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Roll No. | | | | | | | | | | | | | Total No. of Pages :04

03

Total No. of Questions : 09

B.Tech.(Petroleum Refinary Engineering) (2013 Onwards) (Sem.–3)

FLUID FLOW

Subject Code : BTPC-302

Paper ID : [A3260]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**
4. **Make suitable assumptions wherever necessary.**

SECTION-A

Q1. Answer briefly :

a. What is a fluid? How does it differ from a solid? How does a gas differ from a liquid?

b. Consider the flow of air at a Mach number of 0.12. Should this flow be approximated as being incompressible?

c. What is the difference between intensive and extensive properties?

d. Consider two identical fans, one at sea level and the other on top of a high mountain, running at identical speeds. How would you compare

a) The volume flow rates and

b) The mass flow rates of these two fans?

e. What is the difference between gage pressure and absolute pressure?

f. Write the primary dimensions of each of the following variables :

a) Shear stress;

b) Pressure;

c) Momentum;

d) Torque.

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g. Two firefighters are fighting a fire with identical water hoses and nozzles, except that one is holding the hose straight so that the water leaves the nozzle in the same direction it comes, while the other holds it backward so that the water makes a U-turn before being discharged. Which firefighter will experience a greater reaction force?

h. Consider the flow of air and water in pipes of the same diameter, at the same temperature, and at the same mean velocity. Which flow is more likely to be turbulent? Why?

i. What is hydraulic diameter? How is it defined? What is it equal to for a circular pipe of diameter D?

j. Consider a person walking first in air and then in water at the same speed. For which motion will the Reynolds number be higher?

SECTION-B

Q2. An inverted differential manometer is connected to two pipes A and B which convey water. The fluid in manometer is oil of specific gravity 0.85. For the manometer reading shown in Figure 1, find the pressure difference between A and B.

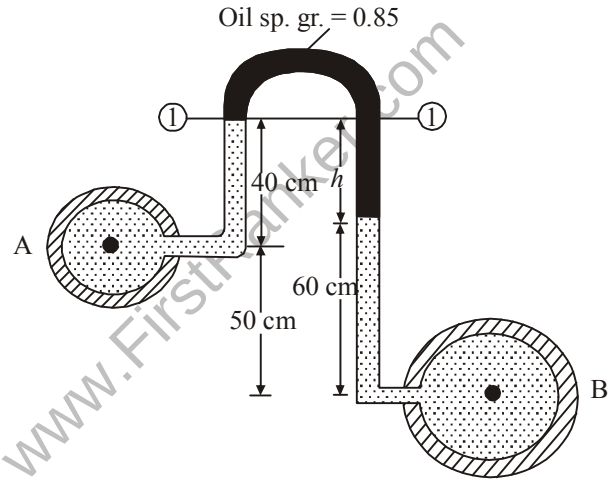

Figure - 1

Q3. Drive the Hagen-Poiseuille equation for the laminar flow through a circular pipe.

Q4. The drag force F_D on a soccer ball is thought to depend on the velocity of the ball V diameter D, air density ρ, and viscosity μ. Determine the number of Pi groups that can be formed from these five parameters.

Q5. The pressure in the air gap is 8000 Pa gage. The tank is cylindrical. Calculate the net hydrostatic force (a) on the bottom of the tank; (b) on the cylindrical side wall CC; and (c) on the annular plane panel BB.

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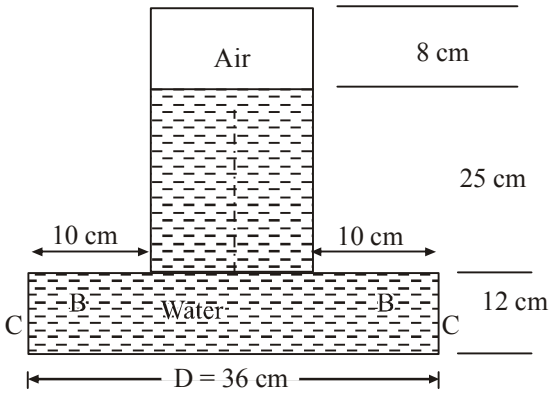

Figure - 2

Q6. The Bernoulli equation for steady flow of inviscid fluids is one of the most famous equations in classical fluid dynamics. How it is obtained from the Euler equation of motion?

SECTION-C

Q7. a. Classify the pumps and explain NPSH.

b. Drive an expression for area velocity relationship for a compressible fluid flow in the following form

$$\frac{dA}{A} = \frac{dV}{V}\left(M^2 - 1\right)$$

Q8. Write short notes on the following :

a. V- notch

b. Pitot tube

c. Rotameter

Q9. A reasonable approximation for the two-dimensional incompressible laminar boundary layer on the flat surface in as shown in Fig. is

$$u = U\left(\frac{2y}{\delta} - \frac{y^2}{\delta^2}\right) \quad \text{for } y \le \delta \quad \text{where } \delta = Cx^{1/2},\ C = \text{const}$$

a. Assuming a no-slip condition at the wall, find an expression for the velocity component $v(x,y)$ for $y \le \delta$.

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b. Then find the maximum value of v at the station x =1 m, for the particular case of airflow, when U=3 m/s and δ = 1.1 cm.

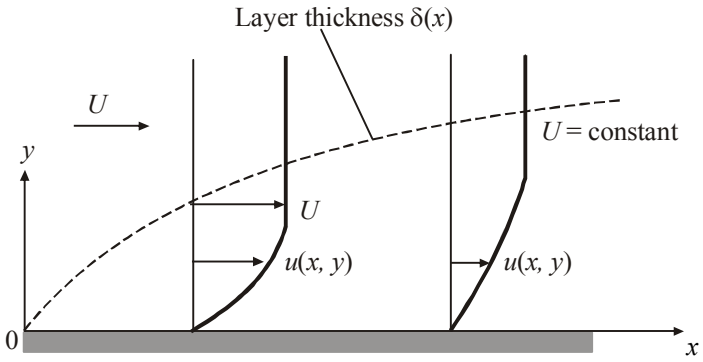

Figure - 3

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