

MAR-21-210152**B. Tech. EXAMINATION, March 2021**

Semester V (NS)

FLUID MACHINES

ME-311

Time : 3 Hours

Maximum Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary continuation sheet will be issued.

Note : Attempt Five questions in all, selecting one question from each Sections A, B, C and D. Q. No. 9 is compulsory.

Section A

1. (a) A jet of water 8 cm in diameter and at a velocity of 20 m/s of curved vanes at the centre moving at velocity of 7 m/s. The vanes are so arranged that each vane appears before the jet in the

same position and at the same velocity. The jet is deflected through 160° . Find the normal force exerted on vanes, the work done per second and the efficiency of the system. 10

- (b) A nozzle of 50 mm diameter delivers a stream of water at 20 m/s perpendicular to a plate that moves away from the jet at 5 m/s. Find : the force on plate, work done and efficiency of jet. 10

2. Design a Pelton wheel which working under a head of 80 m at 300 rpm. It produces a power of 125 kW with an overall efficiency of 85%. The speed ratio for the turbine is 0.45 and the coefficient of velocity of nozzle is 0.98. 20

Section B

3. The Francis turbine data : Net head $H = 60$ m, Speed $N = 700$ r.p.m., shaft power = 294.3 kW, $\eta_0 = 84\%$, $\eta_h = 93\%$, flow ratio = 0.20, breadth ratio $n = 0.1$, outer diameter of the runner is 2 times inner diameter of runner. The thickness of vanes occupies 5% of circumferential area of the runner, velocity of flow is

constant at inlet and outlet and discharge is radial at outlet. Determine : Guide blade angle, runner vane angles at inlet and outlet, diameters of runner at inlet and outlet and width of wheel at inlet. **20**

4. A Kaplan turbine working under a head of 20 m develops 15 MW brake power. The hub and runner diameter of the turbine are 1.5 m and 4 m respectively. The guide blade angle at the inlet is 30° . The hydraulic and overall efficiency is 0.9 and 0.8 respectively. The discharge is radial. Find out the runner vane angles and turbine speed. **20**

Section C

5. State Buckingham's π -theorem. The efficiency of η of a fan depends on density ρ , dynamic viscosity μ of the fluid, angular velocity ω , diameter D of the rotor and the discharge Q . Express η in terms of dimensionless parameters. **20**
6. Explain the working of hydraulic ram with neat sketch. What are its advantages ? Also explain the characteristic curves for hydraulic ram. **20**

Section D

7. A centrifugal pump rotating at 1000 r.p.m. delivers 160 litres/s of water against a head of 30 m. The pump installed at a place where atmospheric pressure is 1×10^5 Pa (abs) and vapour pressure of water is 3 kPa (abs). The head loss in suction pipe is equivalent to 0.2 m of water. Calculate : Minimum NPSH and maximum allowable height of the pump from free surface of water in the sump. **20**
8. Draw the indicator diagram for reciprocating pump considering acceleration and friction head in suction and delivery pipes and find an expression for the work done for a single reciprocating pump. **20**

(Compulsory Question)

9. (a) What are various impingement of jets ?
 (b) Define efficiency of Pelton wheel.
 (c) What is draft tube and its functions ?
 (d) Define Euler's equation for turbomachinery.
 (e) What is specific speed ?

- (f) List dimensionless numbers.
- (g) What is Thomas's cavitation number ?
- (h) Write a short note on hydraulic press.
- (i) What is priming of centrifugal pumps ?
- (j) Define NPSH in pumps. 10×2=20

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