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10ME/AU46B

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
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 Fluid, Bringham plastic fluid and Newtonian fluid. Show the variation of Bringham fluid and Newtonian Fluid on Shear Stress – Strain Rate diagram. **(06 Marks)**

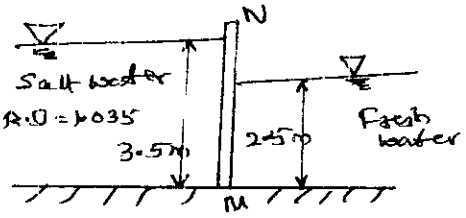
b. A 90N rectangular solid block slides down a 30^0 inclined plane. The plane is lubricated by 3mm thick film of oil of relative density 0.9 and viscosity 8 poise. If the contact area is $0.3m^2$, estimate the terminal velocity of the block. **(06 Marks)**

c. Derive an expression for bulk modulus of elasticity for gas undergoing compression by i) Isothermal process ii) Adiabatic process. **(08 Marks)**

2 a. For an inclined plane surface, submerged in liquid, show that the centre of pressure lies below the centre of gravity of the plane surface. **(08 Marks)**

b. A sheet piling holds fresh water and salt water (Relative Density = 1.035) on either side of it as shown in Q2(b). Find the moment about the base 'M' of the resultant force per unit length of piling. **(08 Marks)**

Fig.Q2(b)



c. State Hydrostatic law and Pascal's law. **(04 Marks)**

3 a. A wooden block in the form of rectangular prism floats with its shortest axis vertical. The block is 40cm long, 20 cm wide and 15cm deep with a depth of immersion of 12cm. Calculate the meta centre position and comment on the stability of the block. **(10 Marks)**

b. Verify whether the potential function $\phi = m\,\ell n(x)$ is valid or not. **(04 Marks)**

c. A flow is described by the stream function $\upsilon = 2\sqrt{3}\,(xy)$. Locate the point at which the velocity vector has a magnitude of 4 units and makes an angle of 150^0 with the X – axis. **(06 Marks)**

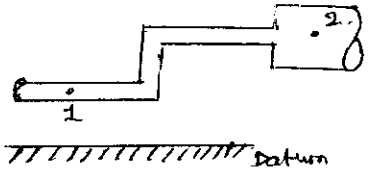
4 a. Stating the assumptions, derive an expression for Euler's equation of motion. **(06 Marks)**

b. For the pipe flow system shown in fig. Q4(b), the following data are available : **(08 Marks)**

Parameter	Point 1	Point 2
Diameter	20 cm	30 cm
Elevation	103m	106m
Pressure	55kPa	75kPa
Velocity	2.5M/s	---

Determine the direction of flow and the loss of energy between these two points.

Fig.Q4(b)



c. A conical tube of length 2.0m is fixed vertically with its smaller end upwards. The velocity of flow at smaller end is 5 m/s while at the lower end is 2m/s. Pressure head at the smaller end is 2.5m of the liquid. The loss of head in the tube is $0.35\frac{(V_1^2 - V_2^2)}{2g}$, where V_1 and V_2 are velocity of flow at smaller and larger end respectively. Determine the pressure head at the lower end. Flow occurs from smaller end to larger end. **(06 Marks)**

PART - B

5 a. Show that the theoretical discharge through the triangular notch is given by $\theta = \frac{8}{15}\tan\left(\frac{\theta}{2}\right)\sqrt{2g}\ H^{5/2}$. **(10 Marks)**

b. The pressure difference Δp in a pipe of diameter 'D' and length 'l' due to viscous flow depends on the velocity 'V', viscosity 'μ' and density 'ρ'. Using Buckingham's π – theorem, obtain an expression for ΔP. **(10 Marks)**

6 a. For a flow through pipe, derive Darcy – Weisbach equation. **(08 Marks)**

b. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4fLV^2}{2gd}$. See the sketch Q6(b). **(08 Marks)**

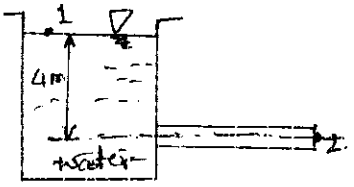


Fig.Q6(b)

c. Define and write expression for Hydraulic gradient line and Total Energy Line. **(04 Marks)**

7 a. For laminar flow between the stationary parallel plates. Obtain an expression for velocity distribution. **(10 Marks)**

b. The flow of liquid in a circular pipe is laminar. At what radial distance from the wall of the pipe, the local velocity is half of the maximum velocity, if the diameter of the pipe is 50mm. **(06 Marks)**

c. There are two pipes A and B. Diameter of the pipe B is half of diameter of pipe A. Both pipes have same length and same fluid flows through each pipe. If volumetric flow rate is maintained same in both the pipes, compare the loss of head. Assume flow to be laminar. **(04 Marks)**

8 a. Define i) Boundary layer ii) Displacement thickness iii) Momentum thickness and iv) Energy thickness. **(08 Marks)**

b. Find the displacement thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. **(04 Marks)**

c. Define Mach number. With neat sketches, explain the propagation of disturbance for M = 1 and M > 1. **(08 Marks)**

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