8E4051

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B. Tech. VIII Semester (Main/Back) Examination-2014

Mechanical Engineering.

8ME3 Gas Turbine & Gas power Plant

Time : 3 Hours **Maximum Marks : 80**
Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five** questions, selecting **one** question from **each** unit. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) Compare reciprocating engines and gas turbine engines and explain why gas turbine engines are more suitable for aviation applications. **(6+2)**

   b) Draw a neat schematic diagram and T-s diagram of reheat cycle, having two turbines operating at optimum pressure ratios and prove the following relation for maximum specific work output of the cycle, $r^{(\gamma-1)/\gamma} = (T_3/T_1)^{2/3}$. **(2+6)**

OR

1. a) Draw schematic diagram and T-S diagram of a Heat Exchanger Cycle and derive an expression for its thermal efficiency. Discuss the effect of cycle pressure ratio and maximum and minimum temperature ratio on the cycle efficiency with the help of suitable diagram. **(2+4+2)**

   b) Why open cycle gas turbines are more in use than closed cycle gas turbines, explain ? **(4)**

   c) Compare Reheat cycle with intercooler and Reheat cycle with intercooler and heat exchanger. **(4)**

Unit - II

2. Air at 15°C enters a gas turbine plant working at a pressure ratio of 15 with 1250°C turbine inlet temperature. Assume polytropic efficiency of compressor and turbine as 0.91, Cp for air and gases as 1.005 and 1.128 respectively, $\gamma = 1.4$ for both air and gases. Calorific value of fuel= 42000 kJ/kg, calculate, overall efficiency, specific work output, fuel air ratio and specific fuel consumption. **(4x4)**

OR

2. A peak load generator is to be powered by a simple gas turbine with free power turbine delivering 20MW of shaft power. The following data are applicable:

Compressor pressure ration	11
Compressor isentropic efficiency	0.82
Combustion pressure loss	0.4bar
Combustion efficiency	0.99
Turbine inlet temperature	1150K
Gas generator turbine isentropic efficiency	0.87
Power turbine isentropic efficiency	0.89
Mechanical efficiency(each shaft)	0.98
Ambient condition	1bar,288K
C_p and γ for air	1.005kJ/kgk and1.4
C_p and γ for gases	1.148kJ/kgk and 1.33
Calorific Value of the fuel	43100kJ/kg

Calculate the air mass flow required and the SFC. **(16)**

Unit - III

3. a) Explain the working of Turbofan engine with the help of suitable diagram **(8)**

b) Derive the following relation for the intake of a turbojet engine: $P_{01}/P_a = \left[1+\left(\eta_i C_a^{\,2}/2C_pT_a\right)\right]^{\gamma/(\gamma-1)}$, where P_a, T_a are ambient pressure and temperature and C_a is forward speed of aircraft. **(8)**

OR

3. a) Explain the working of Ramjet engine with the help of suitable diagram. **(7)**

b) Write a note on following and explain their significance in aircraft propulsion:

i) Propulsion efficiency

ii) Efficiency of energy conversion

iii) Specific Thrust. **(9)**

Unit - IV

4. a) Discuss the combustion process in combustion chamber of a gas turbine engine with the help of suitable diagram. **(8)**

b) Derive an expression for degree of reaction in axial flow gas turbines with the help of velocity triangles. **(8)**

OR

4. a) Discuss the factors which affect combustion chamber performance. **(8)**

b) For an axial flow gas turbine, shaft work is 46.5kJ/kg, blade velocity is 183m/s, axial velocity of air is 91.5m/s, degree of reaction is 30%. Find inlet and outlet blade angles. **(8)**

Unit - V

5. a) Describe the construction and working of free piston engine plant. **(8)**
   b) What are the advantages and disadvantages of gas turbine plant over steam power plant. **(8)**

OR

5. a) What are the advantages and disadvantages of gas turbine plant over gas power plant. **(8)**
   b) Write a note on uses of gas turbine materials. **(8)**
