Total No. of Questions : 10] [Total No. of Printed Pages : 4

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405(N)

B. E. (Fourth Semester)
EXAMINATION, June, 2011

(Common for AU, CE, CM, IP & ME Engg. Branch)

FLUID MECHANICS

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : Attempt all questions. Internal choice is given. All questions carry equal marks. Assume suitable data if needed.

1. (a) Draw the stress-strain relationship for different types of fluid. Also give examples. 10

   (b) A wooden cylinder of circular cross-section (specific gravity = 0·6) having length '*l*' and diameter '*d*' floats in water. Find the maximum permissible $\frac{l}{d}$ ratio so that the cylinder may float in stable equilibrium with its axis vertical. What would be the cylinder length if it is 25 cm in diameter ? 10

Or

2. (a) Explain the principle of floatation. Also explain the different conditions of equilibrium. 10

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(b) A closed oil tanker 2 m deep, 1·8 m wide and 3·5 m long has been filled with an oil of specific gravity 0·80 up to a depth of 1·5 m. Calculate the acceleration which may be imparted to the tank in the direction of its length so that the bottom front end of the tank is just exposed. Also calculate the net horizontal force acting on the tanker sides. Take specific weight of water as 9807 N/m^3. 10

3. (a) Derive the general three dimensional equation of continuity. 10

(b) Describe the different types of displacements and deformations a fluid particle may undergo in course of its motion. 10

Or

4. (a) Explain the terms vorticity and circulation in two-dimensional fluid flow and show how are they related to each other. 10

(b) The velocity components of a two-dimensional, incompressible flow are given by :

$$u = 2y + \frac{y}{\sqrt{x^2 + y^2}} \text{ and } v = -2x - \frac{x}{\sqrt{x^2 + y^2}}$$

Work out the stream function. 10

5. (a) Explain the significance of the kinetic energy correction factor and the momentum correction factor. Suggest their practical values for laminar and turbulent flows. 10

(b) A bend in pipe-line conveying water gradually reduces from 60 cm to 30 cm diameter and deflects the flow through an angle of 60°. At the larger end the gauge

pressure is 2·00 kg/cm^2. Determine the magnitude and direction of the force exerted on the bend : 10

(i) when there is no flow.

(ii) when the flow is 900 litres per sec.

Or

6. (a) Obtain an expression for calculating the discharge over a weir. State the assumptions made. 10

(b) The head of water over an orifice of diameter 08 cm is 08 metre. The water coming out from orifice is collected in a circular tank of dia 1·5 m. The rise of water level in this tank is 0·80 m in 20 seconds. Also the co-ordinate of a point on the jet measured from vena contracta is 4·30 m horizontal and 0·5 m vertical. Find C_c, C_v, C_d. 10

7. (a) Explain the Buckingham's Pi-thereom of dimensional analysis. 10

(b) State the reasons for constructing distorted models of rivers and explain the various types of distortion in models. What are the merits and demerits of distorted models ? 10

Or

8. (a) Explain the different types of similarity laws. 10

(b) Using Buckingham's theorem show that velocity through a circular orifice is given by : 10

$$V = \sqrt{2gH}\,\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$$

9. (a) Prove that for a steady laminar flow between two fixed parallel plates, the velocity distribution across a section is parabolic and that the average velocity is 2/3rd of the maximum velocity. 10

(b) Lubricating oil of specific gravity 0·82 and dynamic viscosity $1{\cdot}2 \times 10^{-3}$ N·s/m^2 is pumped at a rate of 0·02 m^3/sec. through a 0·15 m diameter 300 m long pipe. Calculate the pressure drop, average shear stress at the wall of pipe and the power required to maintain the flow :

(i) if the pipe is horizontal.

(ii) if the pipe is inclined at 15° with horizontal and flow is in upward direction. 10

Or

10. (a) Derive the Hagen-Poiseuille equation and state the assumption made. 10

(b) Determine the Raynolds' No. for litres/sec. of water flowing on a 15 cm dia. pipe at (i) 20°C and (ii) 80°C. If the laminar flow changes to turbulent at Re = 2320 find the critical velocity at the above temperatures and compare them with the actual velocity of water flowing in pipe. Take ν = (kinematic viscosity) at 20°C = 0·01009 and at 80°C = 0·0036 stoke. 10