This question paper contains 4 printed pages.

3270 *Your Roll No.* .....

B. Tech. (E) / III **J**

Paper EME–303

HYDRAULIC MACHINES

Time : 3 hours *Maximum Marks* : 70

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any five questions.
All questions carry equal marks.

1. An inward flow reaction turbine has external and internal diameters as 0·9 m and 0·45 m respectively. The turbine is running at 200 rpm and the width of turbine at inlet is 20 cm. The velocity of flow through the runner is constant and is equal to 1·8 m/s. The guide blades make an angle of 10° to the tangent of the wheel and the discharge at the outlet of the turbine is radial. Draw the inlet and outlet velocity triangles and determine:
   (*a*) The absolute velocity of water at the inlet of runner
   (*b*) The velocity of whirl at the inlet
   (*c*) The relative velocity at the inlet
   (*d*) The runner blade angles

P. T. O.

(*e*) Width of the runner at the outlet.

(*f*) Mass of water flowing through the runner per second

(*g*) Head at the turbine inlet

(*h*) Power developed and hydraulic efficiency of the turbine. 14

2. A radial, single stage, double suction, centrifugal pump is manufactured for the following data:

$Q=75$ L/S; $D_1=100$ mm; $D_2=290$ mm, $H_m=30$ m; $N=1750$ rpm; $b_1=25$ mm per side, $b_2=23$ mm in total, $\alpha=90°$; $\eta_o=55\%$; leakage loss=2·25 L/S: Mech- anical loss=1·04 kW; $\beta=27°$; Contraction factor due to vanes thickness= 0·87.

Determine (*a*) the inlet vane angle, (*b*) the angle at which the water leaves the wheel, (*c*) absolute velocity of water leaving impeller, (*d*) the manometric efficiency and (*e*) the volumetric and mechanical efficiencies. 14

3. A double acting single-cylinder reciprocating pump of 12·5 cm bore and 25 cm stroke runs at 36 rpm. The centre of pump is 4 m above the level of water in the sump and 30 m below the delivery water level. The lengths of the suction and delivery pipes are 6 m and 35 m and the diameter of each pipe is 6 cm. Assuming simple harmonic motion, find the pressure head in metres of water on the piston at the beginning, mid

and end of suction and delivery strokes. Take atmospheric pressure head=10·30 m of water and friction coefficient f=0·01 for both the pipes.

If the mechanical efficiency is 75%, calculate the power required to drive the pump. Also calculate the maximum head at any instant against which the pump has to work and its corresponding duty. 14

4. With the help of suitable sketches explain the function, operation and construction details of Fluid Coupling and Torque Converter. 14

5. (*a*) Explain the terms 'Cavitation' and 'Thoma's cavitation number'. Why does cavitation occur and what are its effects?

(*b*) A Francis turbine works under a head of 25 m and produces 11·76 MW while running at 120 rpm. The turbine has been installed at a station where atmospheric pressure is 10 m of water and vapour pressure is 0·2 m of water. Calculate the maximum height of the straight draft tube for the turbine. 7+7

6. (*a*) Discuss in general the main and operating characteristics of a centrifugal pump. What is the importance of constant efficiency curves?

(*b*) Explain head *vs.* discharge characteristics of a pump. Discuss the Slip factor. 7+7

P. T. O.

7. (*a*) Explain the construction and working of a propeller turbine with the help of a suitable sketch.

   (*b*) Explain the function and theory of draft tube and sketch some typical draft tubes. 7+7

8. Write short notes on the following:

   (*i*) Specific speed of a rotodynamic m/c

   (*ii*) Hydraulic lift

   (*iii*) Hydraulic press

   (*iv*) Air vessels. $3\frac{1}{2} \times 4$

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