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**Question Paper Code : 50327**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

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. What is total pressure (force) and center of pressure?
2. What is Newtonian fluid and give few examples.
3. Define Flow net.
4. Give an example for unsteady non uniform flow.
5. Distinguish between distorted and undistorted models.
6. Write the driving force of each non dimensional numbers.
7. What is an equivalent pipe system?
8. What do you mean by eddy loss and vena contracta in pipe flow?
9. What do you mean by boundary layer separation?
10. If a laminar boundary has a velocity distribution of $u/U = y/\delta$, find the displacement thickness.

PART B — (5 × 13 = 65 marks)

11. (a) The gates of a lock are 5 m wide and 5 m high and, when closed, include an angle of 120°. Each gate is held on two hinges, one placed at the top and the other at the bottom of the gate. If the water levels are 4.5 m and 3 m on the upstream and downstream sides respectively, determine the magnitude of the forces on the hinges due to the water pressure. (13)

Or

(b) (i) An Inverted 'U' tube is connected across two pipes A and B carrying fluids. Pipe B contains water and pipe A contains liquid of sp.gravity 1.1. The sp.gr of manometric liquid is 0.7. The liquid in pipe A rise upto 20 cm and in pipe B raises upto 35 cm. If the level difference between pipe A and pipe B is 10 cm, calculate the pressure difference between the pipes. (8)

(ii) Derive the equations to find the pressure inside the (1) Bubble, (2) Droplet and (3) 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) The velocity components in a two dimensional flow field for an incompressible fluid are expressed as

$$u = \frac{y^3}{3} + 2x - x^2y, v = xy^2 - 2y - \frac{x^3}{3}$$

(i) show that these functions represents a possible case of an irrotational flow, (4)

(ii) obtain an expression for the stream function and (5)

(iii) obtain an expression for the velocity potential. (4)

13. (a) Drag force F on a high speed air craft depends on the velocity of flight V, the characteristic geometrical dimension of the air craft L, the density $\rho$, viscosity $\mu$ and isentropic bulk modulus of elasticity $E_s$ of ambient air. Using Buckingham's $\pi$ theorem, find out the independent dimensionless quantities which describe the phenomenon of drag on the aircraft. (13)

Or

(b) (i) A model 1/10 of prototype of a flying boat is towed in freshwater. The prototype moving in a sea water of density 1030 kg/m$^3$ with a speed of 72km/hr. Find the corresponding speed of the model. Also find out the resistance due to waves on model if the wave resistance experienced by prototype is 750 N. (8)

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

14. (a) A pipe having a length of 8 km and diameter 0.70 m connects two reservoirs A and B, the difference between their water levels is 30 m. Halfway along the pipe there is a branch through which water can be supplied to a third reservoir C. Taking friction factor as 0.022 determine the rate of flow of reservoir B when (i) no water is discharged to reservoir C; (ii) the quantity of water discharged to reservoir C is 0.16 $m^3/s$. Neglect minor losses. (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 6 cm diameter is carrying an oil of viscosity 0.78 stokes. If the Reynold's number of oil flow is 1850, find the velocity at radius 0.65cm from the wall. (5)

15. (a) Derive an expression for displacement, momentum and energy thicknesses in boundary layer theory. (13)

Or

(b) A flat plate is 50 cm long and 100 cm wide. Air is flowing over the plate parallel to 50 cm side with a velocity of 5 m/s. Find (i) boundary layer thickness at the end of the plate, (ii) shear stress at 30 cm from the leading edge of the plate (iii) total drag force acting on the plate. Assume the velocity distribution in the boundary follows the law. $\frac{u}{U} = \sin\left(\frac{\pi}{2} - \frac{y}{\delta}\right)$. Take density as 1.25 $kg/m^3$ and kinematic viscosity as $15 \times 10^{-6} m^2/s$ for air. (13)

PART C — (1 × 15 = 15 marks)

16. (a) With the valve closed, water flows from tank A to tank B as shown in Figure 16(a) What is the flow rate into tank B when the valve is opened to allow water to flow into tank C also? Neglect all minor losses and assume that the friction factor is 0.02 for all pipes. Length of pipe AB is 120 m and 80 m from reservoir A, reservoir C is connected through a pipe of length 75 m. The diameters of each pipe are 0.1 m and elevations of reservoirs A, B and C are 15 m, 0 m and 0 m respectively. (15)

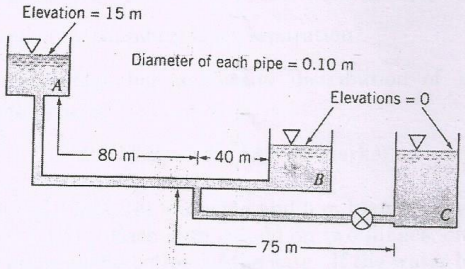


Figure 16(a)

Or

(b) A pipe is tapered in section is carrying full of water. The pipe diameters at the inlet and exit are 120 cm and 60 cm respectively. The water surface is 2 m above the centre of the inlet and exit is 3 m above the free surface of the water. The pressure at the exit is 26 cm of Hg vacuum. The friction loss between inlet and exit of the pipe is 1/10 of the velocity head at the exit. Determine the discharge passing through the pipe. (15)

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