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QUESTION BANK

Subject with Code : TM(16HS8803) **Course & Specialization**: M.Tech – Th. Engg

Year & Sem: I-M.Tech & I-Sem **Regulation:** R16

UNIT –I

1. a) Classify the turbo machines. What are the applications of turbo machines? Explain in brief (5M)
   b) Show that for the processes between two finite states: (5M)
      i) Flow process:
      ii) For non flow process:
2. a) Give an account about classification of turbo machines (5M)
   b) Explain about static and stagnation conditions in turbo machines (5M)
3. a) Show that for adiabatic turbo machine the work transfer equals the change in stagnation enthalpy. (5M)
   b) Explain cavitations, stage efficiency and overall efficiency (5M)
4. Explain about the following terms:
   a) Euler's turbine equation (4M)
   b) Stage efficiency and overall efficiency (3M)
   c) Losses in Turbo Machines (3M)
5. Air (c_p=1.05 kJ/kg K, γ= 1.38) at P_1=3 bar & T_1=500K flows with a velocity of 200 m/sec in a 30 cm diameter duct. Calculate (10M)
   i) Mass flow rate
   ii) Stagnation temperature
   iii) Mach number and
   iv) Stagnation pressure values assuming the flow as compressible & incompressible
6. a) How are devices pumping gases classified? (5M)
   b) What are shrouded and unshrouded turbo machines? ` (5M)
7. a) Classify turbo machines on the basis of work transfer. (5M)
   b) Derive the general Euler's expression for a turbo machine (5M)
8. Define the following efficiencies of power absorbing turbo machines.
   a) Total to Total Efficiency (5M)
   b) Static to Static Efficiency (5M)
9. Define the following efficiencies of power generating turbo machines.
   a) Total to Total Efficiency (5M)
   b) Static to Static Efficiency (5M)
10. A low pressure air compressor develops a pressure of 1400 mm W.G. If the initial and final states of air are P_1=1.01 bar, T_1=305 K, T_2= 320K, determine compressor and the infinitesimal stage efficiencies. (10M)

UNIT –II

1.a) Deduce the expression of mass of discharge through nozzle (5M)

b) The throat diameter of round sectioned nozzle is 0.6 cm, steam with and initial pressure of 10 bar dry and saturated is expanded to 1.5 bar. What is the mass flow rate and exit velocity? (5M)

2. a) Define critical pressure ratio in steam nozzles and Derive the critical pressure ratio(4M)

b) Explain and plot the effect of varying back pressure for a convergent divergent (4M) nozzle.

c) Explain the occurrence of a shock wave within or outside the nozzle (3M)

3. a) Explain with sketches effect of variation of back pressure (5M)

b) Define and explain super saturated flow. (5M)

4. a) What is the effect of wet steam flowing through nozzles in any steam turbine? (5M)

b) Show, by deducing suitable expressions that the divergent portion of the nozzle is necessary to produce supersonic velocity when flow of steam takes place in a nozzle isentropic ally and under steady conditions, the initial velocity being negligible (5M)

5. Air flows through a convergent –divergent nozzle and a shock wave forms in the diversgence at a point where the diameter is 300 mm. Measurements made on the nozzle indicate that the pressure rises in the shock wave from 2 bar to 3 bar. The temperature before the shock wave was calculated to be -10^0C. (10M)

i) The Mach number just before the shock wave
ii) The rate of flow through the nozzle in kg/sec
iii) the temperature just after the shock wave

6. a) Why absolute velocity, radial velocity and axial velocity exists in the turbine?

Explain (5M)

b) The rotor of an impulse turbine is 60 cm diameter and runs at 9600 rpm. The nozzles `are at 20 to the plane at the wheel and the steam leaves them at 600 m/s. The blades outlet angle is 30 and the friction factor is 0.8. Calculate the power developed/kg of steam/second and the diagram efficiency (5M)

7. a) Draw the inlet and exit velocity triangles for a reaction turbine (5M)

b) Show that for maximum utilization the work output per stage of an axial flow impulse machine (with equiangular rotor blades) is double that of a 50% reaction stage which has the same speed. Assume that axial velocity remains constant for a 50% reaction machine (5M)

8. a) What is degree of reaction? Obtain an expression for maximum blade efficiency for Parson's turbine (5M)

b) What are the various sources of leakage of steam in a turbine? Discuss any one(5M)

9. a) Find expressions for force, work done, diagram efficiency, gross stage efficiency and axial thrust for an impulse turbine (5M)

b) Discuss about the losses in steam turbines (5M)

10. a) The blade speed of a single impulse blading is 250 m/sec and nozzle angle is 20^0.

