(3 hours) **Total marks: 80**

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

(2) Attempt any 3 questions out of the remaining 5 questions.

(3) Assume data wherever necessary and clearly mention the assumptions made.

(4) Draw neat figures as required.

Q1 **Solve any four from the following** **20**

a Derive an expression for the equivalent size of the pipe to replace the pipes in series.

b A nozzle is fitted at the end of a pipe of length 300 m and diameter 100 m. For the maximum transmission of power through the nozzle, find the diameter of nozzle. Take f = 0.009.

c Define Mach Cone, Mach angle, Zone of action and Zone of Silence.

d Explain the effect of pressure gradient on boundary layer separation.

e Write a short note on Moody's diagram.

f Explain Dash Pot Mechanism.

Q2 a An old water supply distribution pipe of 250 mm diameter of a city is to be replaced by two parallel pipes of equal diameter having equal lengths and identical friction factor values. Find out the new diameter required. **10**

b. A siphon of diameter 200 mm connects two reservoirs whose water surface level differ by 40 m. The total length of the pipe is 8000 m. The pipe crosses a ridge. The summit of ridge is 8 m above the level of water in the upper reservoir. Determine the minimum depth of the pipe below the summit of the ridge, if the absolute pressure head at the summit of siphon is not to fall below 3 m of water. Take f = 0.006 and atmospheric pressure head = 10.3 m of water. The length of siphon from the upper reservoir to the summit is 500 m. Find the discharge. **10**

Q3 a A pipeline of 0.6 m diameter is 1.5 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if 4f = 0.04. The head at inlet is 300 mm. **10**

b Derive an expression for velocity of sound wave in a compressible fluid. **10**

Q4 a Derive Momentum thickness and energy thickness for the given velocity profile **10**

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

b What do you understand by stagnation properties of a fluid? Find the Mach number when an airplane is flying at 900 kmph through still air having a pressure of 8.0 N/cm^2 and temperature -15^{o}C. Take k = 1.4 and R = 287 J/kg K. Calculate the pressure, temperature and density of the air at the stagnation point on the nose of the plane. **10**

Q5 a A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. **10**

b Prove that for viscous flow through a circular pipe the kinetic energy correction factor is equal to 2 while momentum correction factor is equal to 4/3. **10**

Q6 a Derive Prandtl's universal velocity distribution equation for turbulent flow in pipes. What do you understand by velocity defect? **10**

b A smooth pipe line of 100 mm diameter carries 2.27 m^3 per minute of water at 20^0 C with kinematic viscosity of 0.0098 stokes. Calculate the friction factor, maximum velocity as well as shear stress at the boundary. **10**

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