Total No. of Questions :6]

SEAT No. :

P45

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Oct./ TE/ Insem. - 159

T.E. (Mechanical)

TURBO MACHINES

(2015 Pattern) (Semester - I) (302044)

Time : 1 Hour] *[Max. Marks :30*

Instructions to the candidates:

1) *Answer Q.1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6.*
2) *Figures to the right indicate full marks.*
3) *Use of scientific calculator is allowed.*
4) *Assume data wherever necessary and mention it.*
5) *Draw neat and suitable figures wherever necessary.*

Q1) a) Define Turbo Machines. Give classification of Turbo Machines. **[4]**

b) A jet of water 5 cm diameter moving with a velocity of 25 m/sec. Strikes horizontally a single moving vane, moving in the direction of jet with velocity of 16 m/sec. The vane deflects the jet through 130º. Find the axial force exerted by the jet on the vane. Also find the velocity and direction of water at outlet. Neglect friction. **[6]**

OR

Q2) a) Prove that the work done per second on a series of moving curved vanes by a jet of water striking at one of the tips of the vane tangentially is given by, Work done/sec = $\rho a V_1 [V_{w1} \pm V_{w2}] \times u$. **[4]**

b) A jet of water of diameter 70 mm moving with velocity 20 m/s strikes a fixed plate in such a way that the angle between jet and the plate is 60 degree. Find the force exerted by jet on plate in following cases: **[6]**

i) In the direction normal to the plate

ii) In the direction of jet.

Q3) a) Explain the constructional details of Pelton Wheel (turbine). **[4]**

b) A Pelton turbine is required to work under a head of 250 m to develop 20 MW at 375 rpm. Considering speed ratio of 0.46, jet ratio of 10, mechanical efficiency of 94%, angle of deflection 165 degree and nozzle coefficient as 0.97 determine the number of jets, diameter of runner and number of buckets. Assume bucket friction factor of 0.88. **[6]**

OR

P.T.O.

Q4) a) Derive expression for Unit speed and Unit Discharge. **[4]**

b) Double Jet Pelton Wheel has a specific speed of 14 and is required to deliver 1000 kW. The turbine is supplied through pipeline from a reservoir whose level is 400 m above the nozzles. Allowing 5% for frictional loss in the pipe, calculate: **[6]**

i) Speed in RPM

ii) Diameter of jets.

iii) Mean Diameter of Bucket circle

Take Cv = 0.98, speed ratio = 0.46 and overall efficiency = 85%, the specific speed is based on power output per jet.

Q5) a) Define Jet Ratio and Degree of reaction. **[4]**

b) For the Francis turbine following data is available shaft power = 130 kW Net Head = 9m, Speed = 120 RPM, Overall efficiency = 75%, Hydraulic efficiency = 90%, Velocity of flow at inlet = 1.15 $\sqrt{H}$, **[6]**

Maximum absolute velocity at inlet = 3.45 $\sqrt{H}$ assume radial discharge at exit, find

i) Guide blade angle and moving vane angle at inlet

ii) Diameter of runner at inlet.

OR

Q6) a) A Kaplan turbine operates at a discharge of 77 m^3/s. The runner diameter and hub diameter are 4.2 m and 1.5 m respectively. Taking the speed ratio of 2.1. Determine

i) The net head,

ii) The power developed and

iii) The specific speed.

Assume the mechanical and hydraulic efficiency of 88% and 92% respectively and no whirl at outlet. **[6]**

b) Draw construction and details of Kaplan Turbine. **[4]**