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10ME/IP/IM/MA/AU/PM/TL/AE36B

Third Semester B.E. Degree Examination, December 2011
Fluid Mechanics

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting
at least TWO questions from each part.**

PART – A

- 1 a. Differentiate between :
 - i) Weight density and mass density ii) Compressibility and bulk modulus. (06 Marks)
- b. The space between the two square flat parallel plates is filled with oil. Each side of the plate is 720mm. The thickness of the oil film is 15mm. The upper plate moves at 3m/s requires a force 120N to maintain the speed. Determine i) dynamic viscosity of the oil ii) kinematic viscosity of oil, if the specific gravity of oil is 0.95. (07 Marks)
- c. Calculate the capillary effect in millimeters in a glass tube of 4mm diameter, when immersed in i) water and ii) mercury. The values of surface tension of water and mercury at 20°C in contact with air are 0.0735 N/m and 0.51 N/m respectively. The specific weight of water at 20°C is equal to 9790 N/m³. (07 Marks)

- 2 a. A U-tube manometer containing mercury was used to find the negative pressure in the pipe, containing water. The right limb was open to the atmosphere. Find the vacuum pressure in the pipe, if the difference of mercury level in the two limbs was 100mm and height of water in the left limb from the centre of the pipe was found to be 40mm below. Sketch the manometer with details. (07 Marks)
- b. Derive an expression for the total pressure force and depth of centre of pressure for an inclined surface submerges in water. (08 Marks)
- c. A trapezoidal channel 2m wide at the bottom and 1m deep has side slopes 1:1. Determine
 - i) Total pressure ii) Centre of pressure on the vertical gate closing the channel when it is full of water. (05 Marks)

- 3 a. Derive the continuity equation in the three dimensions in the differential form and write the same for a steady incompressible flow. (08 Marks)
- b. Define the metacentre of floating body. Describe the analytical method of determining the metacentric height. (08 Marks)
- c. A wooden cylinder of circular section and uniform density, specific gravity 0.6 is required to float in an oil of specific gravity 0.8. If the diameter of the cylinder is 'd' and its length 'l'. Show that l cannot exceed 0.817d for cylinder to float with its longitudinal axis vertical. (04 Marks)

- 4 a. Derive the Euler's equation of motion for a steady flow and deduce the Bernoulli's equation of motion. Mention the assumptions made. (10 Marks)
- b. The water is flowing through a tapering pipe having diameter 300mm and 150mm at section 1 and 2 respectively. The discharge through the pipe is 40 litres/sec. The section 1 is 10m above datum and section 2 is 6m above datum. Find the intensity of pressure at the section 2, if that at section 1 is 400 kN/m². (08 Marks)
- c. Discuss the Bernoulli's equation for real fluid. (02 Marks)

PART – B

- 5 a. The efficiency η of a fan depends on the density ' ρ ', dynamic viscosity μ of the fluid angular velocity ω , diameter D of the rotor and the discharge Q . Using the Buckingham's ' π ' theorem express ' η ' in terms of dimensionless parameters. (10 Marks)
- b. With a sketch, derive an expression for the discharge through an inclined venturimeter for an upward flow. (10 Marks)
- 6 a. Derive the Darcy-Weisbach equation. Derive it to the Chezy's equation. (10 Marks)
- b. Water is to be supplied to the inhabitants of a college campus through a supply main. The following data is given:
Distance of the reservoir from the campus = 3000 m
Number of inhabitants = 4000
Consumption of water per day of each inhabitant = 180 litres.
Loss of head due to friction = 18m
Coefficient of friction for the pipe, $f = 0.007$
If half of the daily supply is pumped in 8 hours, determine the size of the supply main. (08 Marks)
- c. Define hydraulic gradient and total energy line. (02 Marks)
- 7 a. What is the Hagen-Poiseuille's formula? Derive the expression for the same. (08 Marks)
- b. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and length of 10m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of the oil is collected in a tank in 30 seconds. Assume laminar flow. (08 Marks)
- c. Write any two characteristics of laminar flow. (04 Marks)
- 8 a. Derive an expression for displacement thickness and momentum thickness of a flow over a plate. (10 Marks)
- b. A flat plate $1.5\text{m} \times 1.5\text{m}$ moves at 50km/hour in the stationary air of density 1.15 kg/m^3 . If the coefficient of drag and lift are 0.15 and 0.75 respectively, determine
i) the lift force ii) the drag force iii) the resultant force. (10 Marks)

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