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B.E. (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL/MAY 2011

MECHANICAL ENGINEERING BRANCH

THIRD SEMESTER

**ME 9202 ENGINEERING THERMODYNAMICS**

(REGULATIONS 2008)

Time : 3 hr Max Mark : 100

(Use of Thermodynamic Tables, Steam Tables and Psychrometric chart is permitted)

Answer ALL Questions

**PART - A (10 x 2 = 20 Marks)**

1. What do you understand by microscopic and macroscopic approach?
2. What are point and path functions?
3. Define efficiency and COP.
4. What is an irreversible process? Give two examples of irreversible processes.
5. Define the term exergy.
6. What is entropy generation?
7. What do you understand by triple point and critical point?
8. Calculate the dryness fraction of steam which has 1.5 kg of water in suspension with 50 kg of steam.
9. Define specific humidity and wet bulb temperature.
10. Show the heating and dehumidification on a psychrometric chart.

**PART- B (5 x 16 = 80 Marks)**

11 i). A piston and cylinder machine containing a fluid system has a stirring device. The piston is frictionless and it is held down against the fluid due to atmospheric pressure of 101.3 kPa. The stirring device is turned 9500 revolutions with an average torque against the fluid of 1.25 mN. Meanwhile the piston of diameter 0.65 m moves out 0.6 m. Find the net work transfer for the system. Draw the schematic of the system. **(6)**

ii). Consider a system with a stone of 20 kg mass and a tank containing 200 kg of water. Initially the stone is 15 m above the water level. The stone and water are initially at the same temperature. Then the stone falls into the water. Determine $\Delta U$, $\Delta PE$, $\Delta KE$, Q and W when

(i) the stone is about to enter the water,
(ii) the stone has come to rest in the tank and
(iii) heat is transferred to the surroundings so that the stone and water come to their initial temperature. **(10)**

12 a i). State the Kelvin Planck and Clausius statements. **(4)**

ii). Explain the operation of a Carnot heat engine with p-V and T-s diagrams. **(12)**

(PTO)

(OR)

b i). A heat engine receives heat at the rate of 1500 kJ/min and gives an output of 8.2 kW. Determine the thermal efficiency and the rate of heat rejection. **(6)**

ii). What do you mean by Clausius inequality? Obtain the expression for the same. **(4)**

iii). What do you understand by principle of entropy increase? Explain. **(6)**

13 a i). Draw and explain the p-T diagram of a pure substance. **(6)**

ii). A vessel having a capacity of. 0.05 $m^3$ contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Find the (i) pressure, (ii) mass, (iii) specific volume, (iv) specific enthalpy, and (v) specific internal energy. **(10)**

(OR)

b i). Describe the different operations of a Rankine cycle. Derive the expression for its efficiency. **(8)**

ii). In a steam power cycle the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work. **(8)**

14 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°C and leaves at 70°C while oil (specific gravity = 0.82, specific heat = 2.6 kJ/kg K) enters at 240°C and leaves at 90°C. If the surrounding temperature is 27°C determine the loss in exergy on the basis of one kg of oil per second. **(8)**

15 a i). Describe briefly (i) Sensible heating and (ii) Cooling and Dehumidification. **(8)**

ii). The sling psychrometer in a laboratory test recorded the dry bulb temperature as 35°C and wet bulb temperature as 25°C. Calculate the (i) specific humidity (ii) relative humidity (iii) dew point temperature and (iv) enthalpy of mixture per kg of dry air. Take atmospheric pressure as 1.0132 bar. **(8)**

(OR)

b i). Draw a skeleton psychrometric chart indicating clearly all the properties. **(4)**

ii). One kg of air at 35°C DBT and 60 % RH is mixed with 2 kg of air at 20°C DBT and 13°C dew point temperature. Calculate the specific humidity of the mixture. **(12)**

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