Roll No.									

(15)

B.E./B.TECH (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL /MAY 2012

MECHANICAL ENGINEERING BRANCH

THIRD SEMESTER

ME 9202 ENGINEERING THERMODYNAMICS

(REGULATIONS 2008)

Time : 3 Hours **Max. Marks : 100**

(Use of Steam Tables and Mollier Chart Permitted)

Answer ALL Questions

PART – A (10 x 2 = 20 Marks)

1. State the zeroth and first law of thermodynamics.
2. What do you understand by open and closed systems?
3. Define efficiency and COP.
4. What is Clausius inequality?
5. Give the combined expression of first and second laws of thermodynamics.
6. What do you understand by entropy generation? Give its equation.
7. Define saturation pressure and saturation temperature.
8. What is regeneration and reheating?
9. Define relative humidity and dew point temperature.
10. What do you understand by sensible heat and latent heat?

PART – B (5 x 16 = 80 Marks)

11 i). Distinguish between extensive and intensive properties of a system. Classify the following properties – whether they are intensive or extensive ones – using their metric units:
(i) volume, (ii) specific weight,(iii) specific volume, (iv) molecular weight, (v) density, (vi) temperature, and (vii) pressure **(10)**

ii). A centrifugal air compressor delivers 900 kg/h of air. The air velocity at the inlet and outlet is 5 m/s and 7.5 m/s respectively. The enthalpy of compressed air is 20 kJ/kg. The specific volume of the inlet and outlet air is 0.5 m^3/kg and 0.15 m^3/kg respectively. Heat lost to inter-stage cooling is 75 kJ/s. Compute the motor power required to drive the compressor and the ratio of inlet to outlet pipe ID. **(6)**

12 a i). A heat engine, one heat pump and a refrigerator are placed between two heat reservoirs one at 600 K while the other at 300 K. Determine the efficiency of the heat engine, the COP of the heat pump and the COP of the refrigerator. **(6)**

ii). A reversible engine is supplied with heat from two constant temperature sources at 900 K and 600 K and rejects heat to a constant temperature sink at 300 K. If the engine executes a number of complete cycles while developing 100 kW and rejecting 3600 kJ of heat per minute, determine the heat supplied by each source per minute and efficiency of the engine. **(10)**

(OR)

b i). There is a heat source at 1000 K. It loses 2 MJ of heat to sink at (a) 500 K and (b) 750 K. Determine which heat transfer process is more reversible and entropy generation in each case. **(8)**

ii). Briefly explain the principle of entropy increase. **(8)**

13 a i). Derive an expression for exergy in non-flow systems. **(8)**

ii). 8 kg of air at 650 K and 5.5 bar pressure is enclosed in a closed system. If the atmospheric temperature and pressure are 300 K and 1 bar respectively, determine

(i) the exergy if the system goes through the ideal work producing process

(ii) the exergy if the air is cooled at constant pressure to atmospheric temperature without bringing it to complete dead state. Take $c_V = 0.718$ kJ/kg K and $c_p = 1.005$ kJ/kg K. **(8)**

(OR)

b i). Derive an expression for exergy in steady flow systems. **(8)**

ii). In a parallel flow heat exchanger water enters at $50^{\circ}C$ and leaves at $70^{\circ}C$ while oil (specific gravity = 0.82, specific heat = 2.6 kJ/kg K) enters at $240^{\circ}C$ and leaves at $90^{\circ}C$. If the surrounding temperature is $27^{\circ}C$ determine the loss in exergy on the basis of one kg of oil per second. **(8)**

14 a i). Discuss the three different phases that exists. **(6)**

ii). Draw and explain the PVT surface for a substance which expands on freezing. **(10)**

(OR)

b Steam at 30 bar and $400^{\circ}C$ is allowed to expand isentropically in a steam turbine to a pressure of 0.08 bar. Determine the dryness fraction of steam at the end of the cycle and thermal efficiency of the cycle. Now, if the same feed steam is allowed to expand isentropically upto a pressure limit of 3 bar and then reheated to 380 $^{\circ}C$ and then allowed to expand again in the turbine to the final pressure of 0.08 bar, determine the dryness fraction of steam at the end of expansion and thermal efficiency of the cycle. **(16)**

15 a i). Define DPT, DBT, RH and wet bulb depression. **(4)**

ii). 90 m^3 of air per minute at 20^{O}C and 75 % RH is heated until its temperature becomes 30^{O}C. Calculate the RH of the heated air and heat added per minute. **(12)**

(OR)

b i). One kg of air at 35^{O}C DBT and 60 % RH is mixed with 2 kg of air at 20^{O}C DBT and 13^{O}C DPT. Calculate the specific humidity of the mixture. **(12)**

ii). Briefly explain what do you understand by evaporative cooling? Show this on a psychrometric chart. **(4)**

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