

BT-5/D-19
FLUID MACHINES
Paper-ME-303N

Time allowed : 3 hours]

[Maximum marks : 75

Note : Attempt five questions in all. Assume any missing data suitably.

1. (i) Derive an expression for the efficiency of a curved radial vane. 7
- (ii) A jet of 50 mm diameter impinges on a curved vane and is deflected through an angle of 175° . The vane moves in the same direction as that of the jet with a velocity of 35 m/s. If the rate of flow is 170 litres per second, determine the component of force on the vane in the direction of motion. How much would be the power developed by the vane and what would be the water efficiency? Neglect friction. 8
2. Show by dimensional analysis that the power P developed by a hydraulic turbine is given by $P = \rho N^3 D^5 f \left[\frac{N^2 D^2}{gH} \right]$ where ρ is mass density of liquid, N is the rotational speed. D is the diameter of runner, H is the working head and g is the gravitational acceleration. 15

3. (i) How is a Kaplan turbine different from a propeller turbine? 5 ✓
- (ii) It is desired to generate 1000 kW of power and survey reveals that 450 m of static head and a minimum flow of $0.3 \text{ m}^3/\text{s}$ is available. Comment whether the task can be accomplished by installing a Pelton wheel that turns 1000 rpm and has an efficiency of 80%. Further design the Pelton wheel by assuming suitable data for coefficient of velocity, speed ratio and velocity coefficient for the jet. 10 ✓
4. (i) Differentiate between the inward flow and outward flow turbines. 5
- (ii) Two inward flow turbine runners have the same diameter 0.75 m and work under the same head with a velocity of flow of 6 m/s. One runner operates at 450 rpm and has an inlet blade angle of 60° . Determine the speed at which the other turbine should run if its inlet blade angle is 105° . Assume that both the turbines have the same efficiency and radial discharge at outlet. 10
5. (i) What is priming? Why is it necessary? 5
- (ii) The impeller of a centrifugal pump is of 30 cm diameter and 5 cm width at the periphery, and has blades whose tip angles incline backwards 60° from the radius. The pump delivers $17 \text{ m}^3/\text{min}$ and the impeller rotates at 1000

rpm. Assuming that the pump is designed to admit radially, calculate speed and direction of water as it leaves the impeller, torque exerted by the impeller on water, shaft power required and the lift of the pump. 10

6. Derive the pressure head relation for the suction due to acceleration in a reciprocating pump and also show the effect of acceleration on the indicator diagram. 15

7. (i) What is cavitation? How can it be avoided in reaction turbines? 6

(ii) Explain the construction and working of a jet pump with neat sketch. 9

8. (i) Explain the construction and working of hydraulic accumulator with neat figure. 10

(ii) The diameters of two portions of the ram of a differential accumulator are 0.15 m and 0.14 m, respectively. The stroke of the accumulator is 1 m and it is supplied with water at a pressure of 1000 m of water. Evaluate the load on the ram and the capacity of the accumulator. 5