http://www.makaut.com

Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CE-OLD)/SEM-3/CE-302/2011-12

2011
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) When the fluid is at rest, then the shear stress is

   a) – 1 b) 0

   c) 1 d) none of these.

   ii) A rectangular plane surface 2 m wide and 2 m deep lies in vertical plane in water. Its centre of pressure lies at

   a) less than 1·25 m b) 1·25 m

   c) greater than 1·25 m d) none of these.

   iii) Point about which body starts oscillating when the body is tilted, is

   a) centre of gravity b) centre of buoyancy

   c) metacentre d) centre of pressure.

iv) The flow in a pipe is laminar if

a) Reynolds number is equal to 2500

b) Reynolds number is equal to 4000

c) Reynolds number is more than 2500

d) None of these.

v) Condition for maximum discharge over a board-crested weir is

a) H/3 b) 2H/3

c) H/4 d) 2H/5.

vi) If the Froude number in open channel flow is equal to 1·0, the flow is called

a) Critical flow b) Steaming flow

c) Shooting flow d) None of these.

vii) For laminar flow in a pipe carrying a given discharge, the height of surface roughness is doubled. In such a case, Darcy-Weisbach friction factor will

a) remain unchanged b) be halved

c) be doubled d) increase four-hold.

viii) In steady flow of a compressible fluid through a pipe the density, area and velocity at a particular section are 1·5 kg/m^3, 0·5 m^2 and 3 m/s respectively. At another section the density and area are 0·75 kg/m^3 and 1·0 m^2 respectively. What is the velocity at this section ?

a) 1·5 m/s b) 3·0 m/s

c) 4·5 m/s d) 6·0 m/s.

ix) The coefficient of velocity for an orifice is given by (using usual notations)

a) $\frac{x}{2\sqrt{YH}}$ b) $\frac{2x}{\sqrt{YH}}$

c) $\frac{x}{\sqrt{YH}}$ d) $\sqrt{\frac{x^2}{2YH}}$.

x) Which of the following velocity potentials satisfies continuity equation ?

a) x^2y b) $x^2 - y^2$

c) $\cos x$ d) $x^2 + y^2$.

xi) The losses are more in

a) Laminar flow b) Transition flow

c) Turbulent flow d) Critical flow.

xii) Notch is a device used for measuring

a) rate of flow through pipes

b) rate of flow through a small channel

c) velocity through a pipe

d) velocity through a small channel.

xiii) The coefficient of friction in terms of shear stress is given by f =

a) $\frac{2\rho V^2}{\tau_0}$ b) $\frac{2\tau_0}{\rho V^2}$

c) $\frac{2\tau_0}{2\rho V^2}$ d) $\frac{\rho V^2}{2\tau_0}$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. What do you understand by Total Pressure and Centre of Pressure ? Derive expression for each with suitable diagrams.

3. a) Define Buoyancy and Centre of Buoyancy. 2

   b) A stone weighs 395 N in air and 196 N in water. Compute volume of stone and its specify gravity. 3

4. Differentiate between the following :

   a) Pipe flow and open channel flow $2\frac{1}{2}$

   b) Metacentre and centroid. $2\frac{1}{2}$

5. Derive that $h_L = \frac{(V_C - V_2)^2}{2g}$ for loss of energy due to sudden enlargement of pipe.

6. In a rectangular channel there occurs a jump corresponding to $F_{r_1} = 2 \cdot 5$. Determine the critical depth and head loss in terms of the initial depth y_1.

7. State and prove Buckingham's π-theorem.

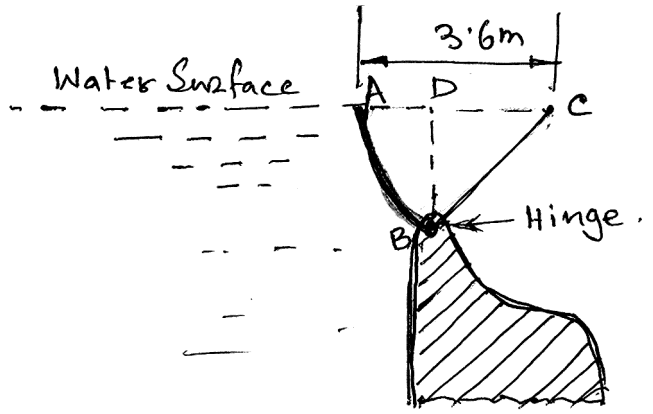
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

8. a) Define metacentric height.

b) A 60° sector gate of 3·6 m radius is mounted on the spillway of a dam as shown in the following figure. Its hinge and one of its end and radius arms are at the same horizontal level as the water surface. What is the magnitude and direction of resultant pressure on the gate if the length of the gate is 3 m.



9. A tank contains water up to a horizontal of 0·5 above the base. An immiscible liquid of sp.gr. 0·8 is filled on the top of water up to 1 m height. Calculate

a) total pressure of the tank

b) the position of centre of pressure for one side of the tank, which is 2 m wide.

10. a) Due to sudden enlargement of water main from 240 mm to 480 mm diameter, the hydraulic gradient raises by 10 mm. Estimate the rate of flow,

b) A horizontal pipeline 40 m long is connected to a water tank at one end and discharge freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm in diameter and its diameter is suddenly enlarged to 300 mm. The height of the water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow (f = 0·001) for both sections of the pipe.

11. a) Prove that for the trapezoidal channel of most economical section

i) half of top width = length of one of the sloping sides

ii) Hydraulic mean depth = 0·5 (depth of flow). 10

b) Define critical depth in an open channel in as many ways as you can. 5.

12. a) For the velocity profile for laminar boundary layer flows given as : $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$ Find an expression for boundary layer thickness (δ), shear stress (τ_0) and co-efficient of drag (C_D) in terms of Reynolds number.

b) Show that the angle of swing of a vertical hinged plate is given by $\sin\theta = \frac{\rho a V^2}{W}$. 8 + 7

13. a) Write short notes on any *two* of the following : $2 \times 2\frac{1}{2}$

i) Borda's mouthpiece

ii) Cipoletti notch

iii) Reynolds number

b) Determine C_d, C_v and C_c experimentally. 5

c) Derive an expression for loss of head due to an obstruction in pipe. 5