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Question Paper Code : X10231

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Third Semester
Civil Engineering
CE 8302 – FLUID MECHANICS
(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Illustrate the effect of temperature on Viscosity.
2. Distinguish between gauge pressure and absolute pressure.
3. Define flow net.
4. State momentum equation.
5. Distinguish between distorted and undistorted models.
6. State the methods of dimensional analysis.
7. List the general characteristics of laminar flow.
8. Glycerine of viscosity 0.835 Ns/m^2 flows through a 150 mm diameter, 40 m long iron pipe at a velocity of 3.25 m/s. Find the loss of head in the pipe. Take density of glycerine equal to 1260 kg/m^3.
9. Recall the ranges of Reynold's number for the flow in the boundary layer to be laminar and turbulent.
10. Define point of separation in the boundary layer.

PART – B **(5×13=65 Marks)**

11. a) i) A sluice gate is 2 m wide and 1.2 m high and hinged at the bottom. On the upstream side, there is seawater extending to a height of 1.6 m above the tip of the gate and on the downstream side, there is freshwater up to the top of the gate. Find (a) the resultant pressure force acting on the gate, (b) the position of the centre of pressure and (c) the least force acting at the top of the gate which will open the gate. Freshwater and seawater weigh 9.81 kN/m^3 and 10.05kN/m^3 respectively. **(8)**

ii) Explain with the neat sketch surface tension and capillarity and obtain necessary expressions. **(5)**

(OR)

b) i) A plate of metal 1 m × 1m × 2 mm is to be lifted up with a velocity of 0.1m/s through an infinitely extending gap 20 mm wide containing oil of specific gravity 0.9 and viscosity 2.15 Ns/m^2. Find the force required assuming the plate to remain midway in the gap. Assume the weight of the plate to be 29.5N. **(8)**

ii) Derive the equations to find the pressure inside the (a) Bubble, (b) Droplet and (c) jet. **(5)**

12. a) i) Derive Euler's equation of motion along a streamline and obtain Bernoulli's equation by its integration. State all assumptions made. **(8)**

ii) Explain the different types of classifications of flows. **(5)**

(OR)

b) i) A two-dimensional potential flow has the velocity potential of $\phi = x(2y-1)$. Determine the velocity at point P (4, 5). Also find the value of the stream function ψ at the point P. **(8)**

ii) Distinguish between Venturimeter, Orifice meter and Pitot tube. **(5)**

13. a) The thrust developed by a propeller shaft (F) depends upon angular velocity 'ω', speed of advance 'v', the diameter of the propeller 'd', the dynamic viscosity of the fluid 'μ', the density of the fluid 'ρ' and modulus of elasticity of the fluid 'K'. Using dimensional analysis (Buckingham's Π theorem) method, find the relationship between the parameters. **(13)**

(OR)

b) i) A prototype submarine moving with 40 km/hr in seawater is to be tested using a model of 1 in 30 size of the prototype in a wind tunnel. Determine the speed of air required in wind tunnel and ratio of drag between prototype and model. The kinematic viscosities of seawater and air are 0.015 stokes and 0.012 stokes respectively. The densities of seawater and air are 1030 kg/m^3 and 1.25 kg/m^3 respectively. **(8)**

ii) Discuss the guidelines for the selection of repeating variable in the dimensional analysis method. **(5)**

14. a) Derive an expression for steady laminar flow in circular pipes and prove that the max. Velocity (U_{max})/mean velocity (V) = 2 and head loss between two sections is $32\mu VL(\rho g D^2)$, where μ is dynamic viscosity. Draw the necessary sketches. **(13)**

(OR)

b) i) Derive the Darcy-Weisbach equation for loss of head due to friction in turbulent flow through pipe. **(8)**

ii) A pipe of 5 cm diameter is carrying an oil of viscosity 0.8 stokes. If the Reynold's number of oil flow is 1800, find the velocity at radius 0.6 cm from the wall. **(5)**

15. a) Derive Von Karman momentum integral equation for bundary layer flows. **(13)**

(OR)

b) The velocity distribution in a boundary layer is given by $\frac{u}{U} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$.

Find the displacement, momentum and energy thicknesses. **(13)**

PART – C **(1×15=15 Marks)**

16. a) A reservoir 'A' of surface-level 60 m above datum supplies fluid to a junction box through a 300 mm dia pipe of 1500 m long. From the junction box two 300 mm dia pipes each of 1500 m long feed respectively into two reservoirs whose surface levels are 30m and 15m above datum. Find the quantity of fluid entering each reservoir. Take the coefficient of friction as 0.01 for all pipes.

(OR)

b) i) Cork has a volume of 4.25 cm^3. The density of cork is 207 kg/m^3.
(i) What volume of the cork is beneath the surface when the cork floats in water ? (ii) What downward force is needed to completely submerge the cork ? **(7)**

ii) A semi-circular 12 m diameter tunnel is to be built under a 45m deep lake shown in figure 16 b (ii) Determine the magnitude and direction of the hydrostatic force on the tunnel for unit length. **(8)**

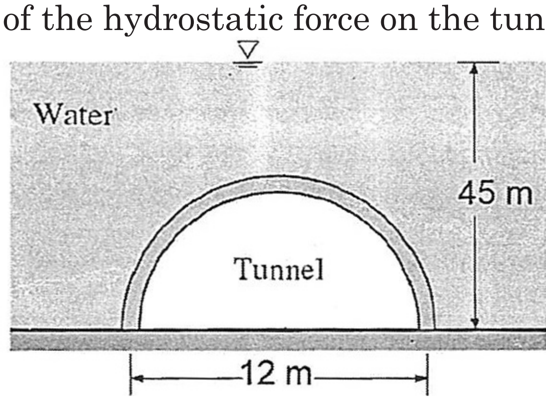

Fig. 16 (b) (ii)