PHYD37 Fall 2014

Introduction to Fluid Mechanics

T at 10-11:30 am (BV 361) and R at 10-11:30am (SW 128)

Description

This course is an introduction to the analysis of motion of fluids such as water, air, magma, as well as an introduction to transport phenomena such as heat and mass transfer. We will cover the topics of mass, momentum and energy conservation. We will derive and discuss several important dimensionless numbers that can help us understand the type of flow and study in more detail two types of regimes: inviscid and highly-viscous flow. We will also cover the theory of waves and instabilities.

Instructor: Professor Diana Valencia UTSC Office SW504B
dvalencia@utsc.utoronto.ca
Office hours Thursdays 2-3pm and by appointment

Prerequisites: It is expected that the student is familiar with vector calculus and basic solutions to ordinary and partial differential equations. Some knowledge of thermal physics may be helpful.

Assignments: There will be homework assigned on a regular basis. The only ground rule is that you may not consult solutions on the Internet and that the work you turn in must be your own. You are encouraged to discuss ideas with other students.

Final project: At the end of the term there will be one final project where you will give a 15-20 minute presentation on a fluid mechanics research article of your choice and write a 5 single space report. Please make sure to run it by your instructor a few weeks before hand to make sure the level and emphasis of the article is adequate. The two most widely read journals describing current research in fluid dynamics are the *Journal of Fluid Mechanics* and *Physics of Fluids*.

Grading:

Assignments ….. 30%
Midterm ……..… 15%
Final project ….. 20%
Final Exam ..….. 35%

Books:

Fluid Mechanics by Pijush K. Kundu and Ira M. Cohen (recommended)
The Physics of Fluids and Plasmas by Arnab Rai Choudhuri

Syllabus: (tentative schedule, we'll try to cover all topics listed time permitting)

1. Introduction: Examples, Dimensional Analysis, Bucking-Pi Theorem, Tensor Notation
2. Heat and mass transfer
3. Derivation of governing equations, mass conservation, material derivative

4. Derivation of momentum and energy equations, constitutive equations
5. Exact solutions to Navier-Stokes equations
6. High Reynolds number flows
7. Low Reynolds number flows (boundary layers)
8. Numerical solutions to N-S equations
9. Waves and instabilities
10. Rayleigh-Bernard Convection

Important Dates:

October 9 – Tentative date for midterm
October 14-18 – Reading Week
Nov 24 -28 – Week to hand in your final report and presentations
December 1 – Last day of classes
December 5-19 – Final Exam schedule