

(3 Hours)

[Total Marks: 80]

Question No.1 is compulsory.

Attempt any three from remaining.

Assume any suitable data if required, state the same clearly.

Figures to the right indicate full marks.

Attempt sub questions in order.

1. Attempt any five

(20)

- a. Compare Pipes in series and pipes in parallel.
- b. Compare Laminar flow and Turbulent flow.
- c. Compare Hydro dynamically smooth and rough boundaries.
- d. What is siphon? Explain its working.
- e. Write short note on Mach cone & Mach line.
- f. Explain HGL and TEL

2 a. Describe Kinetic energy correction factor & momentum correction factor. (06)

b. Write detailed note on Dash pot mechanism and its application. (05)

c. An oil of viscosity 1.5 poise and relative density 0.9 is flowing through circular pipe of diameter 30mm and length 3m at one tenth of the critical velocity for which Reynolds number is 2450. Find (1) the velocity of flow through the pipe.(2) the pressure head of oil to maintain the flow in the pipe. (3) the power required to overcome viscous resistance to flow of oil. (09)

3 a. The speed of supersonic aircraft flying at an altitude of 1100m corresponds to Mach number 2.5. Find the time elapsed between the instant the aircraft was directly over head of an observer & the instant observer feels the disturbance due to aircraft. Consider following three cases: when (a) observer is stationary (b) observer is moving in the direction of aircraft at $M=0.5$. (c) observer is moving in opposite direction of aircraft with $M=0.5$. Take $\gamma = 1.4$, $R = 287 \text{ J/kg K}$ & temperature at given height is $280 \text{ }^\circ\text{K}$. (10)

b. Laminar flow takes place in circular tube. At what distance from the boundary the local velocity is equal to the mean velocity. (04)

c. A compound pipe system consists of 1800 m of 50cm diameter, 1200m of 40cm diameter, 600m of 30cm diameter connected in series. (i) What is equivalent length of 40cm diameter pipe of same material? (ii) If three pipes are connected in parallel, what would be the equivalent length of 50cm diameter pipe? (06)

4 a. An equilateral triangle is divided into two parts by a vertical from the vertex to the horizontal base. The value of K for vertical bisector, two base pipes and other two sides of triangle are 4, 2 and 3 respectively. Take $n = 2$, find the flow distribution in not more than two trials for an input of 100 units at vertex & output of 30 units each from left and right junction and 40 units from the mid point of junction. (08)

- b. Two reservoirs with a difference in elevation of 15m are connected by three pipes in series. The pipes are 300m long of diameter 30cm ;150m long of diameter 20cm and 200m long of diameter 25cm. The friction factor for three pipes are 0.018; 0.020 and 0.019 respectively. The contraction and expansion are sudden. Determine the flow rate in *lps*. Plot HGL and TEL (12)
5. a. Derive Hagen Poiseuille Formula for laminar flow through circular pipes. (10)
 b. Show that the diameter of the nozzle for maximum transmission of power is given by
- $$d = \left[\frac{D^5}{8fL} \right]^{1/4} \text{ where } D \text{ is diameter of pipe and } L \text{ is length of pipe.} \quad (05)$$
- c. A pipe line carrying water has surface protrusions of average height 0.1mm. if the shear stress developed is 8Pa; determine whether the pipe surface acts as a smooth; rough or transition. Take density of water as 1000kg/m³ and kinematic viscosity 0.0093 stokes. (05)
6. a. A smooth pipe of 80mm diameter and 1000m long is carrying water at the rate of 8 lit/sec. if the kinematic viscosity 0.015 stoke; calculate (1) loss of head (2) wall shear stress (3) centre line velocity (4) velocity and shear stress at 20mm from the pipe wall (5) thickness of laminar sub layer. (10)
 b. Write short note on Prandtl Mixing length theory. (06)
 c. Rewrite following with correct choice: (04)
- (i) The most essential feature of turbulent flow is
 (a) high velocity (b) velocity and pressure exhibit irregular fluctuations of high frequency
 (c) large discharge (d) none of above
- (ii) In case of viscous flow through a circular pipe the average velocity of fluid is
 (a) Twice the maximum velocity (b) half the maximum velocity
 (c) 1.5 times the maximum velocity (d) none of above
- (iii) The energy loss in a pipeline is due to
 (a) surface roughness only (b) viscous action only
 (c) friction of pipe wall and viscous function (d) none of above
- (iv) The region outside the mach cone is called
 (a) zone of action (b) zone of silence (c) control volume (d) none of above