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Total number of printed pages – 2

B. Tech  
PCCH 4201(New)

## Special Examination – 2012

### FLUID FLOW AND FLOW MEASUREMENT

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any **five** from the rest.

The figures in the right-hand margin indicate marks.

Assume suitable notations and any missing data wherever necessary.

1. Answer the following questions : 2×10
- (a) What are dynamic and kinematic viscosity ? Mention their SI units.
- (b) Relate Ostwald-de-Waele equation with Newton's law of viscosity equation.
- (c) Calculate the friction factor when the Reynolds number is 1600 for flow of fluid through pipe.
- (d) What is kinetic energy correction factor ?
- (e) What is a hydraulically smooth pipe ?
- (f) What are skin and form friction ?
- (g) The pressure recovery in venturi meter is higher than orifice meter. Explain.
- (h) Why priming is required for centrifugal pumps ?
- (i) Differentiate between single acting and double acting reciprocating pumps.
- (j) Name the pump used for boiler feed water applications.
2. (a) Prove that the pressure at any point is independent of direction. 6
- (b) A simple U-tube manometer is installed across an orifice meter. The manometer is filled with mercury (sp. gr.=13.6) and the liquid above the mercury is carbon tetrachloride (sp. gr. = 1.6). If the manometer reads 200 mm, calculate the pressure difference over the manometer in  $N/m^2$ . 4

3. A venturi meter is installed in a pipe line for the measurement of flow rate of water at 30°C (sp. gr. = 0.99). The pressure drop across the throat and upstream of the venturi is 12 cm of mercury (sp. gr. = 13.6). Calculate the volumetric flow rate of water in m<sup>3</sup>/s if the diameter of throat = 16 mm, diameter of pipe = 28 mm, and coefficient of meter = 0.98. 10
4. The velocity profile for laminar flow in a circular pipe is given by :
- $$u = u_{\max} \left[ 1 - \left( \frac{r}{R} \right)^2 \right]$$
- where,  $u_{\max}$  = constant = velocity at the center line of the pipe,  $r$  = radial distance from the center line of pipe, and  $R$  = radius of pipe. Find the average velocity. 10
5. (a) Draw a neat sketch of orifice meter and explain its construction. 5  
 (b) Derive the flow equation for orifice meter. 5
6. Explain in detail the construction and working of a reciprocating pump with a neat diagram. Also discuss the types of reciprocating pumps. 10
7. The sulphuric acid of density 1600 kg/m<sup>3</sup> and viscosity 8.5 mPa.s is to be pumped for 700 m along through a 60 mm ID pipe at a rate of 3.2 kg/s and then raised vertically 12 m by the pump. If the pump is electrically driven and has an efficiency of 60 %, what power will be required ? 10
8. Write short notes on any **two** : 5×2
- Ergun equation
  - Cavitation
  - Pitot tube
  - Net positive suction head