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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Civil Engineering **Duration: 3 hrs.**
Course Code: 22CV3PCFME **Max Marks: 100**
Course: Fluid Mechanics

Instructions:

1. **Answer 5 full questions choosing one full question from Units 1 and 4**
2. **Answer all parts of the questions together**
3. **Assume missing data suitably**

UNIT - I

1 a) Following data corresponds to a fluid. Check whether the fluid is Newtonian or Non- Newtonian. If it is a Newtonian, determine the dynamic viscosity. **06**

Shear Stress N/m^2	2	4	6	8	10	12	14	16	18
Velocity Gradient, s^{-1}	1	2	3	4	5	6	7	8	9

b) The velocity distribution over a plate is given by $V= (y/2) –y^2$ in which V is the velocity in m/s at a distance y meters above the plate. Determine the shear stress at $y = 0$ and $y = 0.1$ m. Take $\mu = 0.835$ N-s/m^2. **06**

c) A 100 N rectangular block slides down an inclined plane of 40^o. The plane is lubricated by a 2 mm thick film of oil of relative density 0.90 and viscosity 8.0 Poise. If the contact area is 0.3 m^2, estimate the terminal velocity of the block. **08**

OR

2 a) The left limb of a U-tube Mercury manometer is connected to a pipe line conveying water, the level of Mercury in the left limb being 0.65 m below the centre of the pipeline and the right limb is open to atmosphere. The level of Mercury in the right limb is 0.45 m above that in the left limb and the space above Mercury in the right limb contains Benzene (sp.gr. = 0.80) to a height of 0.3 m. Determine the pressure in the pipe. **08**

b) Prove that the pressure varies only in the vertical direction in a static mass of fluid. **06**

c) Hydraulic jacks are used to raise vehicles. State the principle on which the jack works. **06**

UNIT - II

3 a) A circular plate of 3 m diameter is immersed in water in such a way that it's maximum and minimum depths of immersion below the free surface of water are 4 m and 1.5 m respectively. Determine the total pressure on the plate and the position of the centre of pressure. **06**

b) A rectangular gate 5 m x 3 m is hinged at its base and inclined at 50° to the horizontal as shown in the Fig.1. To keep the gate in stable position, a counter weight of 60 kN is attached at the upper end of the gate. Determine the depth of water at which the gate begins to fall. Neglect the weight of the gate and the friction at the pulley and hinge. **08**

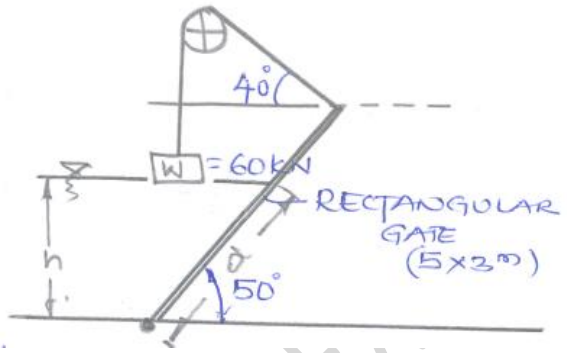

Fig.1

c) Derive an equation for the centre of pressure acting on an inclined lamina. **06**

UNIT - III

4 a) Derive the equation of continuity for a steady incompressible fluid flow in three dimensional Cartesian coordinates. **07**

b) In a two dimensional incompressible flow the fluid velocity components are given by $u= x-4y$ and $v= (-y-4x)$. Show that the velocity potential exists and determine its form. **08**

c) Differentiate between local acceleration and convective acceleration. **05**

UNIT - IV

5 a) A jet of water issues from a sharp edged vertical orifice under a constant head of 0.51 m. At a certain point of issuing jet, the horizontal and vertical coordinates measured from the vena-contracta are 0.406 m and 0.085 m respectively. If the coefficient of discharge for the orifice is 0.62, determine the coefficient of velocity and coefficient of contraction. **05**

b) A rectangular weir 6 m long is divided into 3 bays by two vertical posts each 0.3 m wide. Determine the discharge when the head is 0.45 m. Assume coefficient of discharge as 0.7. **07**

c) For a triangular weir, show that the discharge varies with $H^{5/2}$ where H is the head causing the flow. **08**

OR

6 a) In a 100 mm diameter horizontal pipe, a venturimeter 100 mm x 50 mm has been fixed. The pressure at inlet is 175 kPa and pressure at the throat is 20 cm of Mercury vacuum. Calculate the discharge of water assuming that 4% of the differential head is lost between the inlet and throat. Find the value of the C_d for the venturimeter. **08**

b) A pipe 300 m long has a slope of 1 in 100, tapers from 1.2 m diameter at the high end to 0.6 m at the low end. Quantity of water flowing is 5500 litres/minute. If the pressure at the high end is 70 kPa, determine the pressure at the low end, neglecting the losses. **06**

c) While conducting a flow measurement using a rectangular notch, an error of 20% in head over the notch has occurred. If length of the notch is 40 cm and discharge is 220 lit/s, determine the percentage error in discharge. Take $C_d = 0.60$ **06**

UNIT - V

7 a) A 6 cm diameter pipe has a discharge of 450 lit/min. At a section, the pipe has a sudden expansion to a size of 9 cm diameter. If the pressure just upstream of the expansion is 20 kN/m^2, calculate the pressure just after expansion. Assume the pipe is horizontal at the expansion region. **06**

b) Two pipes each of length L and diameters D_1 and D_2 are arranged in parallel, the loss of head when the total quantity of water Q flows through them being h_1. If the pipes are arranged in series and the same quantity of water Q flows through them, the loss of heads is h_2. If $D_1 = 2D_2$, find the ratio of h_1 to h_2. Neglect minor losses and assume the friction factor f to be constant and to have the same value for both the pipes. **08**

c) Two pipes 1 and 2 each of 10 cm diameter branch off from a point A in a pipe line and re-join at B. Pipe 1 is 400 m long and pipe 2 is 600 m long. The total head at A is 30 m. A short pipe 8 cm diameter is fitted at B and the flow is discharged into atmosphere through it. Assuming Darcy's friction factor $f = 0.02$ for both pipes, determine the total discharge in pipes 1 and 2. **06**

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