

Total No. of Questions :10]

SEAT No. :

P1695

[Total No. of Pages :4

[5058] - 317

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 at inlet & discharge is radial at outlet. The speed is 200 rpm and the discharge is 6 m³/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]

P.T.O.

- 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° 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]
- Head generated
 - Discharge
 - Exit vane angle
 - 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 m³/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

- Temperature of air outlet
- Power required
- Impeller diameter
- Diffuser inlet angle
- 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]

- The work done
 - Exit total temperature
 - 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

