# MA4L0-15 Advanced Topics in Fluids

## 21/22

Department Warwick Mathematics Institute Level Undergraduate Level 4 Module leader Thomasina Ball 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** Lectures Total Required 30 sessions of 1 hour (20%) 150 hours

Туре	Required	
Private study	117 hours (78%)	
Assessment	3 hours (2%)	
Total	150 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	100%	3 hours
Standard 3 hour written exam.		

• Answerbook Gold (24 page)

## Feedback on assessment

Written feedback on the outcome of the exam.

Past exam papers for MA4L0

# Availability

## **Pre-requisites**

To take this module, you must have passed:

- All of
  - MA3D1-15 Fluid Dynamics

# 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)

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)
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)

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)

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 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