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Total No. of Questions : 09] [Total No. of Pages : 03

Paper ID [ME306]

MAY-08

(Please fill this Paper ID in OMR Sheet)

B.Tech. (Sem.- 6th)

FLUID MACHINERY (ME-306)

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section - A

Q1) *(10 × 2 = 20)*

a) Define the terms Euler's head and degree of reaction.

b) Why the buckets of Pelton wheel are provided with an under-cut. What role does the splitter play in the Pelton turbine?

c) Discuss briefly the guide mechanism in reaction turbines.

d) Define specific speed of pump and write its expression.

e) What are unit quantities? Discuss their importance.

f) Justify the statement "Centrifugal pumps having backward curved blades are preferred as compared to those having radial and forward curved blades".

g) What role do the air vessels play in reciprocating pumps?

h) How can you define acceleration head in a reciprocating pump? Show it on the indicator diagram.

i) Define Net Positive Suction Head (NPSH) and write its expression.

j) Draw a neat sketch of simple hydraulic accumulator.

Section - B

(4 × 5 = 20)

Q2) A jet of water impinges at one end of a fixed curved plate tangentially. The diameter of jet is 60 mm and its velocity is 30 m/s. The angle of the plate at the inlet is 30° to the horizontal. Determine the force exerted by the jet on the plate in the horizontal and in the vertical direction if the jet is deflected through an angle of (a) 125° (b) 50°

Also find the magnitude and direction of resultant force in each case.

Q3) Explain the function of draft tube with a neat sketch. Define its efficiency. What is the maximum limit of total angle of divergence of draft tube and why? Why is the draft tube not used with Pelton turbine?

Q4) A single acting reciprocating pump of 20 cm bore and 30 cm stroke handles water. The suction pipe diameter and length are 12 cm and 8 m respectively. The delivery pipe diameter and length 12 cm and 24 m respectively. The speed of operation is 32 rpm. Determine friction power with or without air vessels. Take Darcy's friction factor, f, as 0.02.

Q5) It is proposed to design a homologous model for a centrifugal pump. The prototype pump is to run at 600 rpm and develop 30 m head the flow rate being 1 m^3/s. The model of 1/4 scale is to run at 1450 rpm. Determine the head developed, discharge and power required for the model. Take overall efficiency as 80%.

Q6) With the help of neat diagram, explain the working principle of fluid coupling. Also, describe the slip and the efficiency of the fluid coupling.

Section - C

(2 × 10 = 20)

Q7) (a) Derive the expression for specific speed of turbine. What is the range of specific speed for reaction turbines?

(b) A vertical shaft inward flow reaction turbine works with a net head of 30 m. The external diameter of the runner is 400 mm and the inlet width is 37.5 mm. The inner blade angle at entry is 100° measured from the tangent at the runner periphery drawn at the direction of rotation. Effect of blade thickness at inlet can be neglected. Water enters the runner from the guide blades at an angle of 155° to the tangent at the runner periphery. The velocity of flow through the runner is constant. Water enters the draft tube from the runner without whirl, and the discharge takes place from the draft tube into the tail race with a velocity of 2.5 m/s. The loss of head in the turbine due to friction is 4 m. Determine.

(i) the runner blade angle at a point of the outlet edge, where the radius of rotation is 87.5 mm

(ii) specific speed of turbine

(iii) the approximate value of inlet diameter of the draft tube.

Q8) (a) With the help of neat diagram, show different heads of a centrifugal pump. Also define the following efficiencies

(i) hydraulic

(ii) manometric

(iii) volumetric

(iv) mechanical

(b) Assuming the flow velocity to be constant, prove that manometric head of a centrifugal pump running at speed N and having discharge Q can be expressed as

$$H_{mano} = AN^2 + BNQ + CQ^2$$

Where A, B and C are constants.

Q9) (a) Show that the maximum theoretical efficiency of the Pelton wheel is given by

$$\eta_{max} = \frac{1-k\cos\theta}{2}$$

Where k is bucket friction coefficient and θ is the angle of deflection.

(b) A Pelton wheel driven by two similar jets transmits 3750 kW to the shaft when running at 375 rpm. The head from the reservoir level to the nozzles is 200 m and the efficiency of power transmission through the pipe lines and nozzles is 90%. The jets are tangential to 1.45 m diameter circle. The relative velocity decreases by 10% as the water traverses the buckets, which are so shaped that they would, if stationary, would deflect the jet through 165°. Neglecting windage losses, find

(i) efficiency of the runner

(ii) diameter of each jet.