* 3 9 7 5 *

Fluid Mechanics - I
(1100)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory and solve **any two** bit out of a, b and c at one place only.
5. Figure to right indicates full marks.
6. Use of non-programmable calculator is allowed.
7. Assume suitable data if necessary.

UNIT - I

1. a) Define 'Cohesion and adhesion'. Also solve At a depth of 10km in the ocean the variation in pressure with respect to top surface is $10^5 kN/m^2$. The specific weight of ocean water at surface is 10.1 kN/m^3. and its average bulk modulus is 2.45×10^6 kN/m^2. Determine. **10**
   i) Change in specific volume.
   ii) Specific volume at 10 km depth.
   iii) Specific weight at 10 km depth
   iv) Mass density at 10 km depth.

   b) Define total pressure and Centre of pressure. And solve A 2m diameter vertical gate AB is located in a vertical side of a water tank. A gate is free to swing about horizontal axis located 100mm below C. G. of the gate. Find the height 'h' of the water surface measured above the highest point 'A' of the gate such that there is no unbalance moment of water pressure on gate. **10**

   c) Explain the principle of floatation. And solve A wooden cylinder of 400mm diameter and specific gravity 0.65 is required to float in oil of SP. gravity 0.90 Find the maximum length of cylinder, so that it will float in stable equilibrium. **10**

UNIT - II

2. a) Explain steady and unsteady flow, uniform and nonuniform flow. And solve. **10**

For a two dimensional flow, $\psi = 2x^2 - 3y^2$, find the velocity vector and acceleration vector at (1,4).

b) Define equipotential line, stream line and flow net. And solve A 200mm x 100 mm venturi meter is provided in a vertical pipe carrying water flowing in upward direction. A differential mercury manometer connected to inlet and throat gives reading of 220 mm. Find the rate of flow Assume Cd = 0.98 **10**

c) Define pitot tube and explain how it works. Also state Bernoulli's equation and explain the terms datum head, pressure head and velocity head. **10**

UNIT - III

3. a) What is distorted model why it is adopted. Assuming that rate of discharge Q of centrifugal pump is dependent upon the mass density 'ρ' of fluid, pump speed N (rpm), the diameter of impeller D, pressure p and viscosity of fluid 'μ'. Show using Buckingham π - theorem can be represented by. **10**

$$Q = \left(ND^3\right)\phi\left[\left(\frac{gH}{N^2D^2}\right),\left(\frac{\nu}{ND^2}\right)\right]$$

Where H - head and ν - kinematic viscosity of fluid.

b) What is dimensional analysis and state its uses two parallel plates kept 0.1m apart have laminar flow of oil between them with maximum velocity of 1.5m/s. Calculate the discharge per meter width, shear stress at the plate, the difference in pressure between two point 20m apart. The velocity gradient at the plates and velocity at 0.02 m from plate. Take viscosity of oil to be 2.453 N.s/m^2. **10**

c) Derive Hagen - Poiseuille equation for steady laminar flow in circular pipes of uniform diameter. **10**

UNIT - IV

4. a) What is Cipolletti weir explain it with sketch. And calculate the percentage error in discharge over a rectangular and triangular notch if there is 1% error in measurement of head. **10**

b) What is mouth piece and advantages to provide it. A tank has two identical orifice one vertically over the other and 1m apart in one of its vertical side. The water surface is 1.25m. above the higher orifice and is maintained at a constant level. It is found that the jet intercept each other at horizontal distance of 2.68m from the Vena contracta. Determine Cv for the orifice. **10**

c) Explain end contraction and velocity of approach. And solve A rectangular contracted weir has a length of 2.5m between the abutments. There are two 0.15m thick pier like obstruction on the crest. Estimate the discharge under a head of 0.9m Assume Cd = 0.62 and velocity of approach is negligible. **10**

UNIT - V

5. a) Explain the terms - hydraulic mean depth, wetted perimeter. Also solve A rectangular channel which is laid on a bottom slope 0.0064 is to carry $21m^3/s$ of water, Determine the width of channel when the flow is in critical condition. Take Manning's n = 0.015. **10**

c) Explain most economical section of channel. And derive the equation for most economical trapezoidal section. **10**

c) A rectangular channel 7.6m wide discharges water at 13 m^2/sec with average velocity 1.6m/s. Find specific energy depth at minimum specific energy, critical velocity, minimum specific energy, Froude no and state types of flow. **10**

****