FLUID DYNAMICS

Full Marks : 70
Time: 3 hours

Answer Question No. 1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

1. Answer all questions. [2×10]
   (a) Give any two uses of dimensional analysis.
   (b) Define momentum and displacement thicknesses.
   (c) What are Navier Stokes Equations.
   (d) What is Polar diagram.
   (e) Give any two characteristics of turbulence.
   (f) When do you call teh curves as back water and draw down curves.
   (g) Find the force exerted on the plate when a nozzle of 50 mm diameter delivers a stream of water at 22m/s perpendicular to a plate that moves away from the jet at 6m/s.
   (h) What is a runner in a turbine.
   (i) Give the definition for specific speed of a centrifugal pump.
   (j) When does a negative slip occurs in a reciprocating pump.

2. (a) The characteristics of the spillway are to be studied by means of a geometrically similar model constructed to the scale ratio of 1:10. If the maximum rate of flow in the prototype is 28.3 cumecs, what will be the corresponding flow in model. [5]
   (b) Determine the thickness of the boundary layer of the trailing edge of smooth plate of length 4m and of width 1.5m, when the plate is moving with a velocity of 4m/s in stationary air. Take viscosity of air as $1.5 \times 10^{-5} m^2/s$. [5]

3. (a) Calculate the diameter of a parachute to be used for dropping an object of mass 100 kg so that the maximum terminal velocity of dropping is 5 m/s. The drag coefficient for the parachute which may be treated as hemispherical is 1.3. The density of air is 1.216 kg/m^3. [5]
   (b) Whatis an air foil. [2]
   (c) Give the significance of body force with respect to Navier stokes equations. [3]

4. A rough pipe is of diameter 8.0 cm. The velocity at a point 3.0 cm from wall is 30% more than velocity at a point 1cm from pipe wall. Find the average height of the roughness. [10]

5. (a) Define Specific energy and explain specific energy curve. [5]
   (b) What is meant by hydraulic jump, when does it occur? Also give the applications. [5]

6. A jet of water having a velocity of 45 m/s impiuges without shock. On a series of vanes moving at 15m/s. The direction of motion of the vanes is inclined at 20^0 to that of jet. The relative velocity at outlet is 0.9 of that at inlet, and absolute velocity of water at exit is to be normal to the motion of vanes. Find vane angles at inlet and outlet, work done on vanes per N(newton) of water supplied by the jet and hydraulic efficiency. [10]

7. Explain working of Pelton wheel with sketch. [10]

8. The diameter and width of a centrifugal pump impeller are 300 mm and 60 mm respectively. The pump is delivering 144 litres of liquid per second with a manometric efficiency of 85%. The effective outlet vane angle is 30^0 of the speed of rotation is 950 r.p.m. Calcuate specific speed of the pump. [5]
   (b) Describe the principle and working of a single acting reciprocating pump. [5]