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10MEB306/10AUB306

Third Semester B.E. Degree Examination, June/July 2018
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. 3.6 m^3 of certain liquid weighs 24.72 kN. Calculate (i) Specific weight (ii) Mass Density (iii) Specific volume (iv) Specific gravity (v) Dynamic viscosity in centipoise if kinematic viscosity is 7.8 stokes. (vi) The rise of liquid height in a tube of diameter 10 mm, taking surface tension, 0.0625 N/m and angle of contact, 20° with respect to glass tube. **(08 Marks)**

b. Obtain an expression for intensity of pressure due to surface tension in (i) Liquid Droplet (ii) Hollow Bubble (iii) Liquid Jet. **(06 Marks)**

c. Explain the phenomenon of cavitation and its effects. **(06 Marks)**

2 a. State and prove the Hydrostatic law. An open tank contains three immiscible liquids for the depths of 1m, 1.5m and 2m as shown in Fig.Q2(a). Determine the value of pressures at the interface points A and B and pressure at point C. **(10 Marks)**

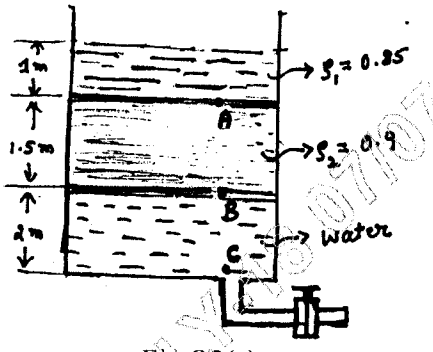

Fig.Q2(a)

b. Define Centre of pressure and Total pressure. Obtain an expression for centre pressure and Total pressure for the vertical surface immersed in a liquid. **(10 Marks)**

3 a. Define the following : (i) Buoyancy and centre of Buoyancy
(ii) Metacentre and Metacentric Height
A rectangular pontoon is 5 m long, 3 m wide and 1.2 m high. The depth of immersion of the Pontoon is 0.80 m in sea water. If the centre of gravity is 0.6 m above the bottom of the pontoon, determine the metacentric height. Take 'ρ' for sea water at 1025 kg/m^3. **(10 Marks)**

b. Define velocity potential function and stream function. The stream function for a two-dimensional flow is given by $\psi = 2xy$. Calculate the velocity at the point P(2, 3). Find the velocity potential function 'ϕ' equation. **(10 Marks)**

4 a. Derive the Bernoulli's equation of motion and state its assumptions. **(10 Marks)**

b. What do you understand by Bernoulli's equation for Real fluids? A pipe of diameter 350mm at one end is varying with a slope of 1 in 30 for a length of 150 m. The diameter at the other end is 200 mm. Calculate (i) intensity of pressure at the smaller end if the pressure at the bigger end is 40.5 N/cm^2. (ii) Determine the Head loss and direction of flow if the pressure at the smaller end is 28.5 N/cm^2. Take discharge through the pipe as 40 litres/s. **(10 Marks)**

PART – B

5 a. What is venturimeter? Obtain an expression for the rate of flow through venturimeter. **(10 Marks)**

b. What do you mean by Dimensional Homogeneity? The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express the efficiency η in terms of dimensionless parameters using Buckingham π - theorem. **(10 Marks)**

6 a. How the loss of energy in pipes is classified? **(04 Marks)**

b. Obtain the Chezy's equation for the loss of Head through pipes. **(06 Marks)**

c. Define Hydraulic Gradient-line and Total energy line. Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m. When one end of the pipe is open to the atmosphere. The pipe is horizontal and Height of water in tank is 4 m above the centre of the pipe. Take f = 0.009. **(10 Marks)**

7 a. Obtain an expression for shear stress distribution and velocity distribution for the flow of viscous fluid in a pipe. **(08 Marks)**

b. Prove that $\frac{\partial p}{\partial x} = \frac{\partial \tau}{\partial y}$ for the viscous flow between the two parallel plates. **(06 Marks)**

c. What power is required per km of a line to overcome the viscous resistance to the flow of glycerine through a horizontal pipe of 200 mm at the rate of 15 litres/s. Take μ = 8.5 poise and kinematic viscosity, ν = 6.5 stokes. **(06 Marks)**

8 a. Obtain an expression for Drag force and lift force for the flow post over the solid body. **(07 Marks)**

b. Explain the formation of a Boundary layer for the flow over a plate having free stream velocity. **(05 Marks)**

c. What is a Mach number and how is it important as a non-dimensional parameter. A projectile travels in air of pressure 10.1043 N/cm^2 at 10°C at a speed of 1500 km/hr. Find the Mach number and Mach angle. Take K = 1.4, R = 287 J/kgK. **(08 Marks)**

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