Math 8610 (Tanveer): Fall Semester, 2012: Introduction to Mathematical Fluid Dynamics

This course is designed to introduce you to fluid dynamics, both its physical and mathematical aspects. Much of the material is essentially applied PDE, but some useful physical insights will be developed as well.

Prerequisite: Analysis at the 700 level, Math 835-836 (PDE sequence) or sufficient familiarity with PDEs including Sobolev spaces.

Syllabus:

(1.) Basic derivation of fluid dynamics equations from physical considerations.

(2.) Ideal Fluids, Vorticity, Irrotational Flows. Kelvin Circulation Theorem.

(3.) Some exact solutions in flows with high degree of symmetry.

(4.) Some Free boundary Problems like water waves, bubbles and drops.

(5.) Low Reynolds number (Highly viscous) flow.

(6.) Basic Existence and Uniqueness Theorems for Navier-Stokes Equations and sufficient conditions for global existence.

(7.) Hydrodynamic Stability–analysis in special cases.

Text:

(1.) Notes will be handed out from other sources.

Additional References (SEL Library Reserves):

(2.) Vorticity and Incompressible Flow, Majda & Bertozzi, Cambridge U. Press.

(3.) A mathematical introduction to fluid mechanics, Chorin & Marsden, Springer-Verlag, 1979.

(4.) Navier Stokes Equations, R. Temam, AMS Chelsea Publishing, 2001

(5.) Introduction to Fluid Dynamics, Batchelor, Cambridge U. Press, 1979

Grading Policy:

Homework will be roughly 30 percent of the grades. Rest of the grades will be based on a project; you can choose your own project or I can suggest one for you. The idea will be to dig deeper into any of the topics we covered in class. Final Project due last week of classes. You will present the material in class as well (roughly 25 minute presentation each).