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Question Paper Code : 60245

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Civil Engineering

CE 2202/ 080100015/ 10111 CE 305/ CE 1203/ CE 35 — MECHANICS OF FLUIDS

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed with proper justification.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Differentiate between mass density and relative density of fluid.

2. Highlight the concept of continuum.

3. What is the hydrostatic pressure at 100 m below sea level? Take the specific gravity of seawater as 1.028 g/cm^3.

4. Sketch a flow net.

5. Give the relation between friction factor and frictional coefficient.

6. Define Reynold's number.

7. Substantiate why minor losses are not considered in large pipe networks.

8. Bring out the practical feasibility of pipes to be connected in parallel.

9. Check the dimensional homogeneity of the basic particle dynamics equation: $S = ut + 0.5at^2$.

10. What do you mean by distorted model?

PART B — (5 × 16 = 80 marks)

11. (a) (i) With usual notations, show that the shear stress is proportional to the rate of change of velocity across the differential depth of fluid flow. (8)

(ii) In a large reservoir, two parallel and wide glass plates are immersed in water at a distance of 1 mm between them. What may be the rise in water level away from the ends on the plate, if the contact angle and the surface tension being 20° and 0.073 N/m? (8)

Or

(b) (i) Define kinematic viscosity, surface tension and bulk modulus of fluid. (6)

(ii) A 10 × 100 × 1 cm^3 smooth flat plate is dragged by an inclined force of 1N at 60° to horizontal over a smooth surface. If the gap between the plate and surface is filled by water of 0.1 mm having a viscosity of 1 mPas, what amount of power is required to maintain the constant horizontal velocity of the plate? (10)

12. (a) (i) Find the absolute pressure at M shown in Fig.1. (8)

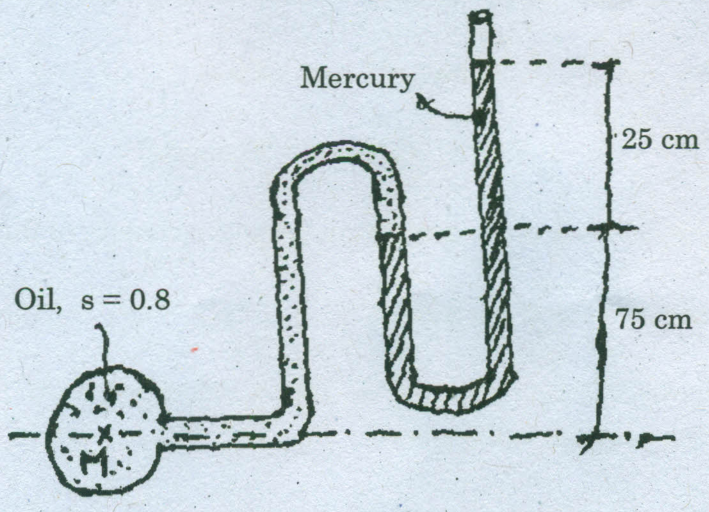

Fig. 1.

(ii) The potential function is given by $\phi = 3x^2 - 3x - 3y^2 + 16t^2 - 16zt$. Find the equation for irrotational velocity and check its compressibleness. (5+3)

Or

(b) (i) A vertical cylindrical buoy is 2 m in diameter, 2.5 m long and weighs 22 kN. If the relative density of sea water is 1.03 check its stability about its vertical axis. (8)

(ii) Enlist the uses of hot wire anemometers. If the stagnation and static pressures recorded by the pitot-tube are 3 and 2 m of water respectively, find the velocity of flow in a stream. Take the coefficient as 0.98. (3+5)

13. (a) (i) Starting with Euler's equation, derive the Bernoulli's equations, clearly highlighting the assumptions. (8)

(ii) Mention two merits and two demerits of orifice meter. Also, determine the discharge of water through the orifice of 15 mm diameter fitted at the bottom surface of the tank containing 1 m depth of water. Take $C_d = 0.6$. (4+4)

Or

(b) (i) With usual notations, derive the Hagen-Poiseuille equation along with the assumptions made in it. (10)

(ii) Estimate the discharge of water through the vertical pipe of 150 mm diameter fitted with a venturimeter of throat of 70 mm diameter with the absolute pressure at a point 6 m below the throat as 5 Atm. and the pressure at the throat is equivalent to 20 cm of water. (6)

14. (a) (i) Using Prandtl's 1/7 power law, derive the turbulent boundary layer thickness. (8)

(ii) Water flows from a reservoir through a series of pipes as shown in Fig.2. Estimate the discharge. Also, find the percentage error in discharge if the minor losses are neglected. Take f = 0.02. (5+3)

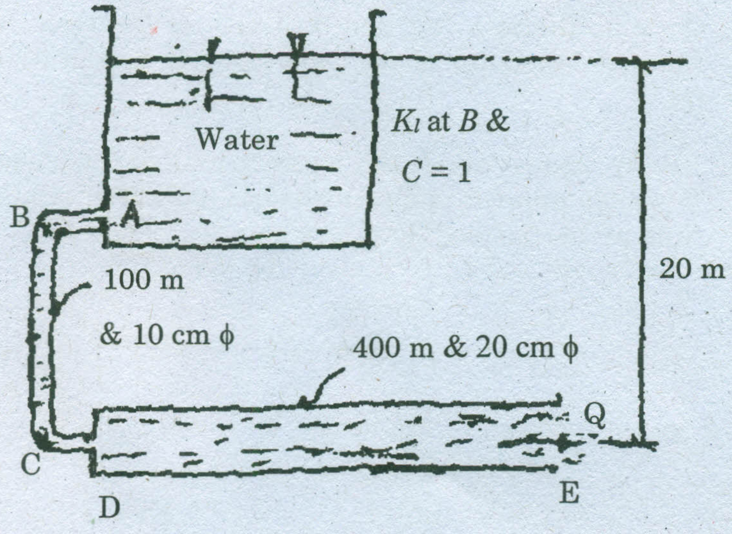

Fig. 2.

Or

(b) (i) Calculate the displacement and momentum thicknesses in terms of δ for the laminar boundary layer profile shown below; where, u is the velocity at a distance y from the surface and $y \to \delta$ when $u \to U$

$$\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right)^2 - \frac{1}{2}\left(\frac{y}{\delta}\right)^3.$$ (4+4)

(ii) Two reservoirs with their difference in water levels is 20 m and connected by three pipes whole details are given below. Determine the discharge at the end of the pipe system, by neglecting the minor losses. (8)

Pipe No.	Length, m	Diameter, cm	Friction factor
1	300	30	002
2	250	25	0.025
3	200	20	0.03

15\. (a) (i) By Rayleigh's index method, prove the basic hydrostatic equation (8)

(ii) What is similitude ? A model of an air duct operating with water creates a pressure drop of 10 kpa over 10 m length. Find the corresponding drop in 20 m long air duct, by taking scale ratio as 1/50, ratio of mass densities between air and water as 1.2×10^{-3} and ratio of viscosities of air and water as 0.02. Take Euler number as pressure drop divided by the product of mass density and square of the velocity. (2+6)

Or

(b) (i) Using Buckingham's π theorem, show that the major head loss in the pipe (h_f) is a function of length of the pipe (l), velocity of the fluid (v), diameter of the pipe (d), and acceleration due to gravity (g). (8)

(ii) Briefly discuss about the various similarities. Also, prove that the Reynolds number is dimensionless (only by considering the various fluid properties and flow parameters). (4+4)