Total No. of Questions :10]

SEAT No. :

P1695

[Total No. of Pages :4

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T.E. (Mechanical)

TURBO MACHINES

(2012 Pattern) (End Semester) (Semester - II)

Time : 2½Hours] *[Max. Marks :70*

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, Q.9 or Q.10.***
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) A Pelton turbine develops 3000 kW under a head of 400 m. The overall efficiency of the turbine is 87%. If the speed ratio is 0.48 and the coefficient of velocity is 0.96 and specific speed 18, Find **[6]**

i) Diameter of the turbine

ii) Diameter of the jet

b) 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%. **[4]**

OR

Q2) a) The external & internal diameters of an inward flow reaction turbine are 2 m & 1 m respectively. The head on the turbine is 60 m. The width of the vane at inlet & outlet are same and equal to 0.25 m. The runner vanes are radial are inlet & discharge is radial at outlet. The speed is 200 rpm and the discharge is 6 m^3/s. Determine: **[6]**

i) The vane angle at outlet and inlet of the runner

ii) The hydraulic efficiency

b) Define specific speed of turbine & state its significance. **[4]**

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Q3) a) Define the term: Degree of reaction and explain the meaning of pure reaction and 50% reaction turbines. **[4]**

b) A Kaplan turbine develops 1500 kW under a head of 6 m. The turbine is set 2.5 m above the tailrace level. A vacuum gauge inserted at the turbine outlet records a suction head of 3.2 m. If the turbine efficiency is 85%, what will be efficiency of the draft tube having inlet diameter of 3 m. (Neglect losses in draft tube). **[6]**

OR

Q4) a) Define the following terms: **[4]**

i) Diagram efficiency

ii) Nozzle efficiency

b) In a Parson's turbine running at 1500 rpm, the available enthalpy drop for an expansion is 63 kJ/kg. If the mean diameter of the rotor is 100 cm, find the number of moving rows required. Assume that efficiency of a stage is 0.8, blade outlet angle 20^{o} and speed ratio 0.7. **[6]**

Q5) a) Derive an expression for the minimum speed for starting a centrifugal pump. **[6]**

b) Explain different types of casing used in centrifugal pump. **[4]**

c) A centrifugal pump delivers 1800 lit / min against a total head of 20 m. Its speed is 1450 rpm. Inner & outer diameters of impeller are 120 mm & 240 mm respectively and the diameter of suction & delivery pipes are both 100 mm. Determine the blade angles of the impeller vane at inlet & outlet respectively if the water enters radially. Assume manometric efficiency is 0.90. **[8]**

OR

Q6) a) Derive an expression of specific speed of centrifugal pump? **[6]**

b) Write a short note on Priming of a centrifugal pump. **[4]**

c) A three stage centrifugal pump has impellers 50 cm diameter and 3 cm width at outlet. The thickness of the blades has reduced the circumferential area by 10%. The manometric efficiency is 90%, overall efficiency is 80%,, whirl velocity at outlet is 20 m/s, velocity of flow at outlet is 2.25 m/s and speed is 1000 rpm. Calculate **[8]**

i) Head generated

ii) Discharge

iii) Exit vane angle

iv) Shaft power

Q7) a) Explain the terms surging and choking in a rotary compressor. **[6]**

b) The inlet conditions of a centrifugal compressor are 1 bar, 30°C and running at 10000 rpm. It delivers a free air stream of 1.5 m^3/s. The compression ratio is 5. The velocity of flow is 50 m/s and is constant. Assume that the blades are radial outlet & the slip factor is 0.92, Calculate

i) Temperature of air outlet

ii) Power required

iii) Impeller diameter

iv) Diffuser inlet angle

v) Blade angle at inlet

Assume that power factor is 1.11 and isentropic efficiency is 0.90. **[10]**

OR

Q8) a) A centrifugal compressor develops a pressure ratio of 5.0 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 **[6]**

i) The work done

ii) Exit total temperature

iii) The power required

b) What do you mean by slip & slip factor? Why diffusers are necessary in a centrifugal compressor? **[6]**

c) What is 'Pre-whirl' in centrifugal compressor? Why it is necessary? **[4]**

Q9) a) Compare Axial flow compressor and Centrifugal compressor. **[4]**

b) Write a short note on losses in axial flow compressor. **[4]**

c) The ambient conditions at inlet are 20°C and 1 bar. At exit the total head temperature and pressure are 150°C and 3.5 bar, and static pressure at exit is 3 bar. Calculate **[8]**

i) Isentropic efficiency

ii) Polytropic efficiency

iii) Air velocity at exit

OR

Q10)a) Represent and explain the process involved in axial flow compressor on (h-s) diagram And derive an expression for isentropic efficiency and stage pressure ratio. **[6]**

b) The speed of an axial flow compressor is 15000 rpm. The mean diameter is 0.6 m. The axial velocity is constant and is 225 m/s. The velocity of whirl at inlet is 85 m/s. The work done is 45 kJ / kg of air. The inlet conditions are 1 bar & 300 K. Assume a stage efficiency of 0.89, mechanical efficiency of 0.95 & power developed is 425 kW. **[10]**

Calculate:

i) Fluid deflection angle

ii) Pressure ratio

iii) Mass flow rate

iv) Shaft power