CBCS SCHEME

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15AU42

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019

Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define following: i) Density ii) Specific gravity iii) Viscosity iv) Surface tension **(04 Marks)**

b. Discuss effect of variation temperature on viscosity of liquid and gases. **(04 Marks)**

c. The dynamic viscosity of oil, used for lubrication between shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in bearing for sleeve length of 90 mm. The thickness of oil film is 1.5 mm. **(06 Marks)**

d. Define total pressure and centre of pressure. **(02 Marks)**

OR

2 a. State and prove Pascal's law. **(04 Marks)**

b. An inverted differential manometer is connected to two pipes A and B as shown in Fig.Q2(b), which conveys water. The fluid in manometer is oil of specific gravity 0.8. For manometric readings shown in figure, find the pressure difference between A and B. **(04 Marks)**

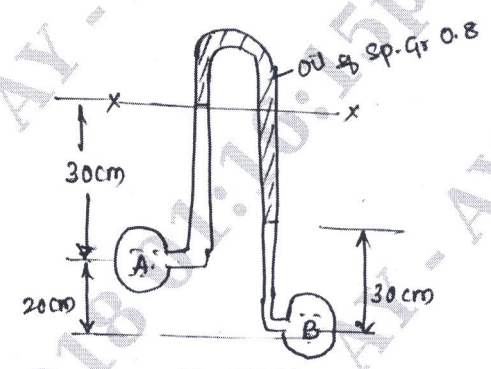

Fig.Q2(b)

c. A cylindrical gate of 4m diameter of 2m long has water on its both sides as shown in Fig.Q2(c). Determine magnitude, and direction of resultant force exerted by water on gate. Also find least weight of the cylinder so that it may not be lifted away for floor. **(08 Marks)**

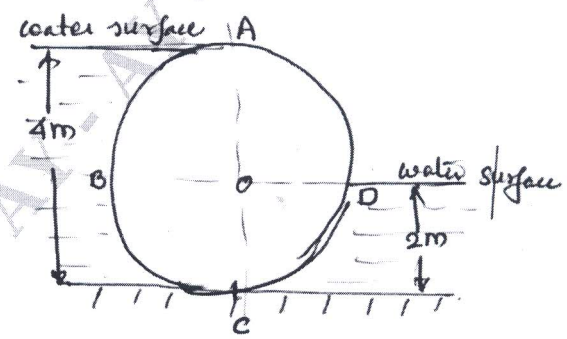

Fig.Q2(c)

Module-2

3 a. Discuss conditions for equilibrium of submerged and floating bodies in fluid. **(04 Marks)**

b. Derive equation for meta centric height of floating body by experimental method. **(04 Marks)**

c. A wooden cylinder of specific gravity 0.6 and circular in cross section is required to float in oil of sp.gr. 0.90. Find L/D ratio for the cylinder to float with its longitudinal axis vertical in oil where L is height of cylinder and D is its diameter. **(08 Marks)**

OR

4 a. Define following: i) Steady and unsteady flow
ii) Uniform and non uniform flow
iii) Compressible and incompressible flow **(06 Marks)**

b. In two dimensional incompressible flow, the velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form. Find also the stream function. **(10 Marks)**

Module-3

5 a. Derive Euler's equation of motion for ideal fluids and hence deduce Bernoulli's equation of motion. Also mention assumptions made. **(06 Marks)**

b. A pipe line carrying oil of specific gravity 0.87 changes in direction from 200 mm diameter at position A to 500 mm diameter at a position B, which is 4m at a higher level. If pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and discharge is 200 lit/sec, determine loss of head and direction of flow. **(10 Marks)**

OR

6 a. Find the discharge of water flowing through a pipe 30 cm diameter placed in an inclined position where a venturimeter is inserted, having a throat diameter of 15 cm. Difference in pressure between main and throat is measured by a liquid of specific gravity 0.6 in an inverted U tube which gives reading of 30 cm. The loss of head between main and throat is 0.2 times the kinetic head of the pipe. **(10 Marks)**

b. Water flows over a rectangular weir 1m wide at a depth of 150 mm and afterwards passes through right angled weir. Take C_d for rectangular and triangular weir as 0.62 and 0.59 respectively. Find depth over the triangular weir. **(06 Marks)**

Module-4

7 a. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. Prove this by Buckingham's π theorem. **(10 Marks)**

b. Explain geometric, kinematic and dynamic similarity between model and prototype. **(06 Marks)**

OR

8 a. Derive Darcy's equation for head loss due to friction. **(06 Marks)**

b. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into atmosphere at other end. For first 25 m its length from tank the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in tank is 8 meter above the centre of the pipe. Considering all losses of head which occurs, determine the rate of flow. Take f = 0.01 for both sections of pipe. **(10 Marks)**

Module-5

9 a. An oil of viscosity 0.1 NS/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and length 300 meter. The rate of flow of fluid through pipe is 3.5 liters/sec. Find the pressure drop in length of 300 meters and also the shear stress at the pipe wall. **(06 Marks)**

b. Define: (i) Displacement thickness
(ii) Momentum thickness
(iii) Energy thickness **(03 Marks)**

c. Find the displacement thickness, the momentum thickness and energy thickness for velocity distribution in boundary layer is given by $\frac{U}{u} = \frac{y}{\delta}$ where u is the velocity at a distance of y from plate and u = U at y = δ where δ = boundary layer thickness. **(07 Marks)**

OR

10 a. Experiments were conducted in a wind tunnel with a wind speed of 50 kmph n flat plate of size 2m long and 1 meter wide. The density of air is 1.15 kg/m^3. The coefficient of lift and drag are 0.75 and 0.15 respectively. Determine:
(i) The lift force
(ii) The drag force
(iii) The resultant force
(iv) Direction of resultant force
(v) Power exerted by air on plate. **(10 Marks)**

b. Classify fluid flow on the basis of mach number. **(03 Marks)**

c. An aeroplane is flying at an height of 15 km where temperature is –50°C. The speed of plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg°K, find speed of plane. **(03 Marks)**

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