PHYD37: Fall 2017
Introduction to Fluid Mechanics

Tuesday 10-11:30 am IC 328, Thursday 10-11:30am AC332
(on some occasions weÕll be meeting until noon)

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

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OfÞce hours Tuesdays 12-1pm and by appointment

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

Problem sets: There will be homework assigned on a regular basis. The only ground rul is that you may not consult solutions on the Internet and that the work you turn in must b your own. You are encouraged to discuss ideas with other students If you have worked with another student, make sure you write her/his name as collaborator on the Þrst page the work you hand in.

Showing your work: On your problem sets, make sure you show all the work that wen into solving each question. This will allow the grader to follow your method, to know if you understand the material and where you are having difÞculties. DonÕt be afraid explain what you are doing. Your solution should look like an explanation to someone

a 5 single space page report (on LaTeX). 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 ßuid dynamics are the Journal of Fluid Mechanics and Physics of Fluids, with Annual Review of Fluid Mechanics a great source for students to get an overview picture.

Grading:
Problem sets

Learning Outcomes:

By the end of this course the student shall be able to:

- Be able to non-dimensionalise physical problems and extract the relevant parameters
- Understand and implement tensor notation with ease
- See the connection between the microscopic and macroscopic treatment of transpor properties and ßuid dynamics
- Be able to derive conservation equations starting from written statements
- Be able to solve the conservation law equations for mass and energy transfer with n motion, including the three different types of boundary conditions
- Understand the conservation quantities in mass and energy transfer in 1D, 2D, and 3D
- Follow the derivation of the equations governing ßuid motions: mass, momentum and energy conservation equations
- Understand how F=ma is applied to a ßuid and be able to identify each of the terms in the ßuid equations
- Understand the differences between the Eulerian and Lagrangian treatments
- Understand the meaning of the Reynolds number and other dimensionless number (e.g. Rayleigh number)
- Point to the differences of the high and low Reynolds number ßows and the derivations of the simpliÞed equations
- Be able to analytically solve equations pertaining to both regimes, including identifying the boundary conditions
- Understand qualitatively the emergence of turbulence, and the difference with laminar ßows