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Total No. of Questions : 09]

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Paper ID [A0821]

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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) Distinguish between an impulse turbine and a reaction turbine.

b) What role does the surge tank play in hydro - electric power plant?

c) What are the different ways to control the flow through the Pelton turbine?

d) Why is it necessary to install draft tube at the runner exit in a reaction turbine?

e) Differentiate between Francis and Kaplan turbines.

f) Define specific speed of turbine and write down its expression.

g) What do you understand by priming of the centrifugal pump? Explain briefly.

h) Distinguish between the positive displacement and non-positive displacement pumps. Give one example for each pump.

i) Define slip for reciprocating pumps. When does the negative slip occur.

j) Draw a neat sketch of hydraulic intensifier.

Section - B

(4 × 5 = 20)

Q2) A jet of water 25 mm in diameter and moving with a velocity of 10 m/s strikes horizontally at the centre of square plate of edge 250 mm. The plate is of uniform thickness and has a mass of 7 kg. It is suspended vertically by a hinge on its top horizontal edge. Find

(a) the force to be applied at the lower edge to keep the plate vertical.

(b) the angle of inclination of the plate if it is allowed to swing freely.

Q3) Draw the performance characteristic curves for both impulse and reaction turbines and discuss their nature.

Q4) Derive the expression for the acceleration head in a reciprocating pump with a neat sketch. Show the variation in suction and delivery acceleration and friction heads along the stroke length on indicator diagram.

Q5) A homologous model of a centrifugal pump runs at 600 rpm against a head of 8 m, the power required being 5 k W. If the prototype 5 times the model size is to develop a head of 40 m, determine its speed, discharge and power. The overall efficiency of the model is 0.8 while that of prototype is 0.85.

Q6) With the help of neat diagram, explain the working principle of torque converter. Define the efficiency of the torque converter. Compare the efficiencies of the fluid coupling and the torque converter.

Section - C

(2 × 10 = 20)

Q7) (a) Draw a neat sketch of hydroelectric power plant and label all the components from head race level to tail race level.

(b) At hydroelectric power plant, water available under a head of 250 m is delivered to the power house through three pipes each 2500 m long. Through these pipes the friction loss is estimated to be 20 m. The project is required to produce a total shaft output of 13.25 MW by installing a number of single jet pelton wheels whose specific speed is not to exceed 38.5. The wheel speed is 650 rpm, overall efficiency is 0.85 and speed ratio is 0.46. Determine (i) the number of pelton wheels to be used (ii) jet diameter (iii) diameter of supply pipe. Take velocity coefficient for the nozzle and Darcy's friction factor as 0.97 and 0.02 respectively.

Q8) (a) With the help of neat sketch, draw the inlet and exit velocity triangles for (i) Forward curved (ii) Radial curved and (iii) Backward curved blade centrifugal pumps. How does the Euler's head vary with discharge in the above mentioned type of centrifugal pumps? Give reason why the backward curved blade centrifugal pumps are most commonly used.

(b) The diameter of the impeller of a centrifugal pump is 800 mm. The pump delivers water at the rate of 90 m^3 / min. The head raised by is 72 m and the speed is 900 rpm. Peripheral area of the outlet is 0.3 m^2. The vanes of the impeller are curved back at 30° to the tangential direction. The leakage loss is 2.5 %., the input head is reduced by 20% of the theoretical head and the external mechanical losses are 30 kW. Find the power input and the overall efficiency of the pump.

Q9) (a) Explain the phenomenon of cavitation and its effect. Define Thoma's cavitation number and cavitation factor. Describe different methods of preventing cavitation.

(b) The inlet and the outlet runner blade angles of a propeller turbine are 90° and 25° respectively to the tangential direction of the runner. The inlet guide vane angle is 30°. The speed of the turbine 30 rpm. The mean diameter of the runner blades is 3.6 m and the area of flow is 30 m^2. Assuming that the velocity of flow is constant throughout, determine (i) Discharge (ii) Power developed (iii) Hydraulic efficiency (iv) Specific speed.