ME 422 - Fluid Mechanics II

Victor Yakhot

Syllabus - Fall 2009

9/2 Fluids; Continuum description; Elements of kinetic theory; Derivation of viscosity and pressure.

9/9-9/14 Kinematics; Acceleration; Streamlines/pathlines; Fluxes; Vorticity. **HW 1**

9/16-9/23 Conservation laws; Continuity, Euler and Navier-Stokes equations; Euler equation; Boundary conditions; Vorticity; Vortex force; Hydrostatics: barometric formula; Shapes of the fluid surfaces. The Bernoulli equation and it simplest applications. **HW 2-3**

9/28-10/13 Kelvin's theorem; Incompressible fluids; Potential flows; 2D examples: uniform flow; Sinks and sources; Vortex; Doublets and multi-pole expansion; Flow past cylinder; Joukovskii theorem. Drag and lift; Joukovskii theorem; Accelerating cylinder and cylinder + vortex: Panel method. **HW 4-5**

10/12 – No class – Columbus Day.

10/19-10/26 The gravity waves; Introduction to environmental flows.

10/28 Review.

11/2   Midterm.

   Viscous flows.

11/4-11/18 The Navier Stokes equations; Reynolds number; Laminar-Couette; Channel and pipe flows; Separation; Prandtl laminar boundary layer theory; Turbulent boundary layers; Pumps; Friction and drag coefficients; Similarity variables. **HW 6-8**

11/23-12/2 I and II Stokes problems; Introduction to nanofluidics; Nanoresonators; Sensors.

12/9-12/11 Review; Discussion

12/16 Final Exam

Two Labs – The dates to be discussed.

Books:

1. D. Wilcox, "Basic Fluid Mechanics"
2. V. Yakhot, ME 422 – Fluid Mechanics. My Lecture Notes.