduate Applied Professional Engineering (Product Design

and Development Engineer) (Degree Apprenticeship)