

**BT-5/D-21****45125****FLUID MACHINES****Option-I****Paper-ME-303N**

Time Allowed : 3 Hours]

[Maximum Marks : 75

**Note** : Attempt **five** questions in all, selecting at least **one** question from each Unit. All questions carry equal marks. Unless stated otherwise, the Symbols have their usual meaning in context with the subject. Assume suitably and state, additional Data required if any.

**UNIT-I**

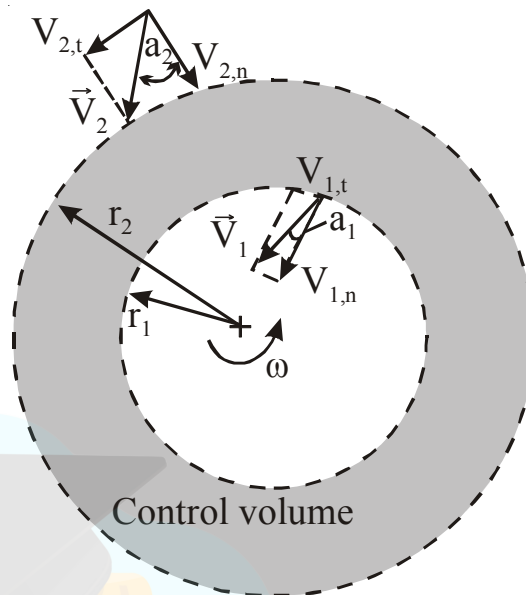
1. A jet of water of diameter 45 mm moving with a velocity of 30 m/s, strikes a curved fixed symmetrical plate at the centre. Find the force exerted by the jet of water in the direction of the jet, if the jet is deflected through an angle of  $120^\circ$  at the outlet of the curved plate. 15
2. The Aerodynamic drag of a new sports car is to be predicted at a speed of 50.0 km/h at an air temperature of  $25^\circ\text{C}$ . Automotive engineers build a one fifth scale model of the Car to test in a wind tunnel. It is winter and the wind tunnel is located in an unheated building; the temperature of the wind tunnel air is only about  $5^\circ\text{C}$ . Determine how fast the Engineers should run the wind tunnel in order to achieve similarity between the model and the prototype. 15

**UNIT-II**

3. A Pelton wheel is used to produce Hydroelectric power. The average radius of the wheel is 1.83 m and the jet velocity is 102 m/s from a nozzle of exit diameter equal to 10.0 cm. The turning angle of the buckets is  $\beta = 165^\circ$  :
  - (a) Calculate the volume flow rate through the turbine in  $\text{m}^3/\text{s}$ .
  - (b) What is the optimum rotation rate (in rpm) of the wheel (for maximum power)?

(c) Calculate the output shaft power in MW if the efficiency of the turbine is 80 percent. 15

4. A Francis radial-flow Hydro-Turbine is being designed with the following dimensions :  $r_2 = 2.00$  m,  $r_1 = 1.42$  m,  $b_2 = 0.731$  m and  $b_1 = 2.20$  m. The runner rotates at  $n = 180$  rpm. The wicket gates turn the flow by angle  $a_2 = 30^\circ$  from radial at the runner inlet and the flow at the runner outlet is at angle  $a_1 = 10^\circ$  from radial (refer Figure). The volume flow rate at design conditions is  $340 \text{ m}^3/\text{s}$  the gross head provided by the dam is  $H_{\text{gross}} = 90.0$  m. For the preliminary design, irreversible losses are neglected. Calculate the inlet and outlet runner blade angles  $\beta_2$  and  $\beta_1$ , respectively and predict the power output (MW) and required net head (m). Is the design feasible? 15



### UNIT-III

5. The impeller of a centrifugal pump has inner and outer diameters of 13 and 30 cm, respectively and a flow rate of  $0.15 \text{ m}^3/\text{s}$  at a rotational speed of 1200 rpm. the blade width of the impeller is 8 cm at the inlet and 3.5 cm at the outlet. If water enters the impeller in the radial direction and exits at an angle of  $60^\circ$  from the radial direction, determine the minimum power requirement for the pump. 15

6. A double acting reciprocating pump has a bore of 150 mm and stroke of 250 mm and runs at 35 rpm. The piston rod diameter is 20 mm. The suction head is 6.5 m and the delivery head is 14.5 m. The discharge of Water was 4.7 l/s. Determine the slip and the power required. 15

#### UNIT-IV

7. Describe the working of gear pump and lobe pump. List the advantages and disadvantages of the both. 15
8. Explain the Working of torque converter with the help of neat sketch along with the advantages and disadvantages. 15

