Total No. of Questions : 10]

SEAT No. :

P3670

[Total No. of Pages : 4

[4758]-517

T.E. (Mechanical)

TURBO MACHINES

(2012 Pattern) (Semester - II) (302049) (End - Semester)

Time : 2½ Hours] *[Max. Marks :70*

Instructions to the candidates:

1) ***Answer Q.No.1 or 2, Q.No.3 or 4, Q.No.5 or 6, Q.No.7 or 8, Q.9 or Q.10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of Calculator, Steam Table is allowed.***
5) ***Assume suitable data if necessary.***

Q1) a) A jet of water moving with V m/s strikes at the centre of a curved vane which is moving with 'u'm/s. If the outgoing jet makes an angle θ with the incoming jet, prove that **[6]**

i) Maximum efficiency = $\eta_{max} = \frac{8}{27}(1+\cos\theta)$

ii) Blade speed u = V/3

b) Explain the functions of following **[4]**

i) Casing of pelton wheel.

ii) Notch of bucket.

OR

Q2) a) Describe with a neat sketch the construction of Francis turbine. **[5]**

b) A Kaplan turbine has a runner diameter of 4 m and hub diameter of 1.2 m. Discharge through the turbine = 7000 LPS. The hydraulic & mechanical efficiencies are 90% and 93% respectively. Assume no whirl at outlet. Find the net head and power developed by the turbine. **[5]**

P.T.O.

Q3) a) What is cavitation? How it can be prevented? **[4]**

b) Steam issues from the nozzle at an angle of 22^{o} with a velocity of 430 m/s. The friction factor is 0.9. For a stage turbine designed for maximum efficiency. Find **[6]**

i) The blade velocity

ii) Moving blade angles for equiangular blades

iii) Power developed

OR

Q4) a) Prove that for Parson's reaction turbine moving & fixed blades are symmetrical in shape. **[6]**

b) Explain different types of draft tubes used in reaction turbines. **[4]**

Q5) a) Define specific speed of a hydrodynamic pump. Derive expression for the same. **[8]**

b) A centrifugal pump running at 800 rpm is working against a head of 20.2 m. The external diameter of impeller is 480 mm and its width is 60 mm. If the vane angle at exit is 40^{o} and manometric efficiency is 70% find **[10]**

i) Flow velocity at outlet

ii) Absolute velocity of water leaving the vane.

iii) Angle made by the absolute velocity at outlet with direction of motion at the outlet.

iv) Discharge

v) Specific speed.

OR

Q6) a) Explain effect of blade angle (outlet) on discharge in centrifugal pump. **[6]**

b) A three stage centrifugal pump has impeller diameter 400 mm and 20 mm wide. The vane angle at outlet is 45^{o} 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 that of outlet. The pump discharge is 3.6 m^3 per minute & runs at 920 rpm. Flow velocity is constant from inlet to outlet. Find **[12]**

i) Power output of pump in KW

ii) Total manometric head

iii) Specific speed

iv) Shaft power

v) Vane angle at inlet

Take mechanical efficiency = 88%

Manometric efficiency = 77%

Q7) a) Explain slip and slip factor, its importance in centrifugal compressor. **[6]**

b) A centrifugal compressor inducing air at $20^{o}C$ is running at 15000 rpm. The pressure ratio is 4:1 with an isentropic efficiency of 80%. Curved vanes at inlet give the air a prewhirl of 25^{o} to the axial direction at all radii and mean diameter of eye is 25 cm. Impeller tip diameter is 60 cm. The absolute velocity of air at inlet is 150 m/s. Find the slip factor. **[10]**

OR

Q8) a) Write short note on **[6]**

i) Fan ii) Blower

b) A centrifugal compressor delivers $10m^3$ of air when running at 10000 rpm. The air is drawn in at 1 bar & 300K and delivered at 4 bar. The isentropic efficiency is 80%. The blades are radial at outlet and velocity of flow is constant = 64 m/s. The outer diameter of impeller is twice the inner diameter. Take slip factor as 0.9. Find **[10]**

i) Temperature of air at outlet tip of impeller.

ii) Power required to drive the compressor.

iii) Impeller diameters at inlet & outlet.

iv) Impeller blade angle at inlet.

v) Diffuser blade angle at inlet.

Q9) a) Explain choking and surging in an axial flow compressor. **[6]**

b) An eight stage axial flow compressor takes in air at a temperature of 30°C at the rate of 3 kg/s. The pressure ratio is 6 and isentropic efficiency is 89%. The compressor is designed for 50% reaction. The blade speed for each stage is constant and is equal to 180m/s. Flow velocity is 100 m/s. Find the power required to run the compressor and the direction of air at entry & exit from the rotor & stator. The total work is equally shared between the stages. **[10]**

OR

Q10)a) Explain Pressure co-efficient, flow co-efficient and work input factor. **[6]**

b) An axial flow compressor with eight stages and 50% reaction compresses air with a pressure ratio of 4:1. The air enters the compressor at 20°C and flows through it with a constant velocity of 90m/s. The blades of compressor runs with a mean speed of 180 m/s. Take isentropic efficiency = 82%. Find **[10]**

i) Work done by machine

ii) Blade angles

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