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Total number of printed pages – 2

B. Tech
PCCH 4201

Third Semester Examination – 2013
FLUID FLOW AND FLOW MEASUREMENT

BRANCH : CHEM

QUESTION CODE : C- 487

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.

1. Answer the following questions : 2×10
- (a) What do you understand by dimensional analysis method ? Why this method is chosen over formal mathematical development and a completely empirical study ?
 - (b) Why centrifugal decanters are used ? Write the equation for measuring the liquid-liquid interfacial radius and explain each terms used in the equation.
 - (c) Discuss the effect of T & P on the dynamic and kinematic viscosities of liquids and gases.
 - (d) Differentiate between isotropic and anisotropic turbulence.
 - (e) What are form friction and skin friction ?
 - (f) What do you understand by a hydraulically smooth tube ? Write its equation.
 - (g) Write and explain Kozney-Carman equation and state the Darcy's Law.
 - (h) Why the angle of the downstream section of venturimeters is made small ?
 - (i) What is cavitation ? Mention its effect on pump capacity.
 - (j) Name the types of reciprocating pump used to discharge against a pressure of 1500 atm and 100 atm.
2. (a) State and derive the Barometric equation. 4
- (b) The temperature of the earth's atmosphere falls about 5°C for every 1000 m of elevation above the earth's surface. At ground level the air temperature is 25°C and the pressure is 760 mm Hg. Assuming air to be an ideal gas, calculate the elevation at which the pressure is 400 mm Hg. How much error

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would be introduced in the answer, if hydrostatic equilibrium equation is used with the density calculated at 0°C and an arithmetic average pressure ?

3+3

3. (a) Discuss, in detail, the development of turbulent boundary layer on a flat plate with a neat diagram. 5
- (b) Discuss about Reynolds stresses and Eddy viscosity. 5
4. (a) A desktop computer is to be cooled by a fan whose flow rate is 0.35 m³/min. Determine the mass flow rate of air through the fan at an elevation of 3500 m where the air density is 0.7 kg/m³. Also, if the average velocity of air is not to exceed 105 m/min, determine the diameter of the casing of the fan. 5
- (b) A pitot-static probe is used to measure the velocity of an aircraft flying at 3000 m. If the differential pressure reading is 3 kPa, determine the velocity of the aircraft. 5
5. (a) Prove that the kinetic energy correction factor for laminar flow of Newtonian fluids in pipes is 2.0. 5
- (b) The flow rate of methanol at 20°C ($\rho = 790 \text{ kg/m}^3$ and $\mu = 6.0 \times 10^{-4} \text{ kg/m}\cdot\text{s}$) through a 4 cm diameter pipe is to be measured with a 3 cm diameter orifice meter equipped with a mercury manometer across the orifice place. If the differential height of the manometer is read to be 10 cm, determine the flow rate of methanol through the pipe and the average flow velocity. 3+2
6. (a) A bed of ion-exchange beads 2.44 m deep is to be back washed with water to remove dirt. The particles have a density of 1.25 g/cm³ and have an average size of 1.1 mm. What is the minimum fluidization velocity using water at 20°C and what velocity is required to expand the bed by 22 % ?
Take $\Phi_S = 1.0$ and $\square_M = 0.40$. 6
- (b) Discuss in detail the applications of fluidization. 4
7. (a) Discuss in detail about net positive suction head. 5
- (b) Discuss the construction and working of a reciprocating pump with a neat diagram. 5
8. Write short notes on any **two** of the following : 5×2
- (a) Bernoulli equation for fluid friction
- (b) Terminal settling velocity
- (c) Characteristic curves of centrifugal pumps
- (d) Blowers and compressors.

