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Total number of printed pages – 2

B. Tech
PCCH 4201

Third Semester Regular Examination – 2014

FLUID FLOW AND FLOW MEASUREMENT

BRANCH : CHEM

QUESTION CODE : H 396

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

- Mention the importance of dimensional analysis.
- A hot plate of area 0.13 m^2 is pulled at 0.28 m/s with respect to another stationary parallel plate 1.5 mm distant from it. If the space between the plates containing water of viscosity 0.001 N.s/m^2 , find the forces necessary to maintain this velocity.
- Calculate the pressure at an altitude of 4 km above sea level if the atmospheric pressure and density at sea level are 101.325 kPa and 1.23 kg/m^3 . Assume air as incompressible fluid and neglect the variation of g with altitude.
- What do you understand by isotropic turbulence ? Mention its importance.
- Explain contraction-loss coefficient. Mention its value for laminar flow.
- What do you understand by a hydraulically smooth tube ? Also write the von Karman equation.
- What is creeping flow ?
- For spheres, find out the ratio of terminal settling velocity and minimum fluidization velocity. Take $\epsilon_M = 0.45$.
- Write the applications and disadvantages of fluidization.
- What is net positive suction head in a centrifugal pump ?

P.T.O.

2. In a compressor, the frictional torque T in the impeller depends on diameter of the impeller D , rotational speed N , fluid density ρ , and viscosity μ . Using Buckingham's π -theorem, show that the frictional torque T can be expressed as : 10

$$T = \rho N^2 D^5 f \left(\frac{\mu}{\rho N D^2} \right)$$

3. Water is flowing vertically upwards through a pipeline having diameter 1 m and 0.5 m at the base and top, respectively. The pressure at the lower end is 450 mm Hg, while the pressure at the upper end is 20 kN/m². If the loss of head is 20 % of the difference in velocity head, calculate the discharge. The difference in the elevation is 4 m. 10
4. For laminar flow of Newtonian fluids, prove that the velocity distribution with respect to radius is a parabola with the apex at the centerline of the pipe. Also find out the value of momentum correction factor under these conditions. 10
5. A 300 mm x 150 mm venturimeter is to be replaced by an orificemeter. Both the meters are to give the same differential mercury manometer reading for a discharge of 100 lit/s and the inlet diameter to remain 300 mm. What should be the diameter of orifice ? The coefficient of discharges of the venturimeter and orificemeter are 0.98 and 0.6 respectively. 10
6. A sphere of diameter 30 cm and density 7500 kg/m³ is dropped into a large mass of oil of density 800 kg/m³. If the coefficient of drag of the sphere in oil is 0.4, find the terminal velocity of the sphere. 10
7. Discuss in detail the construction and working of a centrifugal pump with a neat diagram. Also mention in brief, different efficiencies of a centrifugal pump. 6+4
8. Write short notes on any two : 5×2
- Pitot tube
 - Laminar and turbulent flow in boundary layers
 - Types of fluidization
 - Reciprocating pump.