MATH0015 (Fluid Mechanics)

Year: 2018–2019
Code: MATH0015
Old code: MATH2301
Level: 5 (UG)
Normal student group(s): UG: Year 2 Mathematics degrees
Value: 15 credits (= 7.5 ECTS credits)
Term: 1
Structure: 3 hour lectures and 1 hour problem class per week.
Assessment: Assessed weekly coursework. 90% examination, 10% coursework. In order to pass the module you must have at least 40% for both the examination mark and the final weighted mark.
Normal Pre-requisites: MATH0011 (previously MATH1402), (MATH0009 [previously MATH1302] recommended)
Lecturer: Prof E R Johnson
Problem class teacher: Ms G Liu

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