Topic Covered: Reaction Turbines -Assignment -3 (UNIT 3)

1. Explain the working of a reaction turbine. Sketch the variations of velocity and pressure along its axis.
2. With a neat sketch draw the combined velocity triangle of reaction turbine mentioning the lengths and angles
3. What is the difference between Impulse turbines and Reaction turbines?
4. Derive expressions for work done of a reaction turbine.
5. Write short notes on degree of reaction and give the equation
6. Prove that Parson's reaction turbine has a degree of reaction of 50%.
7. The following data refer to a particular stage of a parsons reaction turbine:

   Speed of the turbine = 1500 rpm

   Mean diameter of the rotor = 1m.

   Stage efficiency = 80%

   Blade outlet angle = 20^0

   Speed ratio = 0.7

   Determine the available isentropic enthalpy drop in the stage.
8. A 50% reaction turbine (with symmetrical velocity triangles) running at 400 rpm has the exit angle of the blades as 20^o and the velocity of steam relative to the blades at the exit is 1.35 times the mean blade speed. The steam flow rate is 8.33 kg/s and at a particular stage the specific volume is $1.381\mathrm{m}^3/\mathrm{kg}$. Calculate for this stage:
   i) A suitable blade height, assuming the rotor mean diameter 12 time the blade height and
   ii) The Diagram work
9. At a particular stage of reaction turbine, the mean blade speed is 60 m/s and the steam pressure is 3.5 bar with a temperature of 175^0c. The identical fixed and moving blades have inlet angles of 20^0.

   Determine:

   i) The blade height, if it is $1/10^{th}$ of the blade ring diameter, for flow rate of 13.5 kg/s.
   ii) The power developed by a pair
   iii) Specific enthalpy drops if the stage efficiency is 85%

Topics Covered: Gas Turbines (UNIT-4)- Assignment-4

1. Derive an expression to estimate the thermal efficiency of the Brayton cycle. Sketch the air – standard Brayton cycle on P-v and T-s diagrams
2. A gas turbine working on Brayton cycle with pressure ratio of 8, takes air at 1 bar and 27^0C. If the maximum allowed temperature in the cycle is 1000 K, determine the heat supplied, the net work done per kg of air and the thermal efficiency of the cycle. Take Cp of air as 1.005 kJ/kg
3. Air enters the compressor of a gas turbine plant operating on Brayton cycle at 101.325 kPa, 27°C. The pressure ratio in the cycle is 6. Calculate the maximum temperature in the cycle and the cycle efficiency. Assume $W_T = 2.5\ W_C$, where W_T and W_C are the turbine and the compressor work respectively. Take $\gamma = 1.4$.
4. In a Brayton cycle the ambient conditions limit the minimum temperature T_1 and the metallurgical conditions limit for the turbine blades the maximum temperature T_3. For fixed values of T_1 and T_3 determine the optimum pressure ratio r_p in terms of T_1 and T_3, which gives the maximum work in a Brayton cycle.
5. The air enters the compressor of an open cycle gas turbine at a pressure of 1 bar and temperature of 20^0 C. The pressure of air after compression is 4 bar. The isentropic efficiencies of compressor and turbine are 80% and 85% respectively. The air fuel ratio used is 90 : 1. If flow of air is 3 kg/s find (i) Power developed and thermal efficiency of the cycle. Assume Cp = 1.0 kJ/kg K and γ = 1.4 for air and gases. Calorific value of fuel is 41800 kJ/kg.
6. Explain the methods of improving the specific output and thermal efficiency of an open cycle gas turbine with the help of schematic and T-s diagrams
7. In a gas turbine the compressor takes in air at a temperature of 15^0C and compresses it to four times the initial pressure with an isentropic efficiency of 82 %. The air then passed through a heat exchanger heated by the turbine exhaust before entering the combustion chamber. In the heat exchanger 78% of the available heat is given to the air. The maximum temperature after constant pressure combustion is 600^0C, and the efficiency of the turbine is 70%. Assuming the working fluid throughout the cycle to have characteristic of air, find the efficiency of the cycle. Take R = 0.287 kJ/kg K and $\gamma = 1.4$.
8. A regenerative gas turbine with inter cooling and reheating operates at steady state. Air enters the compressor at 100 kPa, 300 K with a mass flow rate of 5.807 kg/s. The pressure ratio across the two-stage compressor is 10. The pressure ratio across the two stage turbine is also 10. The inter cooler and reheater each operate at 300 kPa. At the inlet to the turbine stages, the temperature is 1400 K. the temperature at the inlet to the second compressor stage is 300 K. The efficiency of each compressor and turbine stage is 80%. The generator effectiveness is 80%. Determine, (a) the thermal efficiency (b) the back work ratio (c) the net power developed

Topics Covered : JET PROPULSION and Rocket Propulsion (assignment-5)

1. What is the principle of jet propulsion and classify the propulsive systems
2. Explain the working of the Turbo – jet with a neat sketch
3. Explain the working of the Turbo – Prop with a neat sketch
4. List some differences between Turbo – jet and Turbo – Prop
5. Explain the working of the Ram – jet with a neat sketch
6. A turbo jet engine consumes air at the rate of 60.2 kg/s when flying at a speed of 1000 km/h. Calculate the following:

(i) Velocity of jet when enthalpy change for Nozzle is 230 KJ/kg and velocity coefficient is 0.96, (ii) Fuel flow rate in kg/s when air fuel ratio is 70:1. (iii) Thrust specific fuel consumption. (iv) Thermal efficiency of the plant when combustion efficiency is 92%and calorific value is 42000 kJ/kg. (v) Propulsive power. (vi) Propulsive efficiency and (vii) Overall efficiency

7. The following data pertains to Turbo jet flying at an altitude of 9500 m:

Speed of the turbo jet = 800 km/h

Propulsive efficiency = 55%

Overall efficiency of the turbine plant= 17%

Density of air at altitude of 9500 m = 0.17 kg/m^3

Drag on the plan = 6100 N

CV of the fuel = 46000 kJ/kg

Calculate the following:

Absolute velocity of the jet (ii) Volume of air compressed per min (iii) Diameter of the jet (iv) Power out put of the plant and Air fuel ratio

8. In a jet propulsion unit air is drawn into the compressor at 15^{0}C and 1.01 bar and delivered at 4.04 bar. The isentropic efficiency of compressor is 82%. After delivery, the air is heated at constant pressure until the temperature reaches to 750^{0}C. The air then passes through a turbine unit which drives compressor only and has an efficiency of 78% before passing through the Nozzle and expanding to a atmospheric pressure of 1.01 bar with an efficiency of 88%. Calculate the following:

(i) Power required to drive the compressor (ii) Air fuel ratio if CV of the fuel is 42000 kJ/kg (iii) Pressure of gas leaving the turbine (iv) The thrust per kg of air per sec.

9. Explain the working of the Rocket engine with a neat sketch