S - 885

Total No. of Pages :4

Seat No.	

S.E.(Civil)(Part - I)(Semester - III) Examination, Dec. - 2013

FLUID MECHANICS - I

Sub. Code : 42658

Day and Date : Tuesday, 24 - 12 - 2013 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions :
1) **Q.1 & Q.5 are compulsory.**
2) **Attempt any two questions from each section.**
3) **Figures to the right indicate full marks.**
4) **Use of calculator is permitted.**
5) **Draw neat diagrams wherever necessary.**

SECTION - I

Q1) Attempt any four : **[20]**

a) State Newton's law of viscosity. Derive formula for shear stress.

b) Differentiate between kinematic viscosity & dynamic viscosity.

c) If density of liquid is 785 kg/m^3, find its specific weight, specific gravity, specific volume. If kinematic viscosity of this liquid is 1.25 cm^2/sec, obtain its dynamic viscosity.

d) A capillary tube of diameter 1.50 mm is dipped in (i) water (ii) mercury. Find the capillary rise for each case. Surface tension for water & mercury may be taken as 0.07 N/m & 0.52 N/m respectively. The contact angle may be taken as 0° & 130° for the two cases respectively.

e) Define:

i) Steady flow & Unsteady flow.

ii) Uniform & Non-Uniform flow.

What combinations of above flows are possible?

f) A cylinder 1.5 m diameter & 2 m long floats in sea water with its axis vertical. The base of the cylinder is 1.5 m below the surface of water. Find the total weight of the cylinder & the position of the centre of gravity if it is 0.3 m below the metacentre. Sea water weighs 10055 N/m^3.

P.T.O.

Q2) a) What do you mean by dimensional Analysis? What is dimensionally homogeneous equation? [5]

b) Explain Rayleigh's method of obtaining relation between a given set of variables influencing a phenomenon. [5]

c) A partially submerged body is towed in water. Assuming that resistance (R) to the motion depends on the density (ρ), length of body (l), the velocity of the body (v), the viscosity (μ) & acceleration due to gravity (g), show that, the resistance is given by, [5]

$$R = \rho l^2 v^2 \phi \left[\frac{\mu}{\rho v l}, \frac{lg}{v^2} \right]$$

Q3) a) Derive expression for forces acting on curved surfaces & their point of applications on curved surfaces. [5]

b) What is meant by stability of a floating body? Explain the three states of equilibrium of a floating body. [5]

c) A rectangular plate 2m x 3m in size is immersed in water with its 2m side parallel to water surface & the upper parallel end at the depth of 2m below free surface. The plate is inclined at an angle of 60° to the vertical. Calculate total water pressure exerted by the water on one side of the plate & find its position. [5]

Q4) a) What is flow net? Show that streamlines & equipotential lines intersect each other orthogonally. [5]

b) Derive a general equation for continuity for a 3-D flow in Cartesian coordinates for a steady incompressible flow. [5]

c) In a two dimensional incompressible flow, the fluid velocity components are given by u = (x-4y) & v = (-y-4x). Show that velocity potential exists & determine its form. Find also the stream function. [5]

SECTION - II

Q5) Attempt any four: [20]

a) State Bernoulli's theorem & the assumptions made in.

b) What is an orifice? State how the orifices are classified.

c) Determine the throat diameter of a venturimeter for installation in a 100 mm diameter pipeline carrying oil of specific gravity 0.87. The maximum range of available oil-mercury differential gauge is 50 cm of mercury. Find the maximum throat diameter which would show full gauge deflection when the flow rate is 20 lps. Take $C_d = 0.984$.

d) What do you understand by laminar flow? Give its characteristics.

e) Differentiate between 'Major losses & minor losses'.

f) The cross-section of a pipe carrying a given discharge is suddenly enlarged. What would be the ratio of the two diameters of the pipe, if the magnitude of the loss of head at this change of section is same irrespective of the direction of flow? Assume $C_c = 0.64$.

Q6) a) Explain Prandtl's Mixing Length Theory. [5]

b) Starting from first principles, show that for laminar flow between fixed parallel plates, the mean velocity is two-third of maximum velocity. [5]

c) Water discharges at the rate of 98.2 lps through a 120 mm diameter vertical sharped orifice placed under a constant head of 10 m. A point on the jet measured from the vena-contracta of the jet has coordinates 4.5 m horizontal & 0.54 m vertical. Find the coefficients of orifice, C_d, C_v & C_c. [5]

Q7) a) Derive an expression for the loss of head due to sudden enlargement in the pipe flow. [5]

b) What is water hammer phenomenon? [5]

c) Two reservoirs are connected by a 250mm diameter pipe 3000 m long. The difference in level of water surface of the two reservoirs is 15 m. Find the discharge to the lower reservoir.

If a 250 mm diameter additional pipe is attached to the last 1500 m length of the existing pipe, find the new discharge to the lower reservoir. Neglect secondary losses. Take $f = 0.01$. [5]

Q8) Write short notes on (any three): **[15]**

a) Reynold's experiment.

b) Hydraulic coefficients of an orifice.

c) Pipes in series & pipes in parallel.

d) Hydrodynamically rough & smooth pipes.

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