(3 Hours) **(Total Marks : 80)**

N.B: 1) **Question no 1** is **compulsory**.

2) Attempt **any three** questions out of remaining **five** questions.

3) Assume any additional **data** if **necessary** and **state clearly**.

4) Draw **neat figures** as **required**.

1. Answer **any 4** of the following. **20**

   a. Derive Dupit's Equation.

   b. Explain different steps in solving distribution network by Hardy Cross method.

   c. Explain boundary layer separation and its control measures.

   d. Explain propagation of pressure waves in a compressible fluid.

   e. Explain kinetic correction factor and momentum correction factor.

   f. Explain Prandlt's mixing length theory.

2. a. In a pipe of 300 mm diameter, the centre line velocity and velocity at a point 2.3 m/s and 2 m/s resp. Assuming the flow in pipe to be turbulent find discharge through the pipe, co-efficient of friction, height of roughness projections. **10**

   b. An aeroplane is flying at 1000 km/hr through still air having a pressure of 78.5 kN/m^2 (abs) and temp. - 8 ^{o}C. Calculate on stagnation point on the nose of plane 1) Stagnation Pressure 2) Stagnation Temp. 3) Stagnation Density. Take R = 287 J/kg K and k = 1.4. **10**

3 a. Two sharp ended pipes of diameter 50 mm and 100 mm resp. each of length 100m resp. is connected in parallel between two reservoirs which have a difference of level of 10m. If friction factor for each pipe is 0.32 ,calculate :- **10**

   1) Rate of flow for each pipe

   2) The diameter of single pipe 100 m long which would give the same discharge, if it were substituted for the original two pipes.

   b. Derive Prandlt's universal velocity distribution for turbulent flow in pipes. **10**

4 a. A siphon of diameter 200 mm connects two reservoirs having a difference in elevation of 12m. The total length of siphon is 600 m and the summit is 4m above the water level in the upper reservoir. If the separation takes place at 2.8 m of water absolute, find the maximum length of siphon from upper reservoir to the summit. Take f=0.004 and atmospheric pressure=10.3 m of water. **10**

b. Water is flowing in a pipe of 140mm diameter with a velocity of 2.5 m/s.When it is suddenly brought to rest by closing the valve. Find the pressure rise assuming pipe is elastic. E=206 GN/m^2, Poisson's ratio= 0.25, K for water = 2.06 GN/m^2 Pipe wall is 5mm thick. **04**

c Explain Hydraulic Gradient Line and Total Energy Line. **06**

5 a. A lubricating oil of viscosity 1 poise and sp.gr.0.9 is pumped through 30 mm diameter pipe. If the pressure drops per meter length of pipe is 20 kN/m^2. Determine 1) the mass flow rate in kg/min 2) the shear stress at the pipe wall 3) Reynolds number of flow 4) The power required per 50 m length of the pipe to maintain the flow. **10**

b. The velocity distribution in boundary layer is given by **10**

$$\frac{u}{U} = 2(\frac{y}{\delta}) - (\frac{y}{\delta})^2$$

δ =boundary layer thickness

Calculate the displacement thickness, momentum thickness and energy thickness.

6 a. Experiments were conducted in a wind tunnel with a wind speed of 60 km/hr on a flat plate of size 2m long and 1 m wide. The density of air is 1.15kg/m^3.The coefficient of lift and drag 0.75 and 0.15 resp. Determine :- 1) Lift Force 2) Drag force 3) Resultant force 4) Direction of resultant force 5) Power exerted by air on plate. **10**

b. In a rough pipe of diameter 0.5 m and length 4400 m water is flowing at the rate of 0.5 m^3/s. If the average height of roughness is 0.48 mm, find power required to maintain this flow. **6**

c Explain Hydraudynamically smooth and rough boundaries. **4**
