Fluid Flow
CHEM/III/CBGS/FF

(1)

QP Code : 4913

(REVISED COURSE)

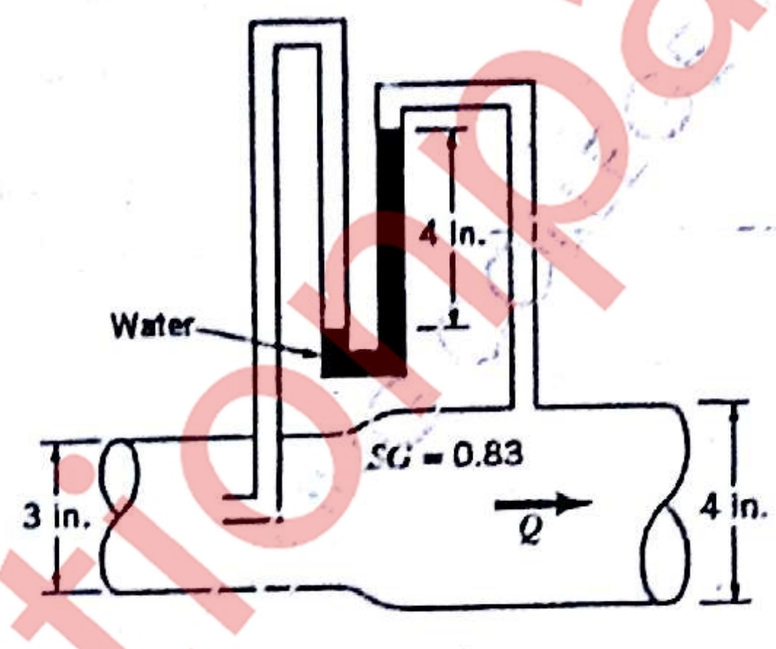
(3 Hours) (28) [Total Marks: 80

N.B. :

1) Question – 1 is compulsory. Answer any three questions from remaining.
2) Assume data if necessary and specify the assumptions clearly.
3) Draw neat sketches wherever required.
4) Answer to the sub-questions of an individual question should be grouped and written together i.e. one below the other.

1. (a) A person holds her hand out of an open car window while the car drives through still air at 65 mph(104.607 km/h). Under standard atmospheric conditions, what is the maximum pressure on her hand? What would be the maximum pressure if the "car" were an Indy 500 racer travelling 220 mph(354.056 km/h)? [05]
   (b) Explain different non-Newtonian fluids with shear stress vs shear rate diagram. [05]
   (c) Using differential analysis show that $p = h\rho g$ if fluid is in hydrostatic equilibrium. [05]
   (d) Discuss NPSH required and available for centrifugal pump. [05]

2. (a) Oil of specific gravity 0.83 flows in the pipe shown in Figure below. If viscous effects are neglected, what is the flowrate in LPS? [10]

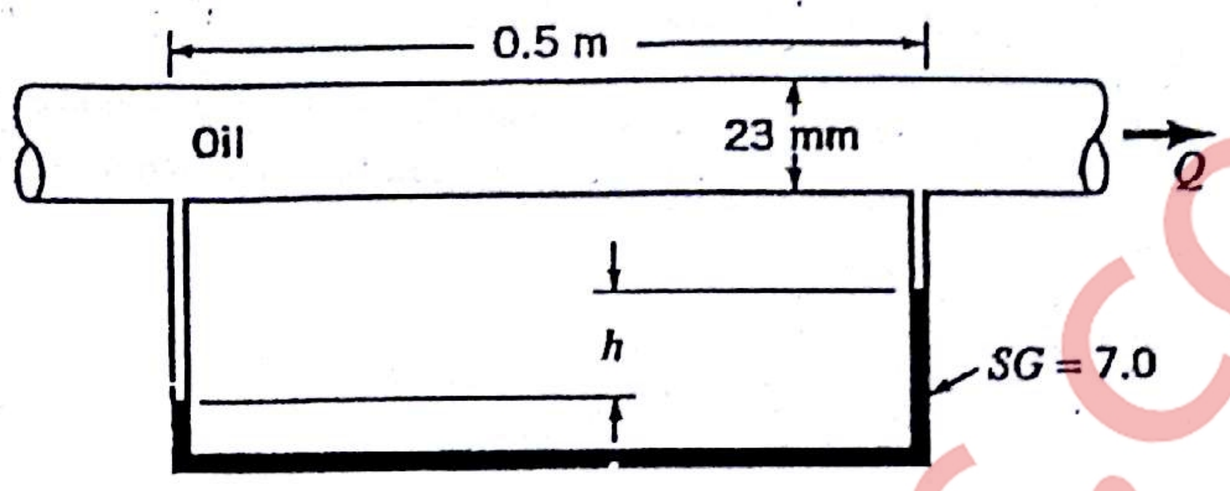


   (b) What diameter orifice hole, d, is needed if under ideal conditions the flowrate through the orifice meter fitted in 2 in. ID pipe is to be 113.562 lit/min of seawater with pressure difference between upstream and downstream tapping of orifice meter is 2.37 lb/in^2? The discharge coefficient(Cd) is assumed to be 0.63. [10]

3. (a) Water flows at a rate of 0.04 m^3/s in a 0.12 m diameter pipe that contains a sudden contraction to a 0.06 m diameter pipe. Determine the pressure drop across the contraction section How much of this pressure difference is due to losses and how much is due to kinetic energy changes? Take $K_c = 0.4$ [10]
   (b) A centrifugal pump having an impeller diameter of 1 m is to be constructed so that it will supply a head rise of 200 m at a flowrate of 4.1 m^3/s of water when operating at a speed of 1200 rpm. To study the characteristics of this pump, a 1/5 scale, geometrically similar model operated at the same speed is to be tested in the laboratory. Determine the required model discharge and head rise. Assume that both model and prototype operate with the same efficiency (and therefore the same specific speed). [10]

[TURN OVER

4. (a) Oil (specific weight = 8900 N/m^3, viscosity = 100cP) flows through a horizontal 23-mm-diameter tube as shown in figure below. A differential U-tube manometer is used to measure the pressure drop along the tube. Determine the range of values for h for laminar flow: [15]



(b) Draw neat sketches of any five types of agitators. [05]

5. (a) Two large plane surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerin. What force is required to drag a very thin plate of surface are 0.5 m^2 between the two large plane surfaces at a speed of 0.6 m/s, if: [15]

i. the thin plate is in the middle of the two plane surfaces, and

ii. the thin plate is at a distance of 0.8 cm from one of the plane surfaces?

Take, the dynamic viscosity of glycerin is 8.10×10^{-1} N-s/m^2.

(b) Explain construction of Globe valve with neat sketch. [05]

6. (a) Beginning with Euler's equation derive Bernoulli's equation for adiabatic flow. [10]

(b) Derive an equation for terminal settling velocity of spherical particle in fluid. [10]