Total No. of Questions : 8]

SEAT No. :

PE2310

[Total No. of Pages : 3

[6584]-219
B.E. (Mechanical)
TURBO MACHINERY
(2019 Pattern) (Semester - VII) (402043)

Time : 2 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Use of steam table/Mollier chart is allowed.***
4) ***Use of non programmable calculator is allowed.***
5) ***Figures to the right indicates full marks.***

Q1) a) Show that the efficiency of a free jet striking normally on a series of flat plates mounted on the periphery of a wheel can never exceed 50%. **[6]**

b) A 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% frictional loss in the pipe,

Calculate:

i) Speed of the turbine

ii) Diameter of jets and

iii) Mean diameter of bucket circle.

Take C_v = 0.98, speed ratio = 0.46, and overall efficiency of turbine = 85%. The specific speed is based on power output per jet. **[8]**

OR

Q2) a) Explain the functions of following **[6]**

i) casing of Pelton wheel

ii) Notch of bucket

iii) Governing mechanism.

b) A Francis turbine with an overall efficiency of 80% is required to produce 130 kW. It is working under a head of 10 m. The peripheral velocity is $0.24\sqrt{2gH}$ and the radial velocity of flow at inlet is $0.9\sqrt{2gH}$. The wheel runs at 150 rpm and the hydraulic losses in the turbine are 10% of

P.T.O.

the available energy. Assuming radial discharge, **[8]**
determine-

i) The guide blade angle
ii) The wheel vane angle at inlet
iii) Diameter of the wheel at inlet and
iv) Width of the wheel at inlet

Q3) a) Why governing of steam turbines is necessary? Explain with neat sketch throttle governing of Steam turbine. **[6]**

b) In an impulse turbine (with a single row wheel) the mean diameter of the blades is 1.05 m and the speed is 3000 rpm. The nozzle angle is 18º, the ratio of blade speed to steam speed is 0.42 and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.84. The outlet angle of the blades is to be made 3° less than the inlet angle. The steam flow rate is 10 kg/sec. Draw the velocity diagrams for the blades and **[6]**
Calculate :

i) Tangential thrust on the blades
ii) Axial thrust on the blades and
iii) Resultant thrust on the blades.

OR

Q4) a) Explain degree of reaction in steam turbines? Why 100% reaction steam turbine is not possible? **[6]**

b) In a reaction steam turbine, the blade tips are inclined at 35º and 20º in the direction of motion. The guide blades are of the same shape as the moving blades, but reversed in direction. At a certain place in the turbine, the drum diameter is 1 m and the blades are 10 cm high. At this place, the steam has a pressure of 1.75 bar and dryness 0.935. If the speed of this turbine is 250 rpm and the steam passes through the blades without shock, find the mass of steam flow and power developed in the ring of moving blades. Velocity of flow is 10.8 m/sec and remains constant from inlet to outlet. Specific volume of dry saturated steam at a pressure of 1.75 bar is 1.004 m^3/kg. **[6]**

Q5) a) What do you mean by cavitation? Explain the phenomenon of cavitation in centrifugal pump. **[6]**

b) A centrifugal pump has effective areas of flow of 15 cm^2 and 17.5 cm^2 at outlet and inlet respectively. Water enters the impeller radially with 5 m/sec. The vanes are set back at 25º to the tangent at outlet. The

peripheral velocities of vane tips at outlet and inlet are 30 m/sec and 15 m/sec respectively. The manometric efficiency is 80%. Neglecting impeller losses, Determine- **[6]**

i) Percentage of outlet velocity head recovered in the diffuser passage.

ii) Inlet angle of diffuser vanes.

OR

Q6) a) Discuss various methods of priming of centrifugal pump. **[6]**

b) A centrifugal pump discharges water at the rate of 0.60 m^3/sec against a head of 20 m. It runs at 1000 rpm. Water enters the impeller radially and the velocity of flow remains constant throughout at 3 m/sec. The manometric efficiency of the pump is 80% and the loss of head due to friction over the impeller is 0.025 V_2^2 m of water. Assume inner diameter as half the outer diameter. **[6]**

Determine -

i) Vane angles at inlet and outlet

ii) Diameter of impeller and

iii) Area of flow at outlet.

Q7) a) The following data is used for a centrifugal compressor. **[6]**

Diameter of inlet eye of the compressor impeller = 35 cm, Mass flow rate =10 kg/sec, Total pressure ratio = 3.6, Axial velocity at inlet = 140 m/sec, Velocity in delivery pipe = 120 m/sec, Tip speed of impeller = 460 m/sec, Speed of compressor = 18000 rpm, Total head isentropic efficiency = 85% Ambient condition = 1.013 bar and 15ºC.

Find -

i) Static pressure and temperature at inlet and outlet

ii) Static pressure ratio

iii) Work done per kg and

iv) Theoretical power

b) What is prewhirl in a centrifugal compressor? Why is it necessary? **[6]**

OR

Q8) a) Explain the phenomenon of surging and stalling in an axial flow compressor. **[6]**

b) Explain various losses in axial flow compressor. **[6]**