K-118

Seat No.	

Total No. of Pages : 3

S.E. (Civil) (Part-I) (Semester-III) Examination, 2013
FLUID MECHANICS-I
Sub. Code : 42658

Day and Date : Friday, 07-06-2013 **Total Marks : 100**

Time : 2.30 p.m. to 5.30 p.m.

Instructions :
1) **Question No. 1 is compulsory.**
2) **Attempt any Three questions from each section, including Q. No. 1.**
3) **Figures to the right indicate full marks.**
4) **Assume any other data, if necessary.**

SECTION-I

Q1) a) 2.5 m^3 of a certain liquid weighs 9.81 kN. Determine:
i) sp. weight ii) mass density, and iii) specific gravity of the liquid.
If the viscosity of the liquid is 6 cp, what is its kinematic Viscosity in cst?

b) Briefly explain the procedure of computing the resultant hydrostatic forces on a curved surface.

c) Write a short note on: Classification of flow.

d) In case of Froude Model Law, obtain scale ratios for: Velocity, Time, Force, Acceleration and discharge and work done. **[4 x 5 = 20]**

Q2) a) Define the following fluid properties and mention their practical evidence: Viscosity, Surface Tension, and Capillarity.

b) A vertical gap of 25mm of infinite extent contains oil of specific gravity 0.95 and viscosity 2.5 N-s/m^2. A square metal plate of 1.5m side and 1.5mm thick weighing 50N is to be lifted through the gap and at a constant speed of 0.1m/s. Estimate the force required to lift the plate and power required to maintain the velocity?

c) A rectangular plate 3m long and 1m wide is immersed vertically in water in such a way that its longer side is parallel to the water surface and is 1.5m below it. Determine the total force on the plate and the position of the center of pressure. Also show that centre of pressure always lies below centre of gravity. **[3 x 5 = 15]**

P.T.O.

Q3) a) A solid cylinder of diameter 1m and height 1m floats in fresh water with its axis vertical. The cylinder is made of a material of specific gravity 0.7. Determine metacentric height and state condition of equilibrium.

b) Explain in brief the laboratory procedure to determine the metacentric height.

c) The viscous force 'F_D' exerted by a fluid on a sphere of dia. 'D' depends on Viscosity 'μ', mass density of fluid 'ρ' and velocity of the sphere 'u'. Perform the dimensional analysis. **[3 x 5 = 15]**

Q4) a) Define: Stream function and Velocity potential. A two dimensional flow field is given by $\phi = 4xy$. Determine the stream function. **[7]**

b) Derive continuity equation in differential form for a 3-D, steady, incompressible flow. **[8]**

SECTION-II

Q5) a) State Bernoulli's equation. List out the assumptions and limitations of Bernoulli's equation. How it is modified while applying in practice? What are the applications of Bernoulli's equation? **[8]**

b) Establish relationship between hydraulic coefficients of orifice.

A large tank has a sharp edged circular orifice of 30mm diameter at a depth of 4m below constant water level. The jet issues horizontally and in a horizontal distance of 2.65m. It fails by 0.5m. The measured discharge is 4 lps. Determine the coefficients of velocity, discharge and contraction for the orifice. **[4]**

c) Calculate the power required to maintain a laminar flow of an oil of viscosity 10 poise through a pipe 100mm diameter at the rate of 10 lps if the length of pipe is 1km. **[4]**

Q6) a) Derive the formula for loss due to sudden expansion. Water is flowing through a horizontal pipe at a flow rate of 200 lps. The diameter of the pipe is suddenly changed from 20cm to 30cm. Find the loss of head due to sudden change in diameter. **[8]**

b) A vertical venturimeter has an area ratio of 5. It has a throat diameter 1cm. When oil of specific gravity 0.8 flows through it, the mercury in the differential manometer indicates a difference in height of 12cm. Find the

discharge through the venturimeter. Take coefficient of discharge, c_d as unity. [4]

c) Write a short note on: HGL and TEL. Draw explanatory sketches. [4]

Q7) a) Two reservoirs open to atmosphere are connected by a pipe of 30cm diameter and 1000m long. The pipe goes over a hill whose height is 3m above the level of water in the upper reservoir. The difference in water levels in the two reservoirs is 12m. If the absolute pressure of water anywhere in the pipeline is not allowed to fall below 2.5m of water in order to prevent vapour pressure formation. Find the length of pipe in the portion between the upper reservoir and the hill summit. Also compute the rate of flow through the pipe. Assume Darcy's friction factor as 0.02 and neglect bend losses only. Take atmospheric pressure head = 10.3m of water. [7]

b) Two pipelines of equal length and with diameters of 20cm and 30cm are in parallel and connect two reservoirs. The difference in water levels in the reservoirs is 4m. If the friction factor is assumed to be equal, find the ratio of the discharges due to larger diameter pipe to that of the smaller diameter pipe. Neglect all minor losses. [5]

c) Write a short note on Prandtal Mixing Length Theory. [4]

Q8) a) Derive Hagen-Poiseuille equation for steady laminar flow in pipes. Further establish relation between Darcy Weisbach friction factor and Reynold's number in laminar flow. [10]

b) Write a short note on (any two): [8]

i) Hydro dynamically smooth and rough pipes.

ii) Nikuradse's experiment on artificially roughened pipes.

iii) Velocity distribution and Reynold's shear stress w.r.t. turbulent flow.

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