

WM3G2-15 Applied Fluid Dynamics

27/28

Department

WMG

Level

Undergraduate Level 3

Module leader

Fatemeh Shahbazi

Credit value

15

Module duration

14 weeks

Assessment

100% coursework

Study location

University of Warwick main campus, Coventry

Description

Introductory description

In this module, students will learn to utilise conservation laws and governing equations of fluid dynamics to solve a number of complex but industrially relevant fluid flow problems using commercial CFD software. Simulations and practical sessions are carried out for the development of software simulation and practical skills using wind tunnel.

Apprenticeship Standards ST0025 and ST0027.

This module is linked with C1, C2, C3, C4 and C12 of the AHEP 4.

LO1 - C1, C2, C3,

LO2 - C1, C2, C3, C4, C12

LO3 - C1, C2, C4, C12

LO4 - C2, C3

LO5 - C12, C16

[Module web page](#)

Module aims

The module builds on the fluid dynamics concepts introduced in Engineering Thermo-Fluids in the second year of the APEP course. The module will cover the fundamentals of different flow types

and their application to product design. Models to estimate fluid dynamics performance through experimental, theoretical, and computational approaches will be used.

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 Fluid Dynamics

Historical perspective

Aerodynamic forces

Applications of fluid dynamics in design, innovation and biomimicry.

Flow types

Introduction to different flow types

Fundamentals of inviscid, incompressible flow

Principles of compressible flow

Viscous flow

Fundamental principles of viscous flow

Analysis of boundary layers

Experimental Measurements

Experimental setup and results

Wind tunnel testing

Computational modelling

Selecting an appropriate physical model and numerical parameters

Computational solution to the problem

Detailed post-processing of the numerical results

Learning outcomes

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

- Solve complex engineering problems related to fluid flows using computational fluid dynamics (CFD) tools and optimise design parameters [AHEP:4-C1, C2, C3]
- Critically examine different aerodynamic forces while analysing experimental and numerical data related to the aerodynamic characteristics and evaluating them based on existing literature [AHEP:4-C1, C2, C3,C4,C12]
- Examine different assumptions in fluid dynamics (e.g., viscosity, compressibility, turbulence, boundary layer etc.) for simplifying complex engineering problems relevant to product design/development in their industry [AHEP:4-C1, C2, C4,C12]
- Apply innovative ideas into designs and examine their efficiency using CFD software package [AHEP:4-C2, C3]
- Demonstrate the ability to function effectively as an individual and as a member or leader of a team in conducting experiments in the lab and working on fluid dynamics engineering projects [AHEP:4 - C12, C16]

Indicative reading list

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

[Specific reading list for the module](#)

Subject specific skills

1. Collate and use a range of data sources and supporting documentation to support projects (S3 ST0027, S3 ST0025).
2. Observe, record and draw accurate and auditable conclusions from data or developmental or test evidence (S5 ST0027, S5 ST0025).
3. Demonstrate leadership when undertaking product design, development, modification, or updating engineering activities (S10 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.

Study

Study time

Type	Required
Lectures	12 sessions of 1 hour (8%)
Seminars	3 sessions of 1 hour (2%)
Tutorials	8 sessions of 1 hour (5%)
Practical classes	1 session of 1 hour (1%)
Work-based learning	15 sessions of 1 hour (10%)
Online learning (scheduled sessions)	6 sessions of 1 hour (4%)
Online learning (independent)	5 sessions of 1 hour (3%)
Other activity	5 hours (3%)
Private study	35 hours (23%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

Pre-class activity.

Further study of the subject.

Educational videos.

Online forums and discussions (asynchronous)

Other activity description

5 hours of other activities: Online support/consultancy for the assignments

15 hours of work-based learning: Apprentices will be required to familiarize themselves with aerodynamic bodies used at their workplace, focusing on their innovative aspects, special designs, and numerical and experimental test methods, including wind tunnels (this activity will be used as a part of their assessments).

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			
Numerical and Experimental Analysis of Aerofoil Performance	40%	24 hours	No
This report consists of two main sections:			
• in the first part, the apprentices will conduct an experiment in a group on an aerofoil in the wind tunnel and analyse the experimental results together; • in the second part, they analyse the fluid dynamics characteristics of an aerofoil using numerical methods and compare them with the experimental results. A typical lab group will consist of 6 students, possibly 5. • Peer marking will be applied in accordance with WMG policy.			
Reassessment component			
Individual report			No
This applies if a student does not, for health or personal reasons, participate in the Group activities for a significant part of the first half of the Term.			
This report consists of two main sections.			
• In the first part, the apprentice will work on an experiment on an aerofoil in the wind tunnel and analyse the experimental results. • In the second part, the apprentice will analyse the fluid dynamics characteristics of an aerofoil using numerical methods and compare them with the experimental results.			
Assessment component			
Individual report	60%	36 hours	Yes (extension)
In this assessment, apprentices will work on the numerical simulation of the flow around a device related to their industry.			
The aim of this section is to simplify a complex engineering system by knowledgeably making assumptions regarding relevant physics and then conduct a computational fluid dynamics analysis and simulation, evaluate predictions, and enhance the design.			
Reassessment component			
Individual report			No
In this assessment, apprentices will work on the numerical simulation of the flow around a device			

Weighting**Study time****Eligible for self-
certification**

related to their industry.

The aim of this section is to simplify a complex engineering system by knowledgeably making assumptions regarding relevant physics and then conduct a computational fluid dynamics analysis and simulation, evaluate predictions, and enhance the design.

Feedback on assessment

Feedback will be given as appropriate to the assessment type:

Formative feedback:

- verbal formative feedback during the classroom, seminars and 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)
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Availability**Courses**

This module is Core for:

- Year 4 of UWMS-H7C1 Undergraduate Applied Professional Engineering (Manufacturing Engineer)
- Year 4 of DWMS-H7C5 Undergraduate Applied Professional Engineering (Manufacturing Engineer) (Degree Apprenticeship)
- 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)