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B.TECH
(SEM VI) THEORY EXAMINATION 2022-23
FLUID MACHINERY

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

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

SECTION A

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

(a) Write the applications of impulse momentum equation.
(b) Define specific speed of a pump.
(c) Explain functions of casing in Pelton turbine.
(d) Define run away speed of turbines?
(e) Write function of braking jet used in Pelton turbine.
(f) What do you mean by cavitations?
(g) Explain functions of draft tube.

SECTION B

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

(a) Derive an equation of force exerted by a jet on an unsymmetrical curved vane tangentially, when vane is moving in the x-direction. Draw the velocity triangles and explain. Also find the work done and efficiency.

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

$$\eta_h = \frac{1}{1+\frac{\frac{1}{2}tan^2\alpha}{1-\frac{\tan\alpha}{tan\theta}}}$$

Where α = guide blade angle, θ = runner blade angle at inlet.

(c) Show from the first principle that the work saved, against friction in the delivery pipe of a single acting reciprocating pump, by fitting an air vessel is 84.8%.

(d) Show that the pressure rise in the impeller of a centrifugal pump when frictional and other losses in the impeller are neglected is given by $1/2g(Vf_1^2+u_2^2-Vf_2^2 cosec^2\phi)$.

Where V_{f1} and V_{f2} are velocity of flow at inlet and outlet., u_2= tangential velocity of impeller at outlet, and ϕ= vane angle at outlet.

(e) Explain working of hydraulic ram with neat and clean sketch.

SECTION C

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

(a) Prove that maximum efficiency obtained from a series of flat vanes is 50%.
(b) How is the governing of Pelton wheel done? Explain it.

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

(a) The following data pertain to a Kaplan turbine:

Power available at shaft	= 22500kW
Head	= 20m
Speed	= 150 rpm
Hydraulic efficiency	= 95%
Overall efficiency	= 88%
Outer diameter of runner	= 4.5 m
Diameter of the hub	= 2 m

Assuming that the turbine discharges without whirl at exit, determine the runner vane angles at the hub and at the outer periphery.

(b) Derive the expression for degree of reaction for a reaction turbine.

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

(a) A centrifugal pump has the following dimensions:
inlet radius = 80 mm;
outlet radius = 160 mm;
width of impeller at the inlet = 50 mm;
width of the impeller at outlet = 50 mm;
vane angle at inlet and outlet are 0.45 radians and 0.25 radians respectively.
Assume shock less entry determine the discharge and the head developed by the pump when the impeller rotates at 90 radians/second.

(b) Define specific speed of the pump. Also derive the expression for the specific speed of the pump. How does it differ from that of turbine?

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

(a) Explain the working of reciprocating pump with neat and clean sketch.

(b) The diameter and stroke length of a single acting reciprocating pump are 12 cm and 20 cm respectively. The lengths of suction and delivery pipes are 8 m and 25 m respectively and their diameters are 7.5 cm. if the pump is running at 40 r.p.m. and suction and delivery heads are 4 m and 14 m respectively, find the pressure head in the cylinder:

(i) At the beginning of suction and delivery stroke.
(ii) At the middle of suction and delivery stroke.
(iii) At the end of suction and delivery stroke.

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

(a) Explain the working of Hydraulic intensifier with a neat and clean sketch.

(b) Explain the working of hydraulic torque converter with a neat and clean sketch.