

Math 605D: September 2018

Introduction to Visco-plastic Fluid Mechanics:

This course is intended to give an introduction to the mechanics of *simple* visco-plastic fluids, e.g. Bingham, Casson, Herschel-Bulkley models. The course audience is applied mathematicians or mathematically oriented engineers at a graduate level with a good grounding in Newtonian fluid mechanics and viscous flows. As well as covering analytical methods and applications to specific types of flow an introduction to numerical methods will be given.

Lectures: Tu/Th, 9.30-11.00 in FNH 30.

Lecture schedule:

Date	Topic	Speaker
06/09	Non-Newtonian fluids introduction	Frigaard
11/09	Visco-plastic fluid origins & the basic models	Frigaard
13/09	Steady 1D flow examples	Frigaard
18/09	1D transient flows	Frigaard
20/09	Numerical solution of 1D problems, examples	Frigaard
25/09	Variational formulation for Stokes flows I	Frigaard
27/09	Variational formulation for Stokes flows II	Frigaard
02/10	Zero flow limit	Frigaard
04/10	Methods for calculating the zero flow limit	Frigaard
09/10	Asymptotics I: lubrication paradox & eccentric annulus	Frigaard
11/10	Asymptotics II: squeeze flow & journal bearing	Frigaard
16/10	Computation I:	Wachs
18/10	Computation II:	Wachs
23/10	Computation III:	Wachs
25/10	Computation IV:	Wachs
30/10	Asymptotics III: wavy walls, plug breaking	Frigaard
31/10	Seminar presentations	
01/11	Asymptotics IV: thin film flow	Frigaard
06/11	Asymptotics V: Visco-plastic boundary layers	Balmforth
08/11	Asymptotics VI: Membranes, jets & beams	Balmforth
13/11	Linear stability of shear flows	Frigaard
15/11	Energy stability	Frigaard
20/11	Particles I	Frigaard
22/11	Particles II	Frigaard
27/11	Bubbles	Frigaard
29/11	Fluid-fluid flows	Frigaard

Text:

Much of the content of the course will be covered in chapters 1-3 of: "Lectures on Vicoplastic Fluid Mechanics", Springer 2018, editors: G. Ovarlez & S. Hormozi

Assessment consists of the following 3 components:

1. **Exercises/reading:** will be assigned throughout the course as we follow the developments (30%)
2. **Seminar:** Participants will read/assess and present a research paper (30%). We will take a couple of hours one afternoon/evening for presentations.
3. **Project report:** participants will complete a short project that will consist of applying some of the techniques learned to a non-trivial visco-plastic flow. (40%)

Project reports (< 20 pages) due 18th December