Fluid Mechanics I
0901-341
Fall 2004

Course Review

I. Building a Fluid Mechanics Vocabulary
   a. Fluid Properties
      i. Density, ρ
      ii. Specific Weight, γ
      iii. Specific Gravity, S
      iv. Viscosity
         1. Absolute (or Dynamic), μ
         2. Kinematic, ν
      v. Surface tension, σ
   b. Hydrostatics
      i. Pressure at a point
      ii. Pressure variations in fluids
         1. Horizontal direction
            a. $dP/dX = 0$
         2. Vertical direction
            a. $dP/dZ = -\gamma$
            b. $P = \gamma h$
      iii. Pressure measurements
         1. Gauges
         2. Piezometers
         3. Manometers
   c. Fluid forces
      i. Integration of pressure distributions: $F = PA$
      ii. Center of pressure (Location of equivalent point loads)
      iii. Buoyancy

II. Fluids in Motion
   a. Flow classification
      i. Temporal changes:
         1. Steady: $dV/dt = 0$
         2. Unsteady: $dV/dt \neq 0$
      ii. Spatial Changes
         1. Uniform: $dV/dS = 0$
         2. Non-uniform: $dV/dS \neq 0$
      iii. Character of flow
         1. Laminar
         2. Turbulent
   b. Control Volume Approach
   c. Conservation of Mass - Continuity Equation
      i. $d\forall/dt = Q_{in} - Q_{out}$
      ii. $Q = VA$

d. Conservation of Energy (simplified) – Bernoulli Equation

i. $\frac{P}{\gamma} + z + \frac{V^2}{2g} = Const.$

ii. $P + \gamma\, z + \frac{1}{2}\rho\, V^2 = Const.$

e. Conservation of Momentum – Momentum Equation

i. $\sum \vec{F} = \frac{d(m\vec{V})}{dt}$

ii. $\sum \vec{F} = \frac{\partial}{\partial t}\left(\int_{ControlVol.} \rho\, \vec{V} d\forall \right) + \int_{ControlSurface} \rho\, \vec{V} \bullet \vec{V} dA$

f. Conservation of Energy (full) – Energy Equation

i. $\frac{P_1}{\gamma} + z_1 + \frac{V_1^2}{2g} + h_P = \frac{P_2}{\gamma} + z_2 + \frac{V_2^2}{2g} + h_T + h_{L_{1-2}}$

III. Applications of Basic Principles

a. Flow in pipes
b. Energy losses
c. Pumps and turbines – general concepts
d. Positive displacement pumps - project