

## Assignment 6

1. Dimensional Analysis. Assume the drag  $D$  acting on a spherical particle that falls very slowly through a viscous fluid is a function of the particle diameter  $d$ , the particle velocity  $v$  and the fluid viscosity  $\mu$ . Determine with the aid of dimensional analysis how the drag depends on the particle velocity.
2. A certain spillway for a dam is 20 m wide and is designed to carry  $125 \text{ m}^3/\text{s}$  at flood stage. A 1:15 model is constructed to study the flow characteristics through the spillway. Determine the required model width and flowrate. What operating time for the model corresponds to a 24 hr period in the prototype? Assume the effects of surface tension and viscosity can be neglected. Consider the Froude number to be equal between the model and prototype.

3. Show for laminar flow in a pipe that:

$$\frac{\Delta P}{\rho v^2} = \frac{64}{Re} \frac{l}{D}$$

$\Delta P =$  press. drop over length  $l$   
 $D =$  pipe diameter

4. Find flow associated with  $w = k \ln z$ 
  - a) Find  $\phi$  and  $\psi$ .
  - b) Find the velocity components  $v_r$  and  $v_\theta$ .
  - c) Plot the streamlines.
5. Flow past a thin plate. Consider a fluid potential  $w = U z^{1/2}$ 
  - a) Find  $\phi$  and  $\psi$ .
  - b) Find the velocity components  $v_r$  and  $v_\theta$ .
  - c) Show streamlines are parabolas.