S.E (Civil) Sem-III (CBGS)

Subject :→ FF

FF

Date : 03/06/2016

16+05 = 21

QP Code : 30757

(REVISED COURSE)

(3 Hours) [Total Marks: 80

06

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) In a stream of glycerin in motion, at a certain point the velocity gradient is 0.25 m/s per meter. The mass density of fluid is 1268.4 kg/m^3 and kinematic viscosity is 6.30×10^{-4} m^2/s. Calculate the shear stress at the point. [05]

   (b) Develop an expression for pressure variation in a liquid in which the specific weight increases with depth, h, as $\gamma = Kh + \gamma_0$, where K is a constant and γ_0 is the specific weight at free surface. [05]

   (c) A steel plate with base 5 cm × 4 cm and thickness 2.5 mm slides down the oily surface with inclination of 30°. If viscosity of oil is 100 cP what is the terminal velocity of plate? Assume oil layer below the plate is 0.9 mm and density of Steel is 7650 kg/m^3. [05]

   (d) Water is flowing through canal of approximately rectangular cross-section with width 20 ft. If depth of water in canal is 3 ft, what is the flow rate in m^3/s? If rectangular weir of width 4 ft and sill 1 ft above bottom of canal, is inserted in flow path of canal, what will be the maximum velocity over weir considering negligible rise in level in canal? Assume $C_d = 0.8$. [05]

2. (a) Pipe A and B contain water under pressures of 2.75 bar and 1.37 bar respectively. What is the deflection of mercury in the differential gauge shown in the figure – 1? [10]

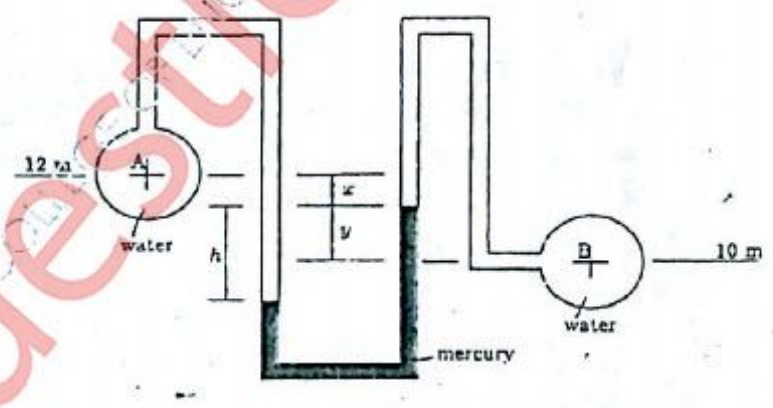

Figure 1: Manometer for question –2a

   (b) Starting with Euler's equation for flow derive Bernoulli's equation for fluid flow. List all assumptions made. [10]

3. (a) Derive Hagen-Poiseullie equation. [10]

(b) The population of a city is 800,000 and it is to be supplied with water from a reservoir 6.4 km away. Water is to be supplied at the rate of 140 litres per person per day and half the supply is to be delivered in 8 hours. The full supply level of the reservoir is 180 m and its lowest water level is 105 m. The delivery end of the main is at 22.5 m and the head required there is 12 m. Find the diameter of the pipe. Take $f_D = 0.01$ [10]

4. (a) A gas with velocity of 300 m/s is flowing through a horizontal pipe, at a point (1) where pressure is 60 kPa a and temperature 40°C. The pipe changes in diameter this section the pressure is 90 kPa a. Find the velocity of the gas at this section if the flow of gas is adiabatic. Also find temperature at other end. Take R = 287 J/kg-K and k = 1.4. [15]

(b) A viscous fiuid flows' in a 0.10 m diameter pipe such that its velocity measured 0.012 m away from the pipe wall is 0.8 m/s. If the flow is laminar. Determine the centreline velocity and the flowrate. [05]

5. (a) Explain construction and working of centrifugal pump with neat sketch showing all important parts of pump. [10]

(b) A tank 1.2 m in diameter and 2 m high is filled to a depth of 1.2 m with a latex having a viscosity of 10 poise and a density of 800 kg/m^3. The tank contains 4 baffles with width 10% of tank diameter. A three blade 360 mm diameter propeller is installed in the tank 360 mm from the bottom. The pitch is 1:1. The motor available develops 8 kW power. Is the motor adequate to drive this agitator at speed of 800 RPM? If not what is the maximum speed the motor can deliver? [10]

$$N_P = 1.2937 N_{Re}^{-0.077}$$

6. (a) Water flows steadily with negligible viscous effects through the pipe shown in Figure – 2. It is known that the 4 in. diameter section of thin-walled tubing will collapse if the pressure within it becomes less than 68.947 kPa below atmospheric pressure. Determine the maximum value that h can have without causing collapse of the tubing. [15]

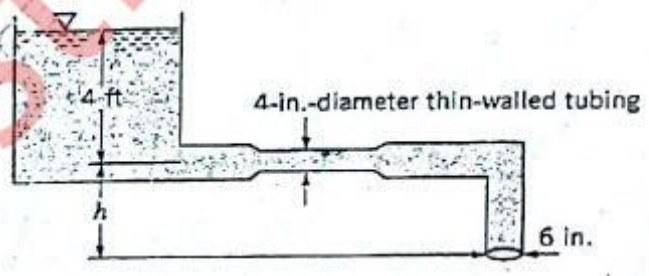

Figure 2: Figure for the question – 6a

(b) A small sample of ground coal is introduced into the top of a column of water 30 cm high, and the time required for the particles to settle out is measured. If it takes 50 seconds for the first particle to reach the bottom and 18 hr for all particles to settle, what is the range of particle sizes in the sample? ($SG_{coal} = 1.4$) [05]