(3 Hours)

Max Marks : 80

**N.B** (1) Question **No.1** is compulsory
(2) Solve **any three** questions of the remaining questions .
(3) Assume suitable data if required.
(4) Draw **neat figures**

Q 1)     Answer **any Four** out of the following.                                                                              20
   a)   Derive Darcy's Weisbach equation for calculating loss of head due to friction in pipe.
   b)   Define mach number and state its significance in compressible fluid flow.
   c)   For turbulent flow in pipes ,find the distance from the pipe at which the local velocity is equal to the average velocity .
   d)   Write a note flow through laterals.
   e)   What are important characteristic of laminar flow .Give examples were such a flow is encountered.

2 2)  a)  A pipeline ABC 200 m long is laid on an upward slope of 1 in 40.The length of          10
          portion AB is 100 m and its diameter is 100 mm ,while the length of portion BC is
          100 m and its diameter is 200 mm .The change of diameter at B is sudden. A flow of
          0.02 m³/s is pumped into the pipe at its lower end A and is discharged at the upper end
          C into a closed tank. The pressure at the supply end A is 200 kN/m² .Find the pressure
          at C and draw the hydraulic gradient and total energy line .Take co-efficient of friction
          as 0.008.

   b)  Show that the power transmitted by a nozzle is maximum when the head lost due to         05
       friction in pipe is equal to one- third the total head supplied at the inlet of pipe

   c)  Prove that the velocity through the nozzle is given by                                                          05

$$V = \sqrt{\dfrac{2gH}{1 + \dfrac{4fL}{D} \times \dfrac{a^2}{A^2}}}$$

3)  a)  A pumping plant forces water through a 600 mm diameter main ,the friction head        10
        being 27 m .In order to reduce the power consumption ,it is proposed to lay another
        main of appropriate diameter along the side of the existing one, so that the two pipes
        work in parallel for the entire length and reduce the friction head to 9.6 m only. Find
        the diameter of the new main if with the exception of diameter ,it is similar to the
        existing one in every respect.

   b)  Calculate the stagnation pressure ,temperature and density on the stagnation point on      10
       the nose of a plane ,which is flying at 800 km/hour through still air having a pressure
       8.0 N/cm³ (abs.) and temperature -10 °C. Take R= 287 J/kg K & k =1.4.

[TURN OVER

**Q 4)** a) For the network given below, the discharge at the nodes are known .Verify whether the suggested discharge is satisfactory , If not, adjust the distribution. An accuracy of 0.5 unit of discharge is adequate. The head loss in a pipe is given by $h_f = rQ^2$     08

| Pipe | AB | BC | DC | ED | CA | BE |
|------|-----|-----|-----|-----|-----|-----|
| r value | 1 | 4 | 5 | 2 | 3 | 4 |
| Discharge (units) | 60 | 19 | 34 | 16 | 40 | 41 |
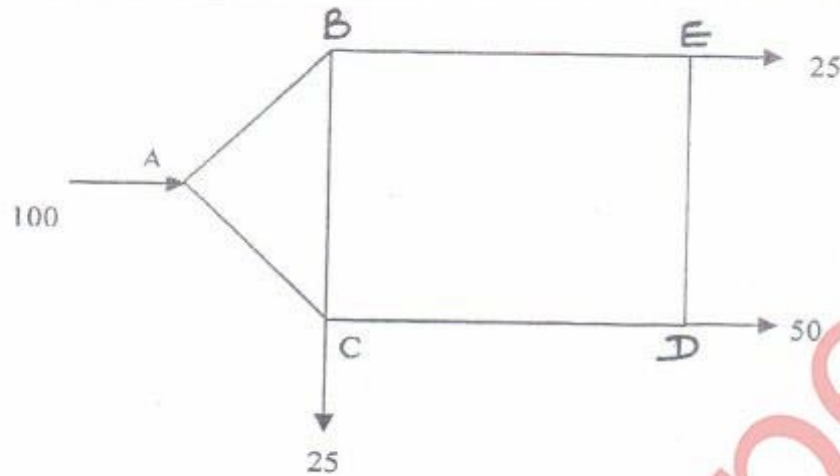


b) A pipeline AB 50 cm in diameter and 4500 m long ,connects two reservoirs whose constant difference of water level is 12 m . A branch pipe,1250 m long and taken at a distance of 1500 m from reservoir A,leads to reservoir C whose water level is 15 m below that of reservoir A .Find the diameter of branch pipe ,so that the flow into both the reservoirs  (B & C) is same .Assume friction factor as 0.03 for all the pipes.     12

**Q 5)** a) Show that the discharge per unit width between two parallel plates distance 'b' apart ,when one plate is moving  at velocity U and the other is  held stationary, for the condition of zero shear stress at the fixed plate is q=Ub/3     10

b) A liquid of viscosity 0.9 poise is filled between two horizontal plates 10 mm apart. If the upper plate is moving at 1 m/s with respect to lower plate which is stationary and the pressure difference between two sections 60 m apart is 60 kN/m²,determine :
(i) The velocity distribution . (ii) The discharge per unit width (iii) The shear stress on the upper plate     10

**Q 6)** a) Explain Prandtl's mixing length theory. Derive expression for velocity distribution for turbulent flow in smooth pipes.     10

b) A pipeline of diameter 0.3 m carries oil at the rate of 540 lit/s. If the specific gravity of oil is 0.80 and its kinematic viscosity is equal to 0.023 stokes, determine (i) the maximum permissible height of protrusions upto which the pipe acts as smooth pipe (ii) the height of protrusions beyond which the pipe would become rough.     10

*End of paper.*