MATH0106 Industrial and Geological Fluids

Year:	2022–2023
Code:	MATH0106
Level:	7(UG)/7(PG)
Normal student group(s):	UG Year 4 Mathematics degrees
	PG MSc Mathematical Modelling
Value:	15 credits (= 7.5 ECTS credits)
Term:	1
Assessment:	90% examination, 10% coursework
Normal Pre-requisites:	MATH0015
	(MATH0077 is also helpful, but not essential)
Lecturer:	Dr D Hewitt

Course Description and Objectives

This course will introduce students to a range of mathematical modelling of fluid flows that occur in geological and industrial settings. These include the flow of ice, lava and mud, subsurface transport of fluid through rock, heat transfer problems in industry and nature, pipe and channel flows, and industrial processing problems. The course is divided into two main parts. First, various problems involving Newtonian fluids will be discussed, including heat transport, convective instabilities and flow through porous media. Second, modelling of non-Newtonian fluids will be introduced. Different types of non-Newtonian behaviour (including plasticity, elasticity and 'memory' effects) will be discussed, along with the challenging - and interesting - mathematical modelling required to describe them. Applications to different geological and industrial settings will be considered.

By the end of the course, students will be equipped with the skills required either to carry out future independent research involving complex viscous or non-Newtonian fluid flow, or to work in a career that involves geological or industrial modelling.

Detailed Syllabus

- Understand definitions and key phenomenology of non-Newtonian fluids
- Understand and be able to apply standard models of canonical non-Newtonian fluids in different settings.
- Understand modelling approaches of heat transfer and convective instabilities.
- Be able to describe flow through porous media in different contexts.
- Be able to reduce physical problems to mathematical ones, and use asymptotic and other techniques to analyze them.
- Be able to infer physical interpretations and implications for geological / industrial settings from modelling and asymptotic results.