

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

Time allowed : 3 hours]

[Maximum marks : 100

Note : Attempt any five questions by selecting at least one question from each unit. Assume the suitable values for missing data, if any.

Unit-I

1. (a) Show by dimensional analysis that the power P developed by a hydraulic turbine is given by :

$$P = \rho N^3 D^5 f \left(\frac{D}{B}, \frac{\rho D^2 N}{\mu}, \frac{ND}{\sqrt{gH}} \right) \text{ where } \rho \text{ is mass}$$

density of liquid, μ is dynamic viscosity of liquid, N is rotational speed, D and B are diameter and width of runner, H is the working head and g is gravitational acceleration. 10

- (b) Establish the following expression for the force F exerted by a jet of area A which strikes a flat plate at an angle θ to the normal to the plate with velocity V. The plate itself is moving with velocity u in the direction of normal to the plate surface. $F = \rho A (V \cos \theta - u)^2 / \cos \theta$ 10

(2)

2. A jet of water having a velocity of 40 m/s impinges without shock on a series of vanes moving at 12 m/s. The direction of motion of vanes is inclined at 20° 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 entrance and exit
 - work done on vanes per kg of water supplied by the jet
 - hydraulic efficiency 20

Unit-II

3. (a) How the hydraulic turbines are classified? 10
(b) Find an expression for the hydraulic efficiency of a Pelton wheel. Also find the condition for maximum efficiency. 10
4. (a) In a reaction turbine with radial vanes at the inlet, the velocity of flow at the outlet is k times that at the inlet. Show that $\eta_h = 2 / (2 + k^2 \tan^2 2\alpha)$ where α is fluid angle at the inlet. 10
(b) Why draft tube is necessary in case of reaction turbines? How does it regain lost head when it is installed above the tail race level. 10

Unit-III

5. (a) Describe the effect of finite number of vanes on Euler head. What is actual head of a centrifugal pump? Also define various types of efficiencies of a centrifugal pump. 10

(b) A centrifugal pump impeller has diameter of 60cm and width of 6cm at the outlet. The pump runs at 1450 rpm and delivers $0.8 \text{ m}^3/\text{s}$ against a head of 80m. The leakage loss after the impeller is 4% of discharge, the external mechanical loss is 20KW and the hydraulic efficiency is 80%. Determine the blade angle at outlet, rotor power and shaft power. 10

6. (a) What is an air vessel ? Why it is used in reciprocating pumps ? Also find an expression for the rate of flow from and into an air vessel fitted to delivery side of a single acting reciprocating pump. 10

(b) Discuss the effect of piston acceleration in a reciprocating pump and derive the expression for accelerating head. What is the effect of accelerating head on indicator diagram ? 10

Unit-IV

7. (a) What is cavitation ? Discuss some methods to prevent cavitation in hydraulic machines. 10

(b) How the model test on centrifugal pumps are conducted ? Why they are needed ? 10

8. (a) Explain with the help of a neat sketch the working of a hydraulic intensifier. 10

(b) With the help of a neat sketch, explain the working of a torque converter. Also discuss the importance of fixed guide blades in torque converter. 10