4E2051

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B.Tech. (Sem.IV) (Main/Back) Examination, June -2013
Mechanical Engineering
Fluid Mechanics

[Time : 3 Hours] **[Total Marks : 80]**
[Min. Passing Marks : 24]

Instructions to Candidates :

*Attempt any **five questions,** selecting **one question** from **each unit**. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/ calculated must be stated clearly.*

Unit - I

1. **(a)** The flow of water from a reservoir is controlled by 5m wide L-shaped gate winged at point A, as shown in fig. If it is desired that gate open when the water height is 12m. Determine the mass of the required weight W.

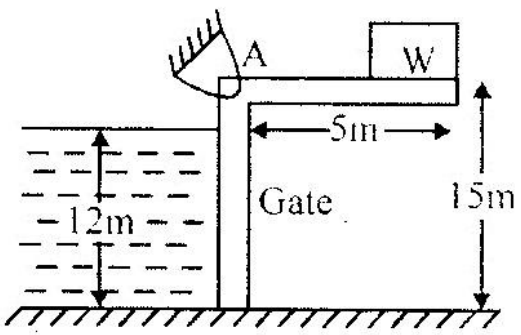

Fig. **[8]**

(b) A water pipe is connected to a double-U manometer as shown in Fig. Determine the absoulte pressure at the center of the water pipe.

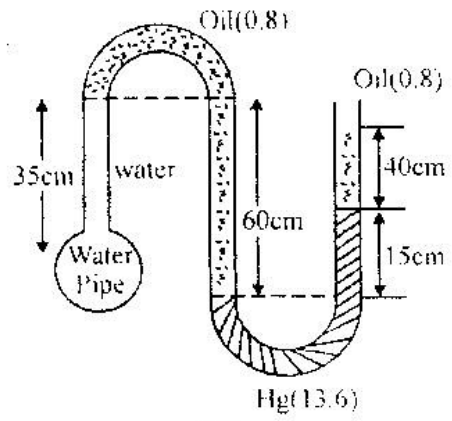

Fig.

OR **[8]**

1. **(a)** Consider a large cubic ice block floating in sea water. The sp. gravity of ice and sea water are 0.92 and 1.025, respectively. If a 10cm high protion of the ice block extends above the surface of the water determine the height h of the ice block below the surface.

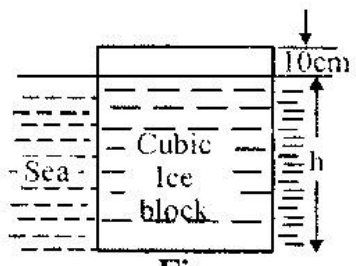

Fig. **[8]**

(b) A circular disc of diameter D is immersed vertically in a liquid of density ρ. The top most point of the disc just touches the liquid surface. Derive an expression for the depth of the center of pressure. **[8]**

Unit - II

2. **(a)** For the velocity components in a fluid flow given by $u = 2xy$ and $v = a^2 + x^2 - y^2$, shown that the flow is possible. Obtain the relevant stream function. **[8]**

(b) A pipe line is 15 cm in diameter and is at elevation of 100m at section A. At elevation B it is at an elevation of 107m and has a diameter of 30cm. When a discharge of 50 lt/s of water is passed through this pipe the pressure at section A is observed to be 30 KPa. The energy loss in the pipe is 2m. Calculate the pressure at B when the flow is (i) from A to B and (ii) from B to A. **[8]**

OR

2. **(a)** A liquid flows downward through a tapered vertical pipe as shown in fig. The pressure at section 1 and 2 are equal and the vertical distance between sections 1 and 2 is H. The diameter at section 1 is twice that at section 2. If H = 1.5m, find the velocities at section 1 and 2 by assuming zero loss of energy between the two sections.

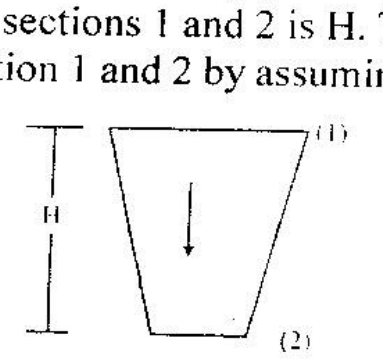

Fig.

(b) A steady two diamensional flow has the following velocity field. **[8]**

$u = 2x + 3y - 5$

$v = 5x - 2y - 9$

Determine the acceleration at the point (1,1) **[8]**

Unit - III

3. **(a)** Water is discharge from a tank maintained at a constant head of 5m above the exit of a straight pipe 100m long, 15cm diameter, Estimate the rate of flow if the friction coefficient for the pipe is given as 0.01. **[8]**

(b) Two identical orifices are mounted on one side of a vertical tank. Show that the jet from the orifices will intersec at the lend of base if the head on the upper orifice is equal to height of lower orifice above the base. **[8]**

OR

3. **(a)** Two sharp ended pipes of diameter 50mm and 100mm respectively, each of length 100m are connected in parallel between two reservoirs which have a difference of level of 10m. If the coefficient of friction for each pipe is f = 0.08, calculate the rate of flow for each pipe and also the diameter of a single pipe 100m long which would give the same discharge, if it were substituted for the original two pipes. **[8]**

(b) A swimming pool, 10m long × 6m wide, contains water to a depth of 1.25m. If the water is discharged through a $0.23m^3$ opening at the bottom of the pool, find the time taken to empty it. A discharge coefficient of 0.62 may be assumed for the opening. **[8]**

Unit - IV

4. **(a)** The pressure drop ΔP generated by a pump of a given geometry is known to depend upon the impeller diameter D, the rotational speed N. The fluid discharge Q, the fluid density ρ and viscosity μ. Obtain the dimensionless from of the functional relationship. **[8]**

(b) Calculate :

(i) The discharge and

(ii) The Power required to pump a liquid of specific gravity 0.8. viscosity 0.01 NS/m^2 through a pipeline 2cm diameter, 100m long operating at Reynolds number of 500. **[8]**

OR

4. **(a)** Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of flow. **[8]**

(b) A 1:36 model of a spillway crest records an acceleration of 1.5 m/s^2, a velocity of 0.5 m/s and a force of 0.30N at a certain area of model. What would be the values of the corresponding parameters in the prototype. **[8]**

Unit - V

5. **(a)** If the velocity profile in boundary layer is given by $\frac{u}{v} = \frac{y}{\delta}$ calculate the

(i) Displacement Thickness

(ii) Momentum Thickness

(iii) Energy thickness in terms of the nominal thickness δ of the boundary layer. **[8]**

(b) A man weighing 900N descends to the ground from a aeroplane with the help of a parachute against the resistance of air. The velocity with which the parachute, which is hemispherical in shape, comes down is 20 m/s. Find the diameter of the parachute. Assume $C_D = 0.5$ and density of air = 1.25 kg/m^3. **[8]**

OR

5. Derive Von-Kazman momentum integral equation. **[16]**