ENME 642: Hydrodynamics

Instructor: James H. Duncan
Class Time: Tuesday and Thursday from 5:00 to 6:15
Lecture Room: JMP 1202

Description:

The course addresses flows of gases and liquids for which the effects of compressibility and viscosity can be neglected. This branch of fluid mechanics has had great practical success in high-Reynolds number subsonic airfoil and wing theory, bubble dynamics, water waves dynamics, etc. and is essential for understanding the physics of more complex flows. The course content, particularly the latter parts, will be adjusted according to the interests of the class. I tentative outline of the course is given below.

Course Outline:

1. Determination of conditions for which incompressible inviscid flow analysis produces realistic results
2. General theorems regarding energy and the velocity field
3. Analysis of two-dimensional flows
   (a) Simple fundamental flows: uniform flow, sources, sinks, vortices and doublets
   (b) The creation of complex flows by the superposition of simple flows
      i. Uniform flow over a half body, an ovoid, and a cylinder with and without circulation
      ii. Lift and the Blassius Theorem
   (c) Conformal mapping
      i. Joukowski transformation (flow over ellipses and airfoils, lift)
      ii. Schwarz-Christoffel transformations (flow in ducts)
      iii. Free streamline theory (analysis of liquid jets).
   (d) Added mass
4. Free surface flows (The content of this last section of the course can change depending on class interests.)
   (a) Bubbles (Cavitation, underwater explosions, oscillating gas bubbles)
   (b) Water waves (including a thorough discussion dispersive wave physics)