Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (CHE(O))/SEM-4/CHE-405/2012

2012

FLUID MECHANICS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) At a given mass flow rate doubling the pipe diameter

a) reduce N_{Re} by $\frac{1}{2}$ b) doubles N_{Re}

c) reduces N_{Re} by $\frac{1}{4}$ d) none of these.

ii) Stokes law is valid, when the particle Reynolds No. is

a) < 1 b) > 1

c) < 5 d) none of these.

iii) For a properly designed orifice meter, the orifice coefficient can be

a) 0·60 b) 1·05

c) 0·8 d) 0·98.

iv) If the ratio of the diameter of the two sphere is 1·5, the ratio of strokes drug on the two sphere should be

a) 1·5 b) 4·5

c) $\frac{1}{4 \cdot 5}$ d) none of these.

v) A $\frac{1}{3}$ decrease in the pipe dia will result in change in average velocity by

a) $\frac{4}{5}$ time decrease b) $\frac{3}{2}$ time increase

c) $\frac{5}{4}$ time increase d) none of these.

vi) Which of the following valves permit flow of slurry material ?

a) Gate valve b) Globe valve

c) Plunger d) Diaphragm.

vii) The sphericity of a cubical particle having length 3 mm is equal to

a) 3·0 b) 1·0

c) 1·274 d) none of these.

viii) A Newtonian fluid (density = ρ, viscosity = μ) is flowing in a smooth pipe with velocity v in a tube of dia D. Then pressure drop across the length L will be proportional to

a) $L\rho v^2 / D$ b) $D\rho v^2 / L$

c) $L\mu v / D^2$ d) $\mu v / L$.

ix) Power loss in an orifice meter is ..... that in a venturimeter.

a) less than b) same as

c) more than d) none of these.

x) Fluidized bed are formed when

a) fluid friction is zero

b) gravity force is less than fluid friction

c) pressure force is equal gravity forces

d) sum of the fluid friction and pressure forces is equal an opposite to gravity forces.

xi) For the laminar flow of a fluid in a circular pipe of radius R, the Hagen-Poissuille equation predicts the volumetric flow rate to be proportional to

a) R b) R^2

c) R^4 d) $R^{0.5}$.

xii) Equivalent diameter of an annulus pipe having outer and inner radius 5 m and 3 m is given by

a) 10 m b) 4 m

c) 6 m d) none of these.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Given that for fully developed lamina flow velocity distribution is given by $u = 2U\{1-(r/R)^2\}$. Show that friction factor (f) =16/Re. U = average velocity.
3. Write the importance of kinetic energy correction factor for modification of Bernoulli's equation and find out an expression for kinetic energy correction factor α.
4. Derive Hagen-Poiseuille equation starting from average velocity distribution for laminar flow and find out the relation between friction factor of Reynolds No.
5. Find out the general expression for average velocity of Pseudoplastic fluid under laminar flow condition.
6. Prove that for laminar flow the average velocity is exactly one-half of maximum velocity for the same system.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) A U-tube manometer with mercury reads 12 cm water is in the pipeline. Express the pressure in N/m^2. Density of mercury = 13600 kg/m^3, density of water = 1000 kg/m^2.

   b) Write the Bernoulli's equation with friction and explain the significance of its each term.

   c) A town delivers its water supply from a river pumping it with a standard pipe. The inlet to the pump is 5 m above the river and the water level in the pipe kept constant at 100 m above the pump discharge. The frictional loss is 1800 gmf cm/gm of water through the 2500 m of 25 cm I.D pipe which includes the total equivalent length of all piping from river to water tower. If the pump capacity is 20000 L/hr and pump is 80 efficient, then what should be the hourly pumping cost if electricity costs Rs. 4 per k watt-hr ? 4 + 3 + 8

8. a) With neat diagram give the difference between suction head and suction lift. Also write the mathematical expression for NPSH. 3 + 2

   b) With neat diagram show the characteristic curves of a centrifugal pump. 3

c) Drops of oil 15 micron in dia ore to be settled from their mixture with air. The sp gravity of the oil is 0·9 and the air is at 21°C and 1 atm pressure. A settling time of 1 min is available. How high should be chamber be to allow settling of a particle ? (Viscosity at 21°C = 0·018 cp) 7

9. a) Find out an expression for a friction loss coefficient for sudden expanded cross section.

b) Water flows through a 200 mm dia pipe with an average velocity of 3·6 m/sec. There is a certain enlargement to a 400 mm dia pipe

i) What is the power loss due to the certain enlargement ?

ii) What will be power loss if water flows into opposite direction with the same average velocity in the smaller pipe ? 7 + 8

10. a) "The pressure drop across a fluidized bed always remain constant." Explain the statement.

b) Establish Kozeny-Carman equation to find out pressure drop in a packed bed.

c) What do you mean by minimum fluidization velocity ? Calculate the minimum fluidization velocity from the given data. Porosity = 0·40, Particle diameter = 1·25 mm (spherical), Density difference = 0·25 g/cc, Fluid viscosity = 1 cp. 2 + 6 + 2 + 5

11. a) With a diagram explain how Rotameter functions ? Show that pressure drop across the float is invariant with flow rate.

b) "The permanent pressure loss in a venturimeter is relatively small than that in a orifice meter." Elaborate the statement.

c) Flow of a liquid in a 75 mm diameter pipe is measured by an orifice. Maximum flow rate is limited to 10 litres in a second. The mercury manometer gives a reading of 35 cm at this flow rate. Estimate orifice size. Liquid density = 1200 kg/m^3. 6 + 3 + 6

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