The heat drop is 550 kJ/kg & the machine develops 30 kW. When consuming 360 kg of steam per hour. Draw the velocity diagram & calculate the axial thrust on the blading & the heat equivalent per kg of steam friction of the blading. (5M)

b)In one stage of a reaction steam turbine both the fixed & moving blades have inlet & outlet blade tip angles 35^0 & 20^0 respectively. The mean blade speed is 80 m/sec & the consumption is 22500 kg per hour. Determine the power developed in the pair, if the iesntrpoic heat drop for the pair is 23.5 kJper kg. (5M)

UNIT –III.

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1. a) Discuss briefly the theory of aerofoil (5M)
   b) Explain about mach number and area-velocity relation (5M)
2. a) Explain with charts ware angle and pressure ratio (5M)
   b) Starting from the energy equation for flow through normal shock obtain the following relation (5M)
   $CxC_y=a^*2$ and $M_x^*\ M_y^* = 1$
3. A jet of air at 275 K and 0.69 bar has an initial Mach number of 2.0. If it passes through a normal shock wave, determine: (10M)
   (a) Mach number. (b) Pressure. (c) Temperature. (d) Jet velocity, downstream of the shock.
4. a) Explain Fanno line (5M)
   b) Derive the energy equation for flow through an oblique shock (5M)
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UNIT –IV.

1. A centrifugal compressor compresses air from 1 bar and 20^0C to 1.5 bars. The index of compression as 1.5. The flow velocity at inlets & outlets of the machine is same and equal to 65 m/sec. The inlet 7 outlet impeller diameter is 0.32 m 7 0.62 m blowers rotates at 8000 rpm. Calculate
   i. The blade angle at inlet & outlet of impeller
   ii. The absolute angle at tip of the impeller
2. An axial flow compressor having 8stages and with 50% reaction design compression air in the pressure ratio of 4:1. The air enters the compressor at 20^0C and flow through with a constant speed of 90 m/sec. The rotating blades of compressor rotate with a mean velocity of 180 m/sec. isentropic efficiency of compressor may be taken as 82%. Calculate
   i. Work done by the machine
   ii. Blade angles

3. In an 8 stage axial flow compressor the overall stagnation pressure ratio achieves is 5:1 with an overall efficiency of 92%. The inlet stagnation temperature, Pressure is 290K & 1 bar the work is divided equally between the stages. The mean blade speed is 160 m/s &50% degree of reaction is used. The axial velocity through the compressor is constant equal to 90 m/s. Calculate,
   i. Blade angles
   ii. Power required
4. A centrifugal compressor delivers 16.5 kg/sec of air with a total pressure ratio 4:1, speed of compressor 15000 rpm inlet temperature is 20^0C, slip factor is 0.9, power input factor is 1.04, 80% of isentropic efficiency. Calculate
   i. Overall Diameter
   ii. Power input
5. a)What is pressure coefficient for a centrifugal stage? Derive $\psi=1-\varphi\cot\beta_{2.}$

   b)Derive Stadola's and Stanitz relation for the slip.
6. i. Draw superimposed velocity triangles for axial compressor stage:
   a. R>0.5
   b. R=1
   c. R<0.5
7. Draw a sketch of an axial flow compressor with inlet guide vanes and explain the working principle of the compressor.
8. How is the degree of reaction of a centrifugal compressor stage defined?
   Prove $R= 1-\varphi^2{}_2 \operatorname{cosec}^2 \beta_2/2(1-\varphi^2{}_2 \operatorname{cosec}^2 \beta_2)$

UNIT –V.

1. a) What is the function of blades in a turbo machine
   b) Classify the aero- foil sections
   c) Define the term Lift and Drag.
2. Explain about the following
   a. Effiencies of an axial flow gas turbine.
   b. Degree of reaction.
3. a) Give the expression to find work done in an axial flow turbine.
   b) Explain about velocity triangles of axial flow reaction turbine
4. An Aerofoil having a chord length 2.25m and a span of 13.5m moves at a velocity of 125 m/sec through Standard atmosphere at an elevation of 2500 m. The angle of attack being $5^0 25^l$. Calculate the weight which the wing carries and the power required to drive aerofoil. Take corresponding to i = $5^0 25^/$, C_L= 0.465 and C_D = 0.022.Density of air = 1.25 kg/m^3.
5. Derive the expression for energy transfer in terms of blade lift and drag coefficients.
6. Draw inlet, mean and outlet velocity triangles. Derive the equation for tangential and axial force.
7. How the losses are estimate in axial flow gas turbine? Explain.
8. Write short notes of the following:
   i. What are the forces the blades of gas turbine subjected to? Explain.
   ii. What are the properties of high temperature materials used in gas turbine?