CBCS SCHEME

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18AU42

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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 v) Total pressure. **(10 Marks)**

b. The dynamic viscosity of oil, used for lubrication between shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190 rpm. Calculate the power lost in bearing for sleeve length of 90mm. The thickness of oil film is 1.5mm. **(10 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 monometer is oil of specific gravity 0.8. For monometric readings shown in figure, fluid the pressure difference between A and B.

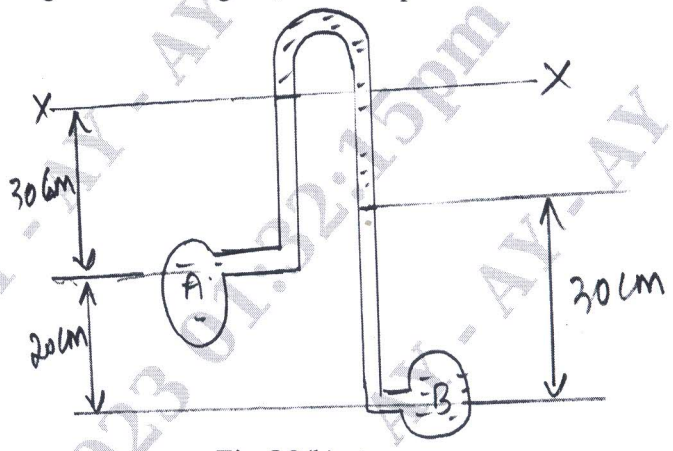

Fig Q2(b) **(06 Marks)**

c. A cylinder gate of 4m diameter of 2m long has water on it's 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.

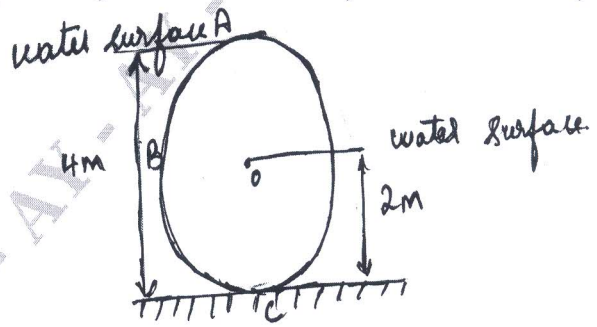

Fig Q2(c) **(10 Marks)**

Module-2

3 a. Derive an equation for meta-centric height of floating body by experimental method. **(10 Marks)**

b. A wooden cylinder of specific gravity 0.6 and circular in cross section is required to float in oil of specific gravity 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. **(10 Marks)**

OR

4 a. Define the following :
i) Steady and unsteady flow
ii) Uniform and non-uniform flow
iii) Compressible and incompressible flow
iv) Laminar and turbulence flow **(10 Marks)**

b. In two dimensional in compressible 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 equations of motion for ideal fluids and hence deduce Bernoulli's equation of motion. Also mention assumptions made. **(10 Marks)**

b. A pipe line carrying oil of specific gravity 0.8f changes in direction from 200mm diameter at position A to 500mm 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 200litre/sec, determine loss of head and direction of flow. **(10 Marks)**

OR

6 a. Find the discharge of water flowing through a pipe 30cm diameter placed in an inclined position where a venturmeter is inserted, having throat diameter of 15cm. 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 30cm. 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 150mm 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. **(10 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. **(10 Marks)**

OR

8 a. Give Darey's equation for head loss due to friction. **(10 Marks)**

b. A horizontal pipe line 40m long is connected to a water tank at one end and discharge freely into atmosphere at other end. For first 25m its length from tank the pipe is 150mm diameter and its diameters is suddenly enlarged to 300mm. The height of water level in tank is 8m 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 0.1Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50mm and length 300m. The rate of flow of fluid through pipe is 3.5 lit/sec. Find the pressure drop in length of 300m and also the shear stress at the pipe wall. **(10 Marks)**

b. Find the displacement thickness, the momentum thickness and energy thickness for velocity distribution in boundary layer is given by $\frac{V}{u} = \frac{y}{\delta}$ where u is the velocity at a distance of y from plate and u = U at y = δ where δ = boundary layer thickness. **(10 Marks)**

OR

10 a. Experiments were conducted in a wind tunnel with a wind speed of 150kmph and flat plate of size 2m long and 1m wide. The density of air is 1.15Kg/m^3. The co-efficient of lift and drag are 0.75 ad 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. Define Mach number. Classify fluid flow on the basis of mach number. **(10 Marks)**

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