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10ME46B/10AU46B

Fourth Semester B.E. Degree Examination, June/July 2015
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following terms and mention their SI units:
   i) Weight density
   ii) Specific gravity
   iii) Absolute viscosity
   iv) Capillarity. **(08 Marks)**

b. Whether viscosity of fluids varies with temperature? If yes, give reason. **(04 Marks)**

c. The velocity distribution of flow over a plate is parabolic with vertex 30cm from the plane, where the velocity is 180 cm/s. If the viscosity of the fluid of 0.9 N-s/m^2 find the velocity gradient and shear stresses at distances of 0, 15 cm and 30cm from the plane. **(08 Marks)**

2 a. Obtain the total pressure and the centre of pressure on an inclined plane surface immersed in a fluid. **(10 Marks)**

b. Establish a relationship among absolute, gauge and atmospheric pressure with a sketch. **(04 Marks)**

c. Two bulbs B and C of equal dimensions and connected with an inverted U-tube with vertical limbs. The bulbs B and C contain water and the monometric liquid is oil of S.G.0.8. The centre of the bulb B is 25 cm above the center of bulb C. The surface of separation of water and oil in the left limb of U-tube to which B is fixed is at a height of 20cm from the centre of bulb B and the surface separation of water and oil in the right limb to which C is fixed is at 50cm from the center of bulb C. Find the pressure difference between B and C. Sketch the arrangements. **(06 Marks)**

3 a. Define the following with example:
   i) Rotational flow
   ii) Irrotational flow
   iii) Laminar flow
   iv) Turbulent flow
   v) Non-uniform flow. **(10 Marks)**

b. A wooden block of specific gravity 0.75 floats in water. If the size of the block is 1m × 0.5m × 0.4m. Find its metacentric height. **(10 Marks)**

4 a. Derive an expression for Bernoulli's equation from the first principles and also mention the assumptions made. **(10 Marks)**

b. A pipe line is carrying an oil of specific gravity 0.87, the diameter of the pipe changes from 200 mm at section A to 500 mm at section B which is 4 m higher than A. If the pressure at A and B is 100 kPa and 60 kPa respectively and if the discharge is 200 kg/sec. Determine: i) Loss of head ii) Flow direction. **(10 Marks)**

PART – B

5 a. Derive an expression for discharge through orifice meter. **(10 Marks)**

b. The pressure difference ΔP in a pipe of diameter D and length ℓ due to turbulent flow depends on the velocity V. Viscosity μ. Density ρ and surface roughness K. Using Buckingham's π-theorem. Obtain an expression for ΔP. **(10 Marks)**

6 a. Derive Darcy's equation for head losses due to friction in a circular pipe. **(10 Marks)**

b. The diameter of a horizontal pipe which is 300mm is suddenly enlarged to 600 mm. The rate of flow of water through this pipe is 0.4 m^3/s. If the intensity of pressure in the smaller pipe is 125 kPa. Determine:

i) Loss of head, due to sudden enlargement
ii) Intensity of pressure in the larger pipe and
iii) Power lost due to enlargement. **(10 Marks)**

7 a. Derive Hagen-Poiseuille equation for viscous flow through a circular pipe. **(10 Marks)**

b. A pipe 240 in diameter and 10km long is laid at a slope of 1 in 80. An oil of specific gravity 0.85 and absolute viscosity 1.5 poise is pumped up at the rate of 20 LPS. Find the head lost due to friction and the power required to pump the oil. **(10 Marks)**

8 a. Define the following:

i) Drag
ii) Lift
iii) Momentum thickness
iv) Mach number
v) Mach cone. **(10 Marks)**

b. On a flat plate of 2m length and 1m width, experiments were conducted in a wind tunnel with a wind speed of 50 km/h, the plate is kept at such an angle that the coefficient of drag and lift are 0.18 and 0.9 respectively. Determine:

i) Drag force
ii) Lift force
iii) Resultant force
iv) Power exerted by the air stream on the plate

Take density of air = 1.15 kg/m^3. **(10 Marks)**

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