Section C

5. (a) Define the following coefficients and obtain the expression for $C_d = C_c \times C_v$:

(i) Coefficient of velocity

(ii) Coefficient of discharge

(iii) Coefficient of contraction. **7.5**

(b) A Circular tank of diameter 1.25 m contains water upto a height of 5 m. An orifice of 50 mm diameter is provided at its bottom. If $C_d = 0.62$. Find the height of water above the orifice after 1.5 min. **7.5**

6. (a) Find the discharge over a triangular notch of angle 60° when the head over the V-notch is 0.3 m. Assume $C_d = 0.6$. **5**

(b) A Ship is 300 m long moves in seawater, whose density is 1030 kg/m^3. A 1 : 100 model of this to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30 m/s and the resistance of the model is 60 N. Determine the velocity of ship in seawater and also the resistance of the ship in sea water. The density of air is given as 1.24 kg/m^3. Take the Kinematic viscosity of seawater and air as 0.012 stokes and 0.018 stokes respectively. **10**

Sep-21-00018

B. Tech. EXAMINATION, 2021

Semester III (CBCS)

MECHANICS OF FLUIDS–I

CE-302

Time : 2 Hours *Maximum Marks : 60*

The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.

Note : Attempt *Four* questions in all, selecting *one* question from any of the Sections A, B, C and D. Q. No. **9** is compulsory.

Section A

1. (a) A 150 mm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 151 mm. Both the cylinders are 250 mm height. The space between the cylinders is filled with a

liquid of viscosity 10 poise. Determine the torque required to rotate the inner cylinder at 100 rpm. **7.5**

(b) Determine the total pressure on the vertical plate of diameter 1.5 is placed vertically in vertically in water in such a way that the centre of the plate is 3 m below the free surface of water. Find the position of centre also. **7.5**

2. (a) A U-tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of the mercury in limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, calculate the new difference in the level of mercury, sketch the arrangements in both cases. **7.5**

(b) Derive the expression for the reaction between the gates as $P = F/2 \sin\theta$. Where F = Resultant water pressure on Lock Gate, θ = Inclination of the Gate with normal to the side of the lock. **7.5**

Section B

3. (a) Explain the terms :

(i) Path line

(ii) Streak line

(iii) Stream line

(iv) Stream tube. **7.5**

(b) A fluid flow field is given by :

$$V = x^2 yi + y^2 zj - \left(2xyz + yz^2\right)k .$$

Prove that it is a case of possible incompressible fluid flow. Calculate the velocity and acceleration at a point (2, 1, 3). **7.5**

4. (a) What is a venturi meter ? Derive the expression for the discharge through venturi meter. **7.5**

(b) A horizontal venturi meter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of sp.gr. 0.8. The discharge of oil through venturi meter is 60 lit/s. Find the reading of the oil mercury differential nanometer. Take C_d = 0.98. **7.5**

Section D

7. (a) Derive the Hagen–Poiseuille equation for laminar flow through a pipe. **7.5**

(b) An old water supply distribution pipe of 250 mm diameter of a city is to be replaced by two parallel pipes of smaller equal diameter having lengths and identical friction factor values. Find the new diameter required. **7.5**

8. (a) Derive an Expression for loss of head due to sudden contraction and enlargement. **6**

(b) The water is flowing with a velocity of 1.5 m/s in a pipe of length 2500 m and of diameter 500 mm. At the end of the pipe a valve is provided, find the rise in pressure if the valve is closed in 25 sec. Take the valve of C = 1460 m/s. **9**

(Compulsory Question)

9. (a) What is the Eulerian description of fluid motion ? How does it differ from the Lagrangian description ?

(b) Mention the similarities between model and prototype.

(c) Define Capillarity.

(d) What are the types of fluid flow ?

(e) State the assumptions used in deriving Bernoulli's equation.

(f) What are the factors to be determined when viscous fluid flows through the circular pipe ?

(g) Define the terms (i) Hydraulic Gradient Line (HGL) (ii) Total Energy Line (TEL).

(h) State Buckingham's π theorem.

(i) Explain the phenomenon of water hammer.

(j) What is syphon pipe and where it will be used ?

1.5×10=15