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10ME/AU43

Fourth Semester B.E. Degree Examination, June/July 2015
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. ***Use of Thermodynamic Data handbook is permitted.***

PART - A

1 a. Explain the following : i) A – F Ratio ii) Calorific value of fuels iii) Adiabatic flame temperature iv) Internal energy of combustion v) Combustion efficiency. **(10 Marks)**

b. Coal with the following mass analysis is burnt with 100% excess air, C = 74% , H_2 = 4.3% , S = 2.7% , N_2 = 1.5% , H_2O = 5.5% , O_2 = 5% , ash = 7%. Find the moles of gases produced, if 100kg of fuel is burnt. **(10 Marks)**

2 a. With the help of T – S and P – V diagrams, derive an expression for m.e.p of otto cycle in terms of compression ratio, pressure ratio, showing all the processes involved. **(10 Marks)**

b. The compression ratio of a Diesel engine working on an ideal diesel cycle is 16. The temperature of air at the beginning of compression is 300K and the temperature of air at the end of expansion is 900K. Determine i) Cut – off ratio ii) Expansion ratio iv) Cycle efficiency. **(10 Marks)**

3 a. Explain the following in detail : i) Morse test method ii) Willan's Line method. **(08 Marks)**

b. A test on a 2S IC engine gave the following results at full load. Speed = 350 rpm ; Net brake load = 650N ; Indicated m.e.p = 3 bar ; Fuel consumption = 1.1×10^{-3} kg/S ; Jacket cooling water flow rate = 0.138kg/s ; Jacket water temperature at inlet = 20^0C ; Jacket water temperature at outlet = 40^0C ; Room temperature = 20^0C ; Exhaust gas temperature = 400^0C ; Air used per kg of fuel = 32kg ; Cylinder diameter = 22cms ; Brake drum circumference = 314cms ; Calorific value of fuel = 43 MJ/kg ; Specific heat of exhaust gases = 1kJ/kg.K. Determine i) Mechanical eficiency ii) Brake mean effective pressure. Draw the heat balance sheet including hat equivalent of BP, heat loss due to friction, heat carried away by cooling water, heat caried away by exhaust gases and unaccounted heat loss. **(12 Marks)**

4 a. With a superimposed T – S diagram, compare Carnot and Rankine vapour cycles operating between the same boiler and condenser temperatures. **(08 Marks)**

b. In a Rankine cycle, the steam inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2bar. Calculate i) Turbine work i) Pump work iii) Rankine efficiency iv) Condenser heat flow v) Dryness fraction at the end of expansion. Assume the mass flow rate of steam as 9.5kg/sec. **(12 Marks)**

PART - B

5 a. Define the following with respect to a compressor .
i) Isothermal efficiency ii) Adiabatic efficiency iii) Mechanical efficiency iv) Overall efficiency v) Volumetric efficiency. **(10 Marks)**

b. An air compressor takes in air at 1 bar and 20^0C and compresses the same according to the law $PV^{1.2} = C$. It is then delivered to a receiver at a constant pressure of 10 bar. Determine i) Temperature at the end of compression ii) Work done and heat transferred during compression, per kg of air. R = 0.287 kJ/kg.K. **(10 Marks)**

6 a. With neat sketches, explain the working of the following :
i) Turbojet engine ii) Liquid propulsion rocket. **(10 Marks)**

b. A gas turbine plant works between the temperature limits of 300K and 1000K and a pressure of 1 bar and 16 bar. The compression is carried out in two stages with perfect inter cooling inbetween. Calculate the net power of the plant, per kg of air circulation :
Cp = 1 kJ / kg.K ; γ = 1.4 for air. **(10 Marks)**

7 a. Define the following : i) Refrigerating effect ii) Ton of refrigeration iii) Ice making capacity iv) Relative Cop. **(04 Marks)**

b. Give four comparisons between vapour compression refrigeration and vapour absorption refrigeration. **(04 Marks)**

c. A vapour compression refrigeration of 10 tonnes capacity using Freon – 12 as the refrigerant has an evaporator temperature of -10^0C and a condenser temperature of 30^0C. Assuming simple saturation cycle, determine i) Mass flow rate of refrigerant in kg/min ii) Power input iii) Cop. Cpv = 0.72 kJ/kg.K.
(Obtain properties of Freon – 12 From Data Handbook). **(12 Marks)**

8 a. Derive an expression for the following :
i) Specific humidity (w) ii) Degree of saturation (μ). **(08 Marks)**

b. The dry and wet bulb temperatures of atmospheric air at 1 atm pressure are measured with a sling psychrometer and found to be 25^0C and 15^0C respectively. Determine
i) Specific humidity ii) Relative humidity iii) Enthalpy of air.
Use the table to find property values Do not use psychrometric chart. **(12 Marks)**

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