(3 hours)

Note: Max. Marks 80

Question no.1 is compulsory

Solve any 3 questions out of remaining

Assume data wherever necessary and clearly mention the assumptions made.

Draw neat figures as required.

1 Answer any 4 questions out of following 20

a. Derive equation for loss of head due to sudden contraction.
b. Explain Boundary layer separation and control measures.
c. Write a note on Rough and Smooth Boundaries
d. Explain Dash Pot mechanism
e. Write a note on propagation of pressure wave
f. Write note on Prandtl mixing length theory for turbulent shear stress.

2 a. Derive the expression for diameter of nozzle for maximum transmission of power through nozzle. 10
A nozzle of diameter 26 mm is fitted at the end of a pipe of length 300 m. Find the diameter of pipe suffering the condition of maximum power transmission through nozzle. Take f = 0.009.

b. A flat plate 2 m x 2 m moves at 40 km/hour in stationary air of density 1.25 kg/m^3. 10
If the coefficient of drag and lift are 0.2 and 0.8 respectively, find: (i) the lift force, (ii) the drag force, (iii) the resultant force and (iv) the power required to keep the plate in motion.

3 a. A pipe 0.2 mm diameter and 1800 m long connect two reservoirs one being 30 m below the other. The pipe line crosses a ridge whose summit is 7.5 m above the upper reservoir. What may be the minimum depth of the pipe below the summit of the ridge in order that the pressure at the apex does not fall below 7.5 m vacuum? The length of the pipe from the upper reservoir to the apex is 300 m. Taking f = 0.032, determine the rate of flow to the lower reservoir in liters per minute. 10

b. Water is flowing between two large parallel plates which are 2.0 mm apart. 10
Determine:(i) maximum velocity, (ii) the pressure drop per unit length and (iii) the shear stress at walls of the plate if the average velocity is 0.4 m/s. Take viscosity of water as 0.01 poise.

4 a. A reservoir A of surface level 60 m above datum supplies a junction box through a 300 mmm pipe 1500 m long. From the junction box two 300 mm pipes each 1500 m long feed respectively into two reservoir whose surface levels are 30 m and 15 m above datum. Find the quantity entering each reservoir. Take f = 0.01. 10

b. Derive the equation for displacement thickness and momentum thickness. 10

5 a. Water flowing in a long pipe is suddenly stopped by closing a valve at the discharge end. The diameter of the pipe is 180 mm and its thickness is 8 mm. The quantity of water flowing in the pipe is 25 liters per second. Find the rise of pressure due to instantaneous closure of valve at the discharge end. Take modulus of elasticity for the pipe material = 2 x 10^5 N/mm^2 and bulk modulus of water = 2 x 10^3 N/mm^2. Find also the corresponding hoop stress developed in the pipe wall. 10

b. Water is flowing through a rough pipe of diameter 40 cm and length 3000 m at the rate of 0.4 m^3/s. Find the power required to maintain this flow. Take the average height of roughness as K = 0.3 mm. 10

6 a. Derive Area Velocity relationship for compressible flow 06

b. A projectile is travelling in air having pressure and temperature as 8.829 N/cm^2 and -2°C. If the Mach angle is 40°, find the velocity of the projectile. Take k = 1.4 and R = 287 J/kg°K. 04

c. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. 10

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