Ref. No.: Ex/ME(M2)/PC/B/T/222/2022

B. E. Mechanical Engineering Second Year Second Semester Examination, 2022

Fluid Machinery-I

Time:-Three Hours Full Marks:-100

Answer Any Five Questions

Assume any data relevant to the questions if not provided

1. a) Draw a neat sketch of a Pelton wheel along with the components. State the Functions of each component. (10)

   b) Derive the conditions for which the wheel efficiency for a Pelton wheel is maximum. (10)

2. a) What are the differences between an impulse turbine and a reaction turbine? Draw the theoretical and actual efficiency vs. blade speed ratio curves for a Pelton wheel turbine. Explain why they differ. (10)

   b) A Pelton wheel running at 260 r.p.m. and operating under an available head of 250 m is required to develop 2.5 M.W. There is only one jet with nozzle diameter 15 cm and the bucket deflection angle is 165°. The co-efficient of velocity of nozzle = 0.98 and blade speed ratio = 0.46. Determine the following:

   i) The Turbine Efficiency
   ii) Bucket pitch circle diameter
   iii) Hydraulic efficiency of the turbine. (10)

3. a) What is manometric efficiency? Write down different expressions for manometric head. (10)

   b) The following data are given for a centrifugal pump:
   Outer diameter = 2 x Internal diameter
   Speed = 3000 r. p. m.
   Internal Diameter = 100 mm.
   Width of Impeller at outlet = 20 mm.
   Blade angle at outlet = 30°
   Flow velocity at inlet = Flow velocity at outlet= 3 m/s
   Manometric Efficiency = 80%
   Overall Efficiency = 70%

   i) Inlet vane angle
   ii) The rate of discharge
   iii) The manometric efficiency.
   iv) The shaft power. (10)

4. a) Derive the equation $H = \left(\frac{\pi DN}{60}\right)^2 - \left[\frac{\pi DN}{60A}\cot\beta_2\right]Q$, in connection with a centrifugal pump, where the symbols have their usual meanings. Draw the H *vs.* Q curves (both theoretical and actual) for radial, backward and forward facing blades. Why the actual curves are parabolic in nature? (10)

b) The outer diameter of an impeller of a centrifugal pump is 400 mm and outlet width 50 mm. The pump is running at 800 r.p.m. and is working against a head of 15 m. The vanes are set back at an angle of 40° and manometric efficiency is 75%. Determine the following:

i) Velocity of flow at outlet,
ii) Velocity of water leaving the vane,
iii) Angle made by the absolute velocity at outlet with the direction of motion at outlet and
iv) The discharge. (10)

5. a) Draw the sectional views of a Francis turbine and level different components of the same. (10)

b) The external and internal diameters of an inward flow reaction turbine are 1.2 m and 0.6 m respectively. The head on the turbine is 22 m and the velocity of flow through the runner is constant and equal to 2.5 m/s. The guide vane angle is given as 10° and the runner vanes are radial at inlet. If the discharge at outlet is radial, determine

i) The speed of the Turbine
ii) The outlet blade angle and
iii) The Hydraulic efficiency. (10)

6. a) With a neat sketch explain the working principal of a reciprocating Pump. (10)

b) Draw the Indicator diagram for the reciprocating pump and explain. Why Air vessel is used in Reciprocating pump. (10)

7. Write Short notes on any two of the following: (2 X 10=20)

1) Cavitation 2) Priming of a Centrifugal Pump 3) Specific speed of a Turbine
4) Surge tank 5) Penstock 6) Different losses of a centrifugal pumps.