Total No. of Questions : 10]

SEAT No. :

P2406

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T.E. (Mechanical) (Semester - II)

TURBO MACHINES

(2012 Pattern)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Solve 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 electronic pocket calculator is allowed.***
4) ***Assume suitable data if necessary.***

Q1) a) What is degree of reaction? Explain its significance. **[4]**

b) A Pelton turbine is to be designed for the following specifications: **[6]**

Power to be developed = 120 MW,

Net head available = 500 m,

Speed = 200 rpm,

Ratio of jet diameter to wheel diameter = l/l0,

Hydraulic efficiency = 86%,

Velocity coefficient = 0.98,

Speed ratio = 0.46.

Calculate

i) Volume flow rate of water required

ii) Number of jets

iii) Diameter of each jet

OR

P.T.O.

Q2) a) What is draft tube? Define efficiency of draft tube. **[4]**

b) A 7.5 cm diameter jet having velocity of 12 m/s impinges in a smooth Plate at an angle of 60º to the normal to the plate. What will be the force when **[6]**

i) The plate is stationery

ii) When the plate is moving in the direction of jet at 6 m/s

iii) Work done per sec in each case

Q3) a) The quantity of water available for hydroelectric station is 250 m^3/s under a head of 2 meter. Assuming the speed of the turbine to be 50 rev/min and efficiency of 85%. Determine the number of turbine required. Assume specific speed of 800. **[4]**

b) Explain with suitable sketch different methods compounding of steam turbines. **[6]**

OR

Q4) a) The following particulars refer to a stage if Parson's turbine comprising one ring of fixed blade and one blade of moving blades; Mean diameter of the blade ring = 70 cm, RPM = 3000, steam velocity at exit from blade = 160 m/s, blade outlet angle = 20º, steam flow through blades = 7 Kg/s. Draw the velocity diagram and find the following. **[6]**

i) Blade inlet angle,

ii) Tangential force on the ring of a moving blade,

iii) Power developed in a stage

b) What is cavitation ? On what factors does the cavitation in reaction turbinesdepend? **[4]**

Q5) a) Explain manometric head, manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump? **[8]**

b) A three stage centrifugal pump has impellers 30 cm diameter and 1.5 cm width at outlet. The velocity of water at inlet is radial, the vanes are curved back at an angle of 30º to the tangent at outlet and occupy 8% of

the outlet area. While running at 1000 rpm , the pump delivers 40 lit/sec with 85% manometric efficiency and 75% overall efficiency. Calculate the head generated by the pump and the input power. **[10]**

OR

Q6) a) A centrifugal pump with a discharge 1565 lit/sec against a mean lift of 6.1 m when the impeller rotates at 200 rpm. The impeller diameter is 12 cm and area of the outlet periphery is 6450 cm^2. If the vanes are set back at an angle of 26º at the outlet. Find :

(i) Hydraulic efficiency

(ii) Power required to drive the pump.

If the ratio of external to internal diameter is 2, find the maximum speed to start pumping. **[12]**

b) What is multistaging in a centrifugal pump ? Describe the methods used for multi staging. **[6]**

Q7) a) A centrifugal blower compressors 4.8 m^3/s of air from 1 bar and 20ºC to 1.5 bar. The index of compression is 1.5. The flow velocity at inlet and outlet of the machine is the same and equal to 65 m/s . The inlet and outlet diameter are 0.32 m and 0.62 m. The blower rotates at 8000 rpm. Calculate :

i) The blade angle at outlet and inlet of the impeller

ii) Absolute angle at the tip of the impeller

iii) Breadth of the blade at inlet and outlet

Assume that no diffuser is employed and pressure increase take place in the impeller and blades have negligible thickness. **[10]**

b) Explain slip and prewhirl in connection to centrifugal compressors. **[6]**

OR

Q8) a) Explain the working of a centrifugal compressor with a neat sketch. **[8]**

b) A rotary compressor working between 1 bar and 15ºC and 2.5 bar has internal and external diameter of impeller as 300 mm and 600 mm

respectively. The vane angle at intel and outlet are 30° and 45° respectively. If air enters the impeller at 15 m/s , find **[8]**

i) Speed of impeller in rpm

ii) Work done by the compressor per kg of air

Q9) a) What is surging in axial-flow compressors? What are its effects? Describe briefly. **[8]**

b) An axial flow compressor with a pressure ratio of 5 draws air at 20ºC and delivers it at 55ºC. Determine the velocity of flow if the blade velocity is 100 m/s and number of stages . Assume 50% degree of reaction and work done factor of 0.87. Take $\alpha_1 = 10°$, $\beta_1 = 40°$. Assume specific heat of air = 1 kJ/kg. **[8]**

OR

Q10)a) An axial flow compressor having 10 stages and with 50% reaction compresses air with a pressure ratio 5:1. Air enters the compressor at 25ºC and flows at a constant velocity of 100 m/s. The blades rotate with a mean speed of 200 m/s. Assuming isentropic efficiency of compressor as 85%. Calculate the blade angles and work required by the machine per kg of air. **[10]**

b) Compare axial flow compressor and centrifugal compressor on the following points **[6]**

i) range of operation within surging and chocking limits

ii) effect on performance when working with contaminated fluids

iii) isentropic efficiency

iv) pressure ratio per stage

v) delivery pressure possible

vi) multistaging limits