Total No. of printed pages = 4

CE 181303

Roll No. of candidate | | | | | | | | | | |

25/2 | 2021

BINA CHOWDHURY CENTRAL LIBRARY
(MIT & IPS)
Agartala, Tripura

B.Tech. 3rd Semester End-Term Examination

CE

FLUID MECHANICS

(New Regulation and New Syllabus)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. (a) Define the following terms:

Surface tension, Ideal Plastic fluid, steady flow, Laminar flow

(b) Differentiate between any two of the following:

(i) Path-line and Streak- line

(ii) Free vortex Flow and Forced vortex Flow

(iii) Pitot tube and Pitot static tube

(c) Choose the correct answer :

(i) If the velocity potential of a fluid flow satisfies the Laplace equation, the flow is

(a) steady and uniform
(b) steady and rotational
(c) uniform, incompressible and irrotational
(d) steady, incompressible and irrotational

(ii) For a floating body, the buoyant force passes through the

(a) C.G of the body
(b) C.G of the submerged part of the body
(c) Metacentre of the body
(d) Centroid of the liquid displaced by the body

[Turn over

(iii) The pressure variation along the radial direction for vortex flow along a horizontal plane is given as

(a) $\frac{\partial p}{\partial r} = -p\frac{V^2}{r}$ (b) $\frac{\partial p}{\partial r} = p\frac{V^2}{r}$

(c) $\frac{\partial p}{\partial r} = p\frac{V}{r}$ (d) none of the above

(iv) Continuity equation deals with the law of conservation of

(a) mass (b) momentum

(c) energy (d) Velocity

(v) Hydrostatic law of pressure is given as

(a) $\frac{\partial p}{\partial z} = \rho g$ (b) $\frac{\partial p}{\partial z} = 0$

(c) $\frac{\partial p}{\partial z} = z$ (d) $\frac{\partial p}{\partial z} = constant$

(vi) Stroke is the unit of

(a) surface tension (b) kinematic gradient

(c) viscosity (d) pressure gradient

2. (a) Each gate of a lock 6 m high and 2 m wide is supported on one side by hinges situated 0.6 m from the top and bottom (Figure – I). The angle between the gates when closed is 140°. If the depths of water on the two sides are 5 m and 1.5 m respectively, find - (10)

(i) the magnitude of the resultant pressure on each gate

(ii) the magnitude of the reaction between the two gates

(iii) the magnitude of the hinge reaction

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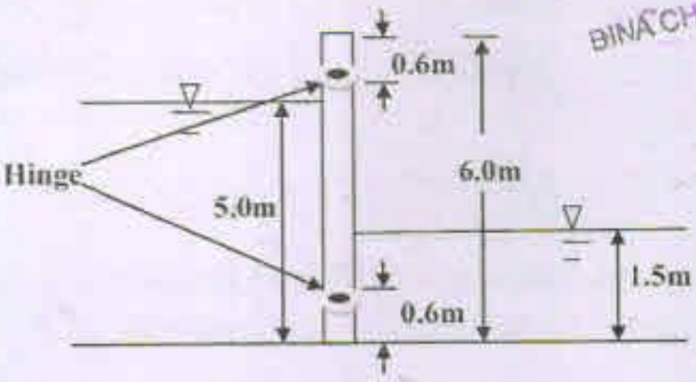

Figure – I

(b) A convergent- divergent mouthpiece having throat diameter of 4.0 cm is discharging water under a constant head of 2.0 m determine the maximum outer diameter for maximum discharge. Find the maximum discharge also. (5)

3. (a) For the system shown in Figure-III, calculate the air pressure shown by the Gauge- A in kPa, if the pressure at the bottom of the water (at B) is one third of the pressure at the bottom of the mercury (at C). (6)

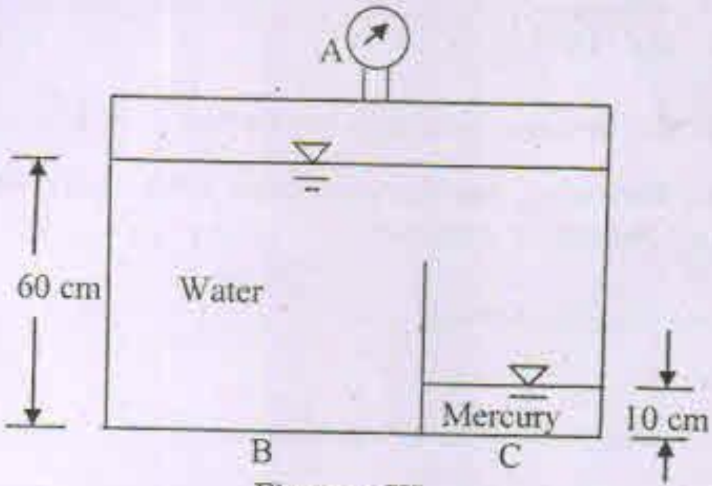

Figure – III

(b) What is Cipolletti weir? Mention the advantages of triangular notch over rectangular notch. Prove that the discharge through Cipolletti weir is given by (2+2+5 = 9)

$$Q = \frac{2}{3} C_d L \sqrt{2g} H^{\frac{3}{2}}$$

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4. (a) Show that the equation of a stream line passing through the point (a, 0) in a 2-D flow described by $u = \frac{-y}{b^2}$, $v = \frac{x}{a^2}$ is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. (8)

(b) A cylindrical vessel closed at the top and bottom, contains water up to a height of 80 cm. The diameter of the vessel is 20 cm and the length of the vessel is 120 cm. The vessel is rotated at a speed of 400 r.p.m about its vertical axis. Find the height of the paraboloid formed. (7)

5. (a) Derive the expression for head loss (h_f) in a pipe of length L and of diameter D is, $h_j = \frac{fLV^2}{2gD}$, where f = friction factor of the pipe and V is the mean velocity of flow. (9)

(b) A hemispherical tank of diameter 4m contains water up to a height of 1.5m. An orifice of diameter 50 mm is provided at the bottom. Find the time required by water (i) to fall from 1.5 m to 1.0 m (ii) for completely emptying the tank. Take C_d for the orifice = 0.62. (6)

6. (a) A small sphere of density ρs and diameter D settles at a terminal velocity V in a liquid of density ρ_f and dynamic viscosity μ. using Buckingham's π- theorem, show that- (11)

$$\frac{V}{gD} = f\left[\frac{\rho_S}{\rho_r}, \frac{\mu}{\rho_f D\sqrt{gD}}\right]$$

where 'g' is the acceleration due to gravity.

(b) Define the following terms and also find their expressions – Reynold's number and Froude' s number (4)

7. Write short notes on (any *three*) $(3 \times 5 = 15)$

(a) Venturimeter

(b) Variation of viscosity with temperature

(c) Minor head losses in pipe flow

(d) Froude Model law

(e) Euler's Equation of motion

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