B.TECH SEM-IV (CBCS 2014 COURSE): CHEMICAL ENGG - WINTER-2017

SUBJECT: FLUID FLOW OPERATIONS

Day: **Tuesday** Time: **02.30 PM TO 05.30 PM**

Date: **21/11/2017** **W-2017-2063** Max Marks: 60

N.B:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Assume suitable data if necessary.
4) Use of non- programmable **CALCULATOR** is allowed.

Q.1 **a)** State and prove Pascal's law by considering a wedge shaped element of fluid. **(06)**

b) The 50 ml sample in the Redwood viscometer experiment [Redwood viscometer formula: kinematic viscosity = 0.0026t- (1.175/t) stokes] has weight 0.44 N. The time required for collecting the given volume was recorded to be 62.4 seconds. Calculate specific weight, mass density, and dynamic viscosity of sample. **(04)**

OR

Q.1 **a)** What is viscosity of fluid? How does it very with temperature? Explain the classification of fluids based on viscosity. **(06)**

b) The right limb of a simple U- tube manometer containing mercury is open to the atmosphere, while the left limb is connected to a pipe carrying a liquid of specific gravity 0.9. The center of pipe is 15 cm below the level of mercury in the right limb. Find the pressure of liquid in pipe if the difference of mercury level in two limbs is 24 cm. **(04)**

Q.2 **a)** State and derive continuity equation for one dimensional fluid flow. Also write S.I. units and dimensions for mass flow rate. **(06)**

b) The water is flowing through a pipe having diameters 20 cm and 10 cm at sections 1 and 2, respectively. The rate flow through pipe is 35 L/s. The section 1 is 6 m above datum line and section 2 is 4 m above datum line. If pressure at section 1 is 39. 24 N/cm^2, find the intensity of pressure at section 2. **(04)**

OR

Q.2 **a)** Derive Hagen Poiseille equation for loss of head in laminar flow through a circular pipe using formula : **(06)**

$$\bar{\mu} = \frac{1}{8\mu}\left(-\frac{\partial p}{\partial x}\right)\cdot R^2$$

b) A laminar flow is taking place in a pipe of diameter 200 mm. The maximum velocity is 1.5 m/s. Find the mean velocity and the radius at which this occurs. Also calculate the velocity at 4 cm from the wall of the pipe. **(04)**

Q.3 **a)** Derive equation for pressure drop in orifice meter with neat labeled diagram. **(06)**

b) A horizontal venturi-meter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the rate of flow. Take coefficient of venturi- meter = 0.98. **(04)**

OR

Q.3 a) Explain in detail Prandtls mixing length theory for turbulent flow. **(06)**

b) Find the velocity of the flow of an oil (specific gravity = 0.8) through a pipe. The difference of mercury level in a differential U- tube manometer connected to the two tapings of the pitot tube is 100 mm. Take coefficient of pitot tube as 0.98. **(04)**

Q.4 Derive Darcy- Weisbach equation for loss of head due to friction for fluid flowing through a pipe. **(10)**

OR

Q.4 a) Explain loss of head due to pipe bends, fittings, and values in pipe. **(06)**

b) Differentiate between major losses and minor losses in pipe. **(04)**

Q.5 Water is to be pumped from a large reservoir resting on floor at a rate of $5m^3$/ hr to the open top of an absorption tower through 50 mm i. d. pipe. The point of discharge is 6 m above the floor and frictional losses in the entire system is 0.25 kgf.m/kg. At what height in the reservoir the water be kept, if the pump can develop 0.1 HP. **(10)**

OR

Q.5 a) Explain in detail cavitation and NPSH of centrifugal pump. **(06)**

b) Write a short note on compressor. **(04)**

Q.6 a) Explain the concept of fluidization with a graph of pressure drop and bed height v/s superficial velocity for a bed of solids. **(06)**

b) Write applications of fluidization. **(04)**

OR

Q.6 Write a note on **ANY TWO** of the following: **(10)**

a) Minimum fluidization velocity
b) Types of fluidization
c) Boundary layer separation and wake formation

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