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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Third Semester

Civil Engineering

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

(Regulation 2008/2010)

(Common to 10111 CE 305 – Mechanics of Fluids for B.E. (Part-Time) Third Semester – Civil Engineering – Regulation 2010)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed with proper justification.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Brief on bulk modulus.

2. Distinguish between vapour and gas.

3. State the significance of metacentric height.

4. Discuss on forced vortex motion.

5. Brief on Darcy friction factor.

6. What is meant by Euler's turbine formula?

7. Define - displacement thickness.

8. Brief on hydraulic gradient line.

9. What is meant by kinematic similarity?

10. Define - Cauchy Number.

11. (a) (i) Derive expressions for the pressure inside a droplet and a free jet. (6)

(ii) A small thin plane surface is pulled through the liquid filled space between two large horizontal planes in the parallel direction. Show that the force required will be minimum if the plate is located midway between the planes. (10)

Or

(b) (i) Derive the linear momentum equation using the control volume approach. (6)

(ii) Derive an expression for the torque required to overcome the viscous resistance when a circular shaft of diameter 'D' rotating at 'N' rpm in a bearing with the clearance 't' varying uniformly from 't_1' m at one end to 't_2' m at the other end. The distance between the ends is 'L' m. The oil has a viscosity of μ. (10)

12. (a) (i) Discuss on flow nets. (6)

(ii) A fish tank that contains 50 cm high water is moved in the cabin of an elevator. Determine the pressure at the bottom of the tank when the elevator is (1) stationary, (2) moving up with an upward acceleration of 3 m/s^2, and (3) moving down with a downward acceleration of 3 m/s^2. (10)

Or

(b) (i) Discuss on LDV. (6)

(ii) A retaining wall against a mud slide is to be constructed by placing 1-m-high and 0.2-m-wide rectangular concrete blocks (ρ = 2740 kg/m^3) side by side. The friction coefficient between the ground and the concrete blocks is 0.28, and the density of the mud is about 1850 kg/m^3. There is concern that the concrete blocks may slide or tip over the lower left edge as the mud level rises. Determine the mud height at which (1) the blocks will overcome friction and start sliding and (2) the blocks will tip over. (10)

13. (a) (i) Discuss on venturimeter. (6)

(ii) The velocity profile for turbulent flow in a circular pipe is $u(r) = u_{max}(1 - r/R)^{1/n}$ where n = 8. Estimate the kinetic energy correction factor for this flow. (10)

Or

(ii) A very large tank contains air at 102 kPa at a location where the atmospheric air is at 100 kPa and 20°C. Now a 2.2-cm-diameter tap is opened. Determine the maximum flow rate of air through the hole. What will happen if air is discharged through a 3-m-long. 4-cm-diameter tube with a 2-cm-diameter nozzle? Solve the problem if the pressure in the storage tank was 300 kPa? (10)

14. (a) (i) Discuss on minor losses. (6)

(ii) Liquid ammonia at −25°C is flowing through a 25-m long section of a 6-mm-diameter copper tube at a rate of 0.2 kg/s. Determine the pressure drop, the head loss, and the pumping power required to overcome the frictional losses in the tube. (10)

Or

(b) (i) Discuss on the boundary layer concept. (6)

(ii) A pipeline of diameter 0.6 m is 10 km long. To increase the discharge another line of same diameter is introduced parallel to the first pipe in the second half of the length. Neglecting minor losses, calculate the increase in flow rate if the head at inlet is 600 mm and the frictional factor is 0.03. (10)

15. (a) (i) Explain the significance of Buckingham pi theorem. (6)

(ii) The volume flow rate of a gas through a sharp edged orifice is found to be influenced by the pressure drop, orifice diameter and density and kinematic viscosity of the gas. Using the method of dimensional analysis obtain an expression for the flow rate. (10)

Or

(b) (i) Discuss on Rayleigh's method. (6)

(ii) The power developed by hydraulic machines is found to depend on the head H, flow rate Q, density ρ, speed N, runner diameter D, and acceleration due to gravity, g. Obtain suitable dimensionless parameters to correlate experimental results. (10)

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