B.E. MECHANICAL ENGINEERING SECOND YEAR SECOND SEMESTER - 2019

Ref. No. EX/ME/T/222/2019

Fluid Machinery-I

Time:-Three Hours Full Marks:-100

Answer Any Five Questions

Assume any data relevant to the questions if not provided

Answer all parts of same question together

1. a) Draw a neat sketch of a reaction turbine along with the components. State the functions of each component. (10)
   b) Define the following in connection with a hydraulic turbine:
   i) Volumetric Efficiency ii) Net head iii) Hydraulic Efficiency iv) Mechanical Efficiency. (10)

2. a) Distinguish between Pelton wheel turbine and Reaction turbine. What is surge tank and why it is used? (10)
   b) Show that for a Pelton wheel turbine the efficiency is maximum when the peripheral velocity is 50% of the flow velocity at inlet. (10)

3. a) With neat diagram explain different types of draft tubes and derive its efficiency. (10)
   b) A Pelton wheel 3.0 m diameter operates under the following conditions:
   Net available head, H=350 m
   Rotational speed, N=400 r.p.m.
   Co-efficient of velocity=0.98
   Blade friction coefficient=0.96
   Blade angle=165°
   Diameter of the jet, d=30 cm
   Mechanical Efficiency=90%
   Draw the inlet and outlet velocity diagram and determine the following:
   i) The power developed
   ii) Hydraulic Efficiency
   iii) Dimensional and non-dimensional specific speed. (10)

4. a) What do you understand by forward, radial and backward facing blades of a Centrifugal pump? Draw the theoretical and actual H vs. Q curves for all of them. Explain why the theoretical curves are linear but the actual curves are non-linear. (10)
   b) A centrifugal pump running at 1000 r.p.m. is working against a total head of 25 m. The external diameter of the impeller is 500 mm and outlet width is 65 mm. If the vane angle at outlet is 35° and manometric efficiency is 72%, determine:
   i) Flow velocity at outlet

ii) Absolute velocity of water leaving the vane
ii) Angle made by the absolute velocity at outlet with the direction of motion at outlet
iii) Rate of flow through the pump. (10)

5.

a) What is cavitation? Where is the probable chance of cavitation in a Francis Turbine and a Centrifugal Pump? (10)

b) In an inward flow reaction turbine the head on the turbine is 32 m. The external and internal diameters are 1.44 m and 0.72 m respectively. The velocity of flow through the runner is constant and equal to 3 m/s. The guide vane angle is 10^{o} and the runner vanes are rigid at inlet. If the discharge at the outlet is radial, determine:

i) The speed of the turbine
ii) The vane angle at the outlet of the runner
iii) The hydraulic Efficiency. (10)

6.

a) Explain the working principle of a Kaplan Turbine with a neat sketch. What are the advantages of a Kaplan Turbine over the Francis Turbine? (10)

b) Calculate the diameter and speed of the runner of a Kaplan turbine developing 6000 kW under the effective head of 5 m. Overall efficiency of the turbine is 90%. The diameter of the boss is 0.4 times the external diameter of the runner. The turbine speed ratio is 2.0 and flow ratio is 0.6. What is the specific speed of the turbine? (10)

7.

a) Explain the working principle of a reciprocating pump. (10)

b) A single acting reciprocating pump has a diameter of piston of 150 mm and stroke length 350 mm. The centre of the pump is 3.5 m above the water surface in the sump and 22 m below the delivery water level. Both the suction and delivery pipes have the same diameter of 100 mm and are 5 m and 30 m long respectively. If the pump is working at 30 r. p. m., determine:

(i) The pressure heads on the piston at the beginning, middle and end of both suction and delivery strokes.

(ii) The power required to drive the pump.
The atmospheric pressure is 10.3 m of water. (10)

8. Write Short notes on any four of the following: (4 X 5=20)

1) Impeller of a Centrifugal Pump
2) Penstock
3) Priming of a Centrifugal Pump
4) Wicket gate
5) Specific Speed of a Centrifugal Pump
6) Air Vessel