



- 7 Define the following (10)
- i. Laminar boundary layer
  - ii. Turbulent boundary layer
  - iii. Boundary layer thickness
- 8 (a) Sketch and label the parts of a venturimeter. (2)
- (b) Find the discharge of water flowing through a pipe of 30cm diameter placed in an inclined position where a venturimeter is inserted. The venturimeter has a throat of diameter 15cm. The difference of pressure between the main and throat is measured by a liquid of specific gravity 0.6 in an inverted U tube which gives a reading of 30cm. The loss of head between the main and throat is 0.2 times the kinetic head of the pipe. (8)

### PART C

*Answer any four questions, each carries 10 marks.*

- 9 a) Compare impulse and reaction turbines. (5)
- b) What is the purpose of draft tube in a reaction turbine? Classify draft tubes. (5)
- 10 a) Derive an expression for force exerted by a jet of water on moving plate. (5)
- b) A jet of water having a velocity of 20m/s strikes a curved vane which is moving with a velocity of 10m/s. The jet makes an angle of  $20^\circ$  with the direction of motion of vane at inlet and leaves at an angle of  $130^\circ$  to the direction of motion of vane at outlet. Calculate the work done per unit weight of water striking the vane per second. (5)
- 11 a) What is the function of spear in Pelton wheel? (2)
- b) A Pelton wheel is to be designed for the following specifications. (8)
- Shaft power-11,772 kW; Head-380m; Speed-750rpm; Overall efficiency-86%; The jet diameter is not to exceed one-sixth the wheel diameter. Determine
- i. The wheel diameter
  - ii. The number of jets required and
  - iii. Diameter of the jet
- 12 a) What is an air vessel? Why do we use air vessels in reciprocating pumps? (5)
- b) With the help of a neat sketch, explain the working of a double acting reciprocating pump. (5)
- 13 a) Define manometric efficiency of centrifugal pump. (2)
- b) Find the power required to drive a centrifugal pump which delivers  $0.04\text{m}^3/\text{s}$  of water to a height of 20m through a 15cm diameter pipe, 100m long. The overall efficiency of the pump is 70% and coefficient of friction  $f=0.015$ . (8)
- 14 a) Why is it necessary to prime a centrifugal pump? (2)
- b) The internal and external diameters of the impeller of a centrifugal pump are 200mm and 400mm respectively. The pump is running at 1200rpm. The vane angles of the impeller at inlet and outlet are  $20^\circ$  and  $30^\circ$  respectively. Water enters the impeller radially and velocity of flow remains constant. Determine the work done by the impeller per unit weight of water. (8)

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