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B TECH
(SEM-VI) THEORY EXAMINATION 2018-19
FLUID MACHINERY

Time: 3 Hours ***Total Marks: 70***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. What is the difference between fluid mechanics and fluid machinery?

b. Why are turbines more efficient than pumps?

c. What is whirl velocity in a turbine? Give the significance of whirl velocity.

d. Why do impulse turbine need high head and low flow rate and the reverse is needed for reaction turbine?

e. What is NPSH? Why do we need to calculate NPSH?

f. Why the reciprocating pump is called positive displacement pump?

g. Why do we use an accumulator in a hydraulic system?

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. A jet of water having velocity of 11.5 m/s impinges a vane, which is moving with a velocity of 4.5 m/s. The vane is so shaped that the jet is deflected through 115^0. Find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of the jet at exit in magnitude and direction and the work done per second per unit weight of striking per second? Assume that the vane is smooth.

b. Show that the hydraulic efficiency for a Francis turbine having velocity of flow through runner as constant, is given by the relation:

$$\eta_h = \frac{1}{1 + \frac{\frac{1}{2}tan^2\alpha}{1-\left(\frac{\tan\alpha}{\tan\theta}\right)}}$$

Where α = the guide blades angle and θ = vane angle of the runner and there is no friction on the blades.
The turbine is having radial discharge at outlet.
If the vanes are radial at inlet, then show that,

$$\eta_h = \frac{2}{2 + tan^2\alpha}$$

c. Why are centrifugal pumps used sometimes in series and sometimes in parallel? Give the operational difficulties commonly experienced in centrifugal pumps and their remedies.

d. What is the effect of acceleration of piston on velocity and pressure in the suction and delivery pipe of reciprocating pump? Obtain an expression for the pressure head due to acceleration in the suction and delivery pipes.

e. What is function of torque converter? Describe with the help of a neat sketch its constructional features and working. Discuss its characteristics. State its merits, limitations and applications.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) What do you understand by the term 'jet of water'? Develop an expression for the efficiency of a series of moving curved plates when the jet of water strikes the plate at one of the tips.

(b) Explain why a notch is made in lips of Pelton turbine buckets. A Pelton wheel is working under a head of 550 m and produces 10000 kW at 450 rpm. If the efficiency of the wheel is 85%, determine the discharge of the turbine, diameter of the wheel and diameter of nozzle (assume coefficient of velocity as 0.98 and speed ratio as 0.45.

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) What is cavitation? How does it affect the performance of hydraulic machines? How can it be avoided in reaction turbines? Define Thoma's cavitation number.

(b) An inward flow reaction turbine works under an average head of 160 m with a discharge of 80 m^3/s. The inlet and outlet diameters of the turbine are 4 m and 2 m, respectively. The runner blade angle at the inlet is 120^0. Radial discharge velocity at the outlet is 15 m/s. Assuming constant breadth of wheel and 90% hydraulic efficiency, determine the HP produced in megawatt and the revolution per minute of the machine.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) Explain why priming is necessary to start pumping by centrifugal pump. Briefly explain the significance of similarity parameters in centrifugal pump.

(b) A centrifugal pump has an impeller of 0.5 m outer diameter and when running at 600 rpm, it discharges at the rate of 8000 l/m against a head of 8.5 m. The water enters the impeller without whirl and shock. The inner diameter is 0.25 m and the vanes are set back at outlet at an angle of 45^0 and the area of flow which is constant from inlet to outlet of the impeller is 0.06 m^2. Determine the

(i) Manometric efficiency of the pump
(ii) Vane angle at outlet
(iii) Least speed at which the pump commences to work.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) Show that work saved in overcoming friction in pipelines by fitting air vessels in a reciprocating pump is 39.2% for double acting pump.

(b) A double acting pump runs at 85 double strokes per minute in a harmonic motion. This pump's piston has a diameter of 0.120 m and stroke of 0.220 m. If the pump has a vertical suction pipe which is 5 m long and 110 mm in diameter, then compute the maximum permissible suction lift, assuming that separation occurs at 2m of absolute. Use atmospheric head of water as 10.3 m.

7. Attempt any *one* part of the following: 7 x 1 = 7

(a) What is function of hydraulic press? Describe with the help of a neat sketch its constructional features and working. Discuss its characteristics. State its merits, limitations and applications.

(b) An accumulator is loaded with 400 kN weight. The ram has a diameter of 300 mm and stroke of 6 m. Its friction may be taken as 5%. It takes 2 minute to fall through its full stroke. Find the total work supplied and power delivered to the hydraulic appliance by the accumulator, when 0.0075 m^3/s of liquid is being delivered by a pump, while the accumulator descends with stated velocity.