1. Velocity Distribution with more than one independent variable
   1. Lecture Notes:
      1. Flow in rectangular channel
   2. Homework Problems:
      1. Homework 5
   3. Expectations:
      1. Apply Navier Stokes equation in multiple dimensions, unsteady state (NVS provided)
      2. Write boundary conditions for multiple variable dependence and change of variable provided
      3. Simplify with given variable change (chain rule)
2. Stream Function, potential flow, boundary layer theory, velocity profile
   1. Book Section:
      1. 4.3
      2. 4.4
   2. Lecture Notes:
   3. Examples:
      1. 4.3-1
      2. 4.4-1
   4. Homework Problems:
      1. Homework 6
      2. Homework 7
   5. Expectations:
      1. Steam function and potential function to get velocity. Complex potential related to velocity components. Use equation of motion that gives Bernoulli equation to get pressure distribution (Eqn 4.3-5)
      2. NVS equation in 2 dimensions, Equation of Continuity and assuming steady state, simplify to arrive at Prandtl Boundary Layer Equations (Eqn. 4.4-9 and 4.4-10)
      3. Simplifying, prandtl boundary layer equations with potential flow equation for relation between pressure gradient and velocity gradient, von-karman equation is derived (Eqn 4.4-13)
      4. Using Von-karman and assumed velocity profiles provides approximate boundary layer solutions used for boundary layer thickness, velocity dependence on x and y, drag force (ex. 4.4-1)
      5. Apply procedures on different kinds of geometries provided (Cartesian and cylindrical coordinates). Assumptions provided. Simplifying assumptions with reasonable justification acceptable.
3. Dimensional analysis
   1. Lecture Notes:
      1. Dimensional analysis introduction
      2. Buckingham Pi Theorem
   2. Examples:
      1. Class problem
      2. Example problem from last year’s exam
   3. Homework Problems:
      1. Homework 7
   4. Expectations:
      1. Using dimensional analysis to obtain functional relationship for a given variable with other variables in a system
      2. Using Buckingham Pi theorem to obtain dimensionless numbers and use for design of systems
      3. Can use buckingham pi theorem for a given problem to identify the dimensionless numbers and relationship between different variables to form dimensionless numbers.
      4. Check dimensional homogeneity for any given equation that describes the fluid flow situation
4. Friction factors
   1. Book Section:
      1. Intro to Chapter 6
      2. 6.1
      3. 6.2
      4. 6.3
   2. Examples:
      1. 6.2-1
      2. 6.2-2
      3. 6.3-1
      4. Class example from Fall 2015 final
   3. Homework Problems:
      1. Homework 8
   4. Expectations:
      1. Friction factors introduced to be able to compute losses easily without going through writing NVS
      2. Understand concept of how friction factor relates forces by fluid with geometrical parameters of system. Use geometries to relate forces and system dimensions
      3. Two common systems - pipe friction factor and friction factor for submerged spheres. Understand derivation and relation of friction factor with dimensionless numbers
      4. Use relationship between friction factor, other dimensionless numbers to calculate unknowns (redraw graph or use already available friction factor chart with new functions for drawing line to get solution)
      5. Use friction factor charts in both cases - fluid flow in pipe and submerged spheres
      6. Develop relationship for friction factor and system parameter for new system. Use known relationship between friction factor and other variable to get unknowns. Use simultaneous equations or graphs for solutions.