ANNA UNIVERSITY OF TECHNOLOGY, COIMBATORE

B.E. / B.TECH. DEGREE EXAMINATOINS : NOV / DEC 2011

REGULATIONS : 2008

THIRD SEMESTER

080190005 - ENGINEERING THERMODYNAMICS

(COMMON TO AUTOMOBILE / MECHANICAL ENGG.)

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

(Approved Steam Table, Mollier diagram, Psychrometric Table and Chart are permitted)

PART - A

(10 x 2 = 20 Marks)

ANSWER ALL QUESTIONS

1. What is quasi static process and explain it?
2. Write the significances of Isothermal process.
3. What is Entropy? and write its unit.
4. Define C.O.P of heat pump.
5. What are the methods to improve the efficiency of Rankine cycle?
6. Explain the quality of steam and how it is measured?
7. Write the Equations of state in terms of mole and mass.
8. What is the use of compressibility chart ?
9. Write the importance of psychrometry in industries.
10. What are the psychrometric properties by which weather forecast are specified?

PART- B

(5 x 16 = 80 Marks)

ANSWER ALL QUESTIONS

11 a) Name the different non flow processes, state their law of process and derive the expression for heat transfer, work transfer and their P - v – T relations.

11 b) An ideal gas of molecular weight 30 and γ = 1.3 occupies a volume of 1.5 m^3 at 100 k Pa and 77 $^\circ$ C. The gas is compressed according to the law $P v^{1.25} = C$ to pressure of 3 M Pa. Calculate the volume and temperature at the end of process. Also calculate the work done, heat transfer, change in internal energy and change in entropy.

12 a) i. State the limitations of Fist law of thermodynamics and explain the need of second law of thermodynamics. Also write the statement of second law of thermodynamics. (8)

ii. A heat engine is supplied heat at the rate of 1700 kJ/ min at 120 $^\circ$C and gives an output of 10 kW. Determine the thermal efficiency, temperature of the sink and the rate of heat rejection. (8)

(OR)

12 b) i. Explain absolute Thermodynamic temperature scale. (4)

ii. An ice plant working on a reversed carnot cycle heat pump produces 15 tonnes of ice per day . The ice is formed from water at 0° C and the formed ice is maintained at 0° C. The heat is rejected to the atmosphere at 25° C. The heat pump used to run the ice plant is coupled to a carnot engine which absorbs heat from a source which is maintained at 220° C by burning liquid fuel of 44500 kJ / kg calorific value and rejects the heat to the atmosphere. Determine: i. power developed by the engine; ii. Fuel consumed per hour; Take enthalpy of fusion of ice is 335 kJ / kg. (12)

13 a) i. In a Rankine cycle, steam enters the turbine at 40 bar and 400 °C. The condenser pressure is 0.5 bar. Find the percentage increase in efficiency If the steam