Total No. of Questions : 10]

SEAT No. :

P3650

[Total No. of Pages : 3

[4859] - 1021

B.E. (Mechanical)

GAS TURBINES & PROPULSION

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

Time : 2½ Hours] *[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) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Assume suitable data if necessary.***

Q1) a) Draw open cycle & closed cycle gas turbine with neat sketch. State the applications. **[3]**

b) Compare ideal & actual Brayton cycle with the help of T-S diagram. **[3]**

c) Write a note on atmospheric jet engines. **[4]**

OR

Q2) a) Explain the principle of aircraft propulsion. **[4]**

b) In a gas turbine plant intake conditions are 1 bar & 27ºC. The air is compressed to 4 bar with an isentropic efficiency of 85%. Isentropic efficiency of turbine is 85%. The maximum temperature is 572ºC. Find the air-fuel ratio. Given : Cp for air as 1.005 kJ/kgK and for gas Cp is 0.996 kJ/kgK. **[6]**

Q3) a) Write a short note on turbo fan engines. **[5]**

b) Explain various nozzle & diffuser losses in brief. **[5]**

OR

Q4) a) A propulsion unit is required to produce a thrust of 320 KN for 20 seconds. Calculate the mass flow rate of the propellant. Also find the volume flow rate of the propellant if the density of a propellant is 1020 kg/m^3. Specific impulse is 2920 N.S/kg generated by the propellant. **[6]**

b) Write the various parameters affecting the flight performance. **[4]**

P.T.O.

Q5) a) A single stage axial flow turbine (impulse turbine) is supplied with a gas at stagnation conditions of 4 bar, 650°C. The expansion of gas in nozzle is upto a pressure of 1 bar. The nozzle discharge angle is 15° to the plane of wheels. The blade speed is 360 m/s and the gas leaves the rotor blade in axial direction with a speed of 300 m/s. Assuming a nozzle efficiency of 96%, find:

i) Rotor blade angles at inlet & outlet.

ii) Work done per kg of air.

iii) Power developed for gas flow of 25 kg/s.

iv) Utilisation factor.

v) Stage efficiency.

[10]

b) Discuss various losses associated with axial flow turbines. **[6]**

OR

Q6) a) In a single stage impulse turbine, gas enters at stagnation pressure of 4 bar and 1000 k and exit static pressure is maintained at 1.2 bar. The nozzle efficiency is 96%. The velocity of gas leaving the stage is at 290 m/s axially while the blade velocity is 320 m/s. The static head efficiency is 88%. The exit pressure from nozzle is 1.25 bar. Find

i) Work done per kg of air.

ii) Nozzle angle.

iii) Blade inlet angle.

iv) Blade outlet angle.

v) Energy utilisation factor for the rotor.

[10]

b) Explain the effect of nozzle angle on work output and effect of axial discharge in axial flow turbines. **[6]**

Q7) a) An axial flow compressor draws air at 20ºC and delivers it at 50ºC. Assuming 50% degree of reaction, calculate the velocity of flow if blade velocity is 100 m/s, work factor is 0.85. Consider, Cp = 1 kJ/kgK, $\alpha = 10^{o}$, $\beta = 40^{o}$. Also find the number of stages. **[12]**

b) Explain the processes involved in an axial flow compressor with the help of T-S dia. **[6]**

OR

Q8) a) An axial flow compressor develops a pressure ratio of 1.2 in the first stage. The inlet conditions are 1 bar and 309 K. The overall efficiency of the compressor including bearing losses is 83%. The axial velocity is 0.47 times the blade velocity. The velocity diagram is symmetrical and the change of velocity of whirl at the mean radius is 0.5 times the axial velocity. Estimate the blade speed required and the absolute velocity of air leaving the stationary inlet guide vanes. **[12]**

b) Compare radial & axial flow compressors. **[6]**

Q9) a) Discuss in detail the factors which are considered for evaluating the performance of combustion chambers. **[8]**

b) What are the theories of combustion? Explain hydroxylation theory of combustion. **[8]**

OR

Q10) a) Explain the working of combustion chamber with swirl vanes. **[8]**

b) Explain the methods of flame stabilisation in combustion chambers for gas turbine. **[8]**