MA4L0-15 Advanced Topics in Fluids

23/24

Department
Warwick Mathematics Institute
Level
Undergraduate Level 4
Module leader
Credit value
15
Module duration
10 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

Fluid dynamics forms a core subject with applications in a number of disciplines including, engineering, nanotechnology, biology, medicine and geosciences. Principles of fluid dynamics serves as an anchor to describe natural phenomena by providing a common language and set of tools for describing, analyzing and understanding observations and experiments in such a diverse array of disciplines. Continuing on from MA3D1: Fluid dynamics, in this module we will study selected advanced topics in fluid dynamics that provides a core understanding of fluid dynamics phenomena.

Module aims

- Students will be able to apply the governing principles of fluid dynamics to specific phenomena, possibly involving some systematic simplification methods.
- They will be introduced to some advanced techniques for analyzing fluid flow.
- They will be able to related observations in nature to the aforementioned analysis techniques.

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.

1. Vorticity dynamics
2. Complex fluids and non-Newtonian rheology
3. Lubrication theory
4. Stokes flow
5. Hydrodynamic stability
6. Computational fluid dynamics
7. Flow through porous media
8. Turbulence

Learning outcomes

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

- Apply and/or simplify the partial differential equations governing fluid flow.
- Solve the derived equations.
- Be able to translate the solution into a physical intuition for the underlying flow phenomenology.

Interdisciplinary

Fluid dynamics is a subject of interest in fields ranging from astronomy to nanotechnology in scale, and from medicine to engineering in application. The common framework provided by fluid dynamics binds the practitioners in a fellowship that transcends these disciplines.

Subject specific skills

Ability to apply and simplify the equations governing fluid flow.
Ability to model physical systems involving fluid flow.
Develop familiarity with different kinds of fluids.

Transferable skills

Ability to interpret observations and propose candidate explanations. Ability to translate scientific ideas into mathematical language and back. Ability to think creatively. Ability to discern the validity of a proposed explanation.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Private study	117 hours (80%)
Total	147 hours

Private study description

Homework problems.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B1

	Weighting	Study time
In-person Examination Standard 3 hour written exam.	100%	3 hours

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- Answerbook Gold (24 page)

Feedback on assessment

Written feedback on the outcome of the exam.

Past exam papers for MA4L0

Availability

Courses

This module is Optional for:

- Year 1 of TMAA-G1PE Master of Advanced Study in Mathematical Sciences
- Year 1 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 1 of TESA-H1B1 Postgraduate Taught Predictive Modelling and Scientific Computing

This module is Option list A for:

- Year 2 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 2 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
    - Year 4 of FG31 Mathematics and Physics (MMathPhys)
    - Year 4 of FG31 Mathematics and Physics (MMathPhys)
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 5 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list B for:

- Year 2 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 2 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 4 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 5 of UCSA-G4G4 Undergraduate Discrete Mathematics (with Intercalated Year)
- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 4 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list C for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
    - Year 3 of G105 Mathematics (MMath) with Intercalated Year
    - Year 4 of G105 Mathematics (MMath) with Intercalated Year
    - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
    - Year 3 of G106 Mathematics (MMath) with Study in Europe
    - Year 4 of G106 Mathematics (MMath) with Study in Europe