

MATH0015 Fluid Mechanics

<i>Year:</i>	2024–2025
<i>Code:</i>	MATH0015
<i>Level:</i>	5 (UG)
<i>Normal student group(s):</i>	UG: Year 2 Mathematics degrees
<i>Value:</i>	15 credits (= 7.5 ECTS credits)
<i>Term:</i>	1
<i>Assessment:</i>	The weighting of the module is 85% exam, 9% written coursework, 4% quizzes, 2% presentation. (The final exam for MATH0015 will take place during the main exam period, April/May 2024)
<i>Normal Pre-requisites:</i>	MATH0011 (MATH0009 recommended)
<i>Lecturer:</i>	Prof E Johnson

Course Description and Objectives

How does a plane fly? How fast do waves move on the surface of water? What is the Severn Bore? With applied mathematics it is possible to give quantitative answers to such questions: this course deals with the simplest cases of fluid motion and is the foundation for more advanced study.

Recommended Text

A recommended book is A R Paterson, *A first course in fluid dynamics* (CUP). There are some excellent and informative photographs in *An Album of Fluid Motion* by M. Van Dyke (Parabolic Press). A detailed discussion of fundamentals can be found in the comprehensive textbook *An Introduction to Fluid Dynamics* by G.K. Batchelor (CUP).

Detailed Syllabus

- Specification and kinematics
 - Definition of a fluid; Specification of the motion; Convected derivatives; Conservation of mass; Sources and sinks; Motion of a fluid element in two dimensions; Irrotational motion
- Two-dimensional motion;
 - The vorticity equation and circulation; Irrotational motion in singly- and doubly-connected regions; Flow past a cylinder with circulation; Complex potential
- Dynamics
 - Static and dynamic forces; Euler’s equations of motion; Bernoulli’s equation; Dynamics of currents; Hydraulic jumps
- Surface waves
 - Small-amplitude gravity waves; Particle paths and group velocity; Standing waves; Two-dimensional waves; Surface tension