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10ME/AU43

Fourth Semester B.E. Degree Examination, June/July 2017
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of thermodynamic data hand book, charts and tables permitted.***

PART – A

1 a. Define the following:
(i) Combustion (ii) Stoichiometric air (iii) Enthalpy of combustion (iv) Enthalpy of formation (v) Adiabatic flame temperature. **(10 Marks)**

b. Butane is burned with air and volumetric analysis of the combustion products on dry basis yield following composition:

Gas	CO_2	CO	O_2	N_2
%	7.8	1.1	8.2	82.9

Determine percentage of theoretical air used. **(10 Marks)**

2 a. Derive the expression for the air standard efficiency of a Otto cycle with usual notation. State the assumptions made and represent the process on P-V and T-S diagram. **(10 Marks)**

b. An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m^3. The initial pressure and temperature are 1 bar and 50°C. If the maximum pressure is limited to 25 bar. Find the following:
(i) The air standard efficiency.
(ii) The mean effective pressure for the cycle.
Assume the ideal condition. **(10 Marks)**

3 a. Write elaborate note on heat balance sheet and Morse test on IC engine. **(10 Marks)**

b. A 4 cylinder petrol engine has an output of 52 KW at 2000 rpm. A Morse test is carried out and the brake torque readings are 177, 170, 168 and 174 N-m respectively. For normal running at this speed the specific fuel consumption is 0.364 kg/kWhr. The calorific value of fuel is 44200 kJ/kg. Calculate (i) Mechanical efficiency (ii) Brake thermal efficiency of the engine. **(10 Marks)**

4 a. Sketch the flow diagram and the corresponding temperature-entropy diagram of a reheat vapour cycle and derive an expression for the reheat cycle efficiency. State the advantages. **(10 Marks)**

b. A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150 bar, 550°C expands through the high pressure turbine. It is reheated at a constant pressure of 40 bar to 550°C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw T-S and h-S diagram find (i) Quality of steam at exhaust (ii) Cycle efficiency (iii) Steam rate in kg/kWhr. **(10 Marks)**

PART – B

5 a. Show that the optimum intermediate pressure of a two stage reciprocating air compressor for minimum work is the geometric mean of the suction and discharge pressures. **(10 Marks)**

b. An air compressor takes in air at 1 bar and 20°C and compresses it according to law $PV^{1.2} = C$. It is then delivered to a receiver at a constant pressure of 10 bar R = 0.287 kJ/kg K. Determine

(i) Temperature at the end of compression.
(ii) Work done /kg of air.
(iii) Heat transferred during Compression/kg of air. **(10 Marks)**

6 a. Explain any two methods to improve the thermal efficiency of simple gas turbine with neat sketch and T-Q diagram. **(06 Marks)**

b. Write a note on turbojet propulsion. **(04 Marks)**

c. A gas turbine unit has a pressure ratio of 6 : 1 and maximum cycle temperature of 610°C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilo watts of an electric generator geared to the turbine when the air enters the compressor at 15°C at the rate of 16 kg/sec. Take
C_P = 1.005 kJ/kgK and δ = 1.4 for compression process, C_P = 1.11 kJ/kgK and δ = 1.333 for the expansion process. **(10 Marks)**

7 a. Write a brief note on properties of refrigerants. **(04 Marks)**

b. With the neat sketch, explain working of vapour compression refrigeration system and draw T-S and H-S diagram for the same. **(06 Marks)**

c. A refrigeration system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 50°C and the lower temperature is -10°C. The capacity is to be 10 tonnes. Neglect all losses.
Determine : (i) C.O.P (ii) Heat rejected from the system per hr. (iii) Power required. **(10 Marks)**

8 a. Define the following: (i) Dry bulb temperature (ii) Wet bulb temperature (iii) Specific humidity (iv) Relative humidity. **(06 Marks)**

b. With neat sketch, briefly describe summer air conditioning system. **(04 Marks)**

c. The atmospheric conditions are 20°C and specific humidity of 0.00095 kg/kg of air. Calculate the following:

(i) Partial pressure of vapour
(ii) Relative humidity
(iii) Dew point temperature. **(10 Marks)**

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