Con. 6591-13. **GS-6573**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Answer any **four** questions from the remaining **six** questions.
(3) Assume **suitable** data if **necessary** and state them clearly.
(4) **Figures** to the **right** indicate full **marks**.

1. Solve any **five** :– **20**
   (a) Explain surface tension and capillarity.
   (b) What is buoyancy and metacentric height ?
   (c) Write short note on application of Bernoulli's equation.
   (d) Explain types of notches and weirs.
   (e) Explain control volume and control surface.
   (f) Show that centre of pressure of any lamina immesed under liquid is always below its centroid.
   (g) Define 'Vena-Contracta'. Explain how it is developed.

2. (a) Derive an expression on variation of pressure in a fluid. **6**
   (b) If the equation of a velocity profile over a plate is $V = 2y^{2/3}$, in which V is the velocity in m/sec at a distance of y meters above the plate, determine the shear stress at y = 0 and y = 7·5 cm, μ = 8·35 poise. **6**
   (c) A spherical container 2 m in dia is made up of two con hemispheres one resting on the other with interface horizontal. The sphere is completely filled with oil of sp.gr 0·7, through a small hole on the top. What is the min weight of the upper hemisphere to prevent it from lifting. **8**

3. (a) Explain experimental method for determination of metacentric height. **6**
   (b) A differential manometer is used to measure the pressure difference due to flow of oil of sp.gr. 0·85 in a vertical conical pipe with oil flowing upwards from broader end to smaller end. Distance between the two point between with manometer is connected is 95 cm and the mercury column difference in the manometer reads 12 cms. The manometer limbs above mercury are filled with oil. Find the pressure difference measured. **6**
   (c) A rectangular tank 6 m long, 2 m deep and 2·4 m wide contains 1 m of water. If the tank moves horizontally in the direction of the length of the tank with a constant linear acceleration of 2·45 m/sec^2. Calculate :– **8**
      (i) the angle of the water surface to the horizontal.
      (ii) the maximum pressure intensity on the bottom.
      (iii) the minimum pressure intensity on the bottom.
      (iv) the total force due to the water acting on each end of the tank.

4. (a) Derive an expression for Euler's equation of motion and state Bernouli's theorem. **6**
   (b) Find the maximum discharge over a broad crested weir of 60 m length. The head of water above crest is 54 cm and cross-sectional area on upstream side is 60 m^2. Take C_d=0·62. **6**
   (c) The following are the data given of a change in diameter effected in laying a water supply pipe line. The change in diameter is gradual from 20 cm at A, 50 cm at B. Pressure at A and B are 78·5 kN / m^2 and 58·9 kN/m^2 respectively with the end B being 3 m higher than A. If the flow in pipe line is 200 lit/sec. **8**
   Find :–
      (i) direction of flow
      (ii) the head lost in friction between A and B.

5. (a) For the velocity potential function $\phi = x^2 - y^2$. Find the velocity components at the point (3, 4). **3**
   (b) A stream function is given by $\phi = 2x - 5y$. Calculate the velocity component and also magnitude and direction of the resultant velocity at any point. **3**
   (c) Water is supplied from tank into a canal through rectangular sluice 1 m wide and 1·75 m high. The water level in the tank is 2 m above the top edge of the opening and the canal water level is 30 cm below the top edge. If the coefficient of discharge 0·62 for both the free and submerged portions. Calculate the discharge. **6**
   (d) Short note on hydraulic coefficients and their experimental method of determination. **8**

6. (a) Derive an expression on continuity equation for three dimentional flow. **6**
   (b) The jet of water issued from a nozzle with a velocity of 18 m/sec. If the maximum height attained by the free jet is 6·82 m. Find **6**
      (i) Angle made by the nozzle with the Horizontal
      (ii) Time of flight
      (iii) Horizontal range of free jet.
   (c) A 15 cm × 5 cm venturimeter is provided in a vertical pipe carrying crude oil sp.gr 0·8. The flow is in upward direction. The difference of elevation between entrance and throat section of the venturimeter is 25 cm. The difference in level between the two limbs of U tube mercury manometer recorded is 20 cm. Calculate :– **8**
      (i) Flow rate of oil
      (ii) Pressure difference between the entrance and throat section C_d = 0·95.

7. Solve short notes on any **four** :– **20**
   (a) Stability of floating and submerged bodies
   (b) Circulation and vorticity
   (c) Stream line and equipotential line
   (d) Pitot tube
   (e) Rotameter
   (f) Atmospheric, gauge, Absolute and vaccum pressures.

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