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Reg. No. : .....

Name : .....

Third Semester B.Tech. Degree Examination, December 2012
(2008 Scheme)
Branch : Civil
08.303 : FLUID MECHANICS – I

Time : 3 Hours Max. Marks : 100

PART – A

I. Answer **all** questions :

1) What is metacentre of a floating body ? How would you estimate the metacentric height experimentally ?

2) Differentiate between :
   i) Steady flow and uniform flow
   ii) Convective acceleration and local acceleration

3) Show that streamlines and equipotential lines intersect orthogonally.

4) What is Cipoletti Weir ? Derive its discharge equation.

5) Explain the use and principle of Pitot tube.

6) Show that for laminon flow between parallel plates kept at rest, local velocity becomes average velocity at a point 0.211 B from one of the plates, where 'B' is the spacing between the plates.

7) A right angled V-notch is used for measuring a discharge of 30 l/sec. An error of 1.5 mm was made while measuring the head over the notch. Calculate the percentage error in discharge. Take $C_d = 0.62$.

8) Show that coefficient of discharge of an external mouthpiece is 0.855.

(8×5=40 Marks)

P.T.O.

PART – B

Module – I

II. a) Determine the pressure difference between A and B for the setup shown in Fig. 1.

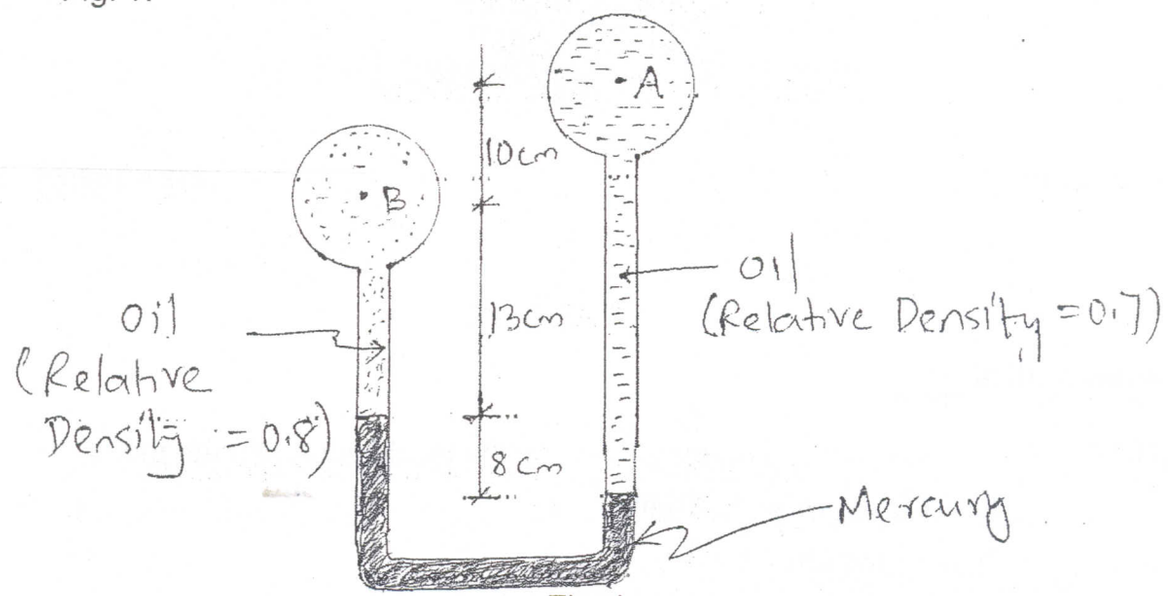

Fig. 1

b) The lower corner of a watertank has the shape of a quadrant of a circle of radius 1.2 m. The water surface is 2.4 m above the centre of curvature as shown in Fig. 2. The watertank is 3 m long. Find the magnitude, direction and location of the total force exerted by the water on the curved surface of the tank.

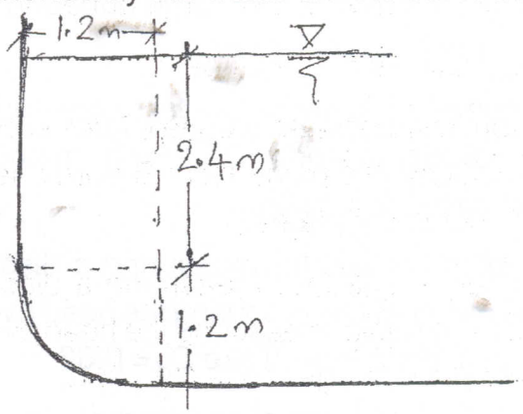

Fig. 2

OR

III. a) A rectangular plate 0.6m wide and 1.2 m deep lies within a waterbody such that its plane is inclined at 45° to the horizontal and its top edge is 70 cm below the water surface. Determine the total pressure force on one side of the plate and the location of centre of pressure. **10**

b) A wooden cylinder of specific gravity 0.6 and circular in cross section required to float in oil (specific gravity = 0.9). Find the $\frac{L}{D}$ ratio for the cylinder to float with its longitudinal axis vertical and is in stable equilibrium. Here L is the length and D is the diameter of the cylinder. **10**

Module – II

IV. a) Derive Darcy-Weisbach equation for major loss in pipes. **10**

b) An 8 cm diameter pipe carrying water has an abrupt expansion to 12 cm diameter at a section. If a differential mercury manometer connected to the upstream and downstream sections of the expansion indicate a gauge reading of 2 cm, estimate the discharge in the pipe. **10**

OR

V. a) It is desired to develop 1000 kW of power at 85% efficiency by supplying water to a hydraulic turbine through a horizontal pipe 500 m long. Determine the necessary flowrate and the maximum diameter of the pipe to carry that discharge water is available at a head of 150 m. Take friction factor as 0.024. **10**

b) A rectangular duct of 25 cm width has a 2D-irrotational flow. It has an elbow made up of circular arcs of radius 40 cm and 65 cm for inner and outer walls respectively. Calculate the discharge per unit width of the duct when the difference in pressure between outer and inner walls of the elbow is 30 kPa. **10**

Module – III

VI. a) Derive Hagen-Poiseuille equation. **10**

b) A hemispherical tank of diameter 4 m contains water upto a height of 1.5 m. An orifice of diameter 50 mm is provided at the bottom. Find (i) the time required to fall water level from 1.5 m to 1 m. (ii) time required for completely emptying the tank. Take : $C_d = 0.6$. **10**

OR

VII. a) Explain 'boundary layer separation'. How it can be controlled ? **8**

b) A smooth flat plate 2 m wide and 2.5 m long is towed in an oil (relative density = 0.8) with a velocity of 1.5 m/sec. lengthwise. Find the boundary layer thickness and shear stress at the centre and trailing edge of the plate. Also find the power required for towing the plate. Take kinematic viscosity of oil = 10^{-4} m^2/sec. **12**