Duration: 3 hour **Marks: 80**

N.B. 1) Question No.1 is Compulsory.

2) Attempt any Three questions from remaining questions.

3) Assume suitable data where required and clearly state the same.

4) Figures to the right indicate full marks.

Q.1 Attempt any Four **(20)**

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

b) What are the important Characteristics of laminar flow? Live the examples.

c) Write a note on Turbulent Boundary layer on a Flat Plate.

d) What is meant by boundary Layer? Why does it Increase with distance from the upstream edge?

e) State practical applications of the momentum equation.

f) Explain principle of dimensional homogeneity and Check dimensional homogeneity with example.

Q.2.a) Two Sharp ended pipes of diameter 60mm and 120 mm respectively, each of length120m are connected in parallel between two reservoirs Which have a difference of level of 12m. If the Coefficient of friction for each pipe is (4f) 0.32. Calculate the rate of flow for each pipe and also the diameter of a single pipe 100m long, Which would give the same discharge? If it were Substituted for the original two pipes. **(10)**

b) Two reservoirs are connected by a pipe line consisting of two pipes, one of 16 cm diameter and length 8 m and the other of diameter 23 cm and length 20m length. If the difference of water levels in two reservoirs is 6m, calculate the discharge and draw the energy gradient line. Take f=0.04 **(10)**

Q.3. a) Explain the phenomenon of water hammer. Obtain an expression for the rise of pressure when the flowing water in a pipe is brought to rest by closing the valve gradually. **(10)**

b) Oil of specific gravity 0.82 is pumped through a horizontal pipeline 160 mm in a diameter and 2.5km long at the rate of 0.016 m³/s. m³/s. The pump has an efficiency of 68%. and requires 7.5kw to pump the Oil. i) What is the dynamic viscosity of the oil? ii) Is the flow laminar? **(10)**

Q.4.a) A 16cm diameter. Pipeline Carries a discharge of 0.28 m³/see calculate for the wall shear stress, and height of roughness projections. N= $0.75X10^{-6}$ m²/s, f=0.025. **(10)**

b) For the velocity distribution for laminar boundary layer flows given as $\frac{u}{U} = \frac{3}{2}(y/\delta) - \frac{1}{2}(y/\delta)^3$ find the expression for boundary layer thickness '**δ**' if shear stress $\mathbf{T_0}$ and coefficient of drag (C_D) In terms of Reynolds number. **(10)**

Q.5.a) A square plate of side 2 m is moved in a Stationery air of density 1.3 kg/m^3 with a velocity of 60 km/hr. of the coefficients of drag and lift are 0.2 and 0.8 respectively Determine i) The lift force ii) The drag force iii) The resultant force iv) The Power required to keep the plate in motion. **(10)**

b) Bend in pipeline convening water gradually 0.8m to 0.4m diameter deflects flow through angle of 60^0. At larger end the gauge pressure is 172.875 kN/m^2 Determine the magnitude and direction of force exerted on bend i) When no flow ii) Water flow is 886 l/s. **(10)**

Q.6.a) i) Write a short note on Froude's number. **(5)**

ii) What are the applications of Model testing. **(5)**

b) The efficiency **η** of a fan depends on density ρ , dynamic viscosity μ of the fluid, Angular Velocity ω, diameter D, discharge Q. Express the efficiency **η** in terms of dimensionless parameter. **(10)**
