Total No. of Questions :10]

SEAT No. :

P3574

[Total No. of Pages : 4

[5560]-518
T.E. (Mechanical)
TURBO MACHINES
(2015 Pattern) (Semester-I) (302044)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.***
2) ***Figures to the right side indicate full marks.***
3) ***Use of Scientific Calculator and steam table is allowed.***
4) ***Assume data wherever necessary and mention it.***
5) ***Draw neat and suitable figures wherever necessary.***

Q1) a) Derive the expression for the force exerted by a jet of water on a hinged plate in the direction of jet. **[4]**

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% for frictional loss in the pipe, calculate:

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. **[6]**

OR

Q2) a) 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 = $1.15\sqrt{H}$, 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. **[6]**

b) Define unit quantities for the turbines. **[4]**

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Q3) a) Explain the necessity of draft tube in reaction turbines. **[4]**

b) A Kaplan turbine operates at a discharge of 77 m^3/s. The runner diameter and hub diameter are 4.2m and 1.5m 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]**

OR

Q4) a) Define

i) Mechanical efficiency

ii) Run away speed. **[4]**

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

Q5) a) Compare impulse turbine & reaction steam turbine. **[4]**

b) Explain the need of compounding in steam turbines. Discuss any one method. **[4]**

c) Steam issues from the nozzles at angle of 20° at a velocity of 440m/s. The friction factor is 0.9. For a single stage turbine designed for maximum efficiency, determine

i) the blade velocity

ii) moving blade angles for equi-angular blades

iii) the blade efficiency

iv) the stage efficiency if the nozzle efficiency is 93%

v) power developed for a mass flow rate of steam of 3kg/s. **[8]**

OR

Q6) a) For a certain stage of 50% reaction turbine mean root diameter is 1.35m and speed ratio is 0.69. The rotor speed is 3000 rpm and outlet blade angle is 55°. Find:

i) Inlet blade angle

ii) Blade efficiency and maximum blade efficiency **[8]**

b) Define the following terms

i) Diagram efficiency

ii) Nozzle efficiency **[4]**

c) Explain with neat sketch throttle governing of steam turbine. **[4]**

Q7) a) Explain the effect of blade angle (outlet) on discharge in centrifugal pump. **[4]**

b) Explain NPSH and cavitation with respect to centrifugal pump. **[4]**

c) A three stage centrifugal pump has impeller diameter at outlet 400 mm and 20 mm wide. The vane angle at outlet is 45° and the area occupied by the thickness of vane is 8% of total area. Inner diameter of impeller is half of outer diameter and inlet width is twice as that of outlet. The pump discharges 3.6 m^3 per minute and runs at 920 rpm. Flow velocity is constant from inlet to outlet. Find

i) Power output of pump in kW.

ii) Total manometric head

iii) Specific speed

iv) Shaft Power

v) Vane angle at outlet

Take mechanical efficiency = 88%

Manometric efficiency = 77%. **[10]**

OR

Q8) a) A centrifugal pump at 900 rpm has an impeller diameter of 500mm and eye diameter of 300 mm. The blade angle at outlet is 35° with tangent. Determine assuming zero whirl at inlet, the inlet blade angle, absolute velocity at outlet and its direction and the manometric head. The velocity of flow is constant throughout and is 3 m/sec. **[10]**

b) What is the significance of specific speed? Derive the relation for the same for centrifugal pump. **[4]**

c) Explain different types of casing used in centrifugal pumps. **[4]**

Q9) a) Explain the construction and working of an axial flow compressor. **[6]**

b) A centrifugal compressor develops a pressure ratio of 5 and an air consumption of 30 kg/s. The inlet temperature and pressure are 15°C and 1 bar respectively. If isentropic efficiency is 0.85, Calculate

i) The work done

ii) Exit total temperature

iii) the power required. **[6]**

c) Describe the classification of compressors. **[4]**

OR

Q10)a) Following data is given for a centrifugal compressor.

i) RPM = 15000

ii) Air flow rate = 30 kg/sec.

iii) Air enters the compressor axially

iv) Conditions at exit : Radius = 0.3 m and relative velocity of air at the tip = 100 m/s at an angle of 80°. Find the torque and power required to drive the compressor. **[8]**

b) Explain surging and chocking of centrifugal compressor. **[8]**

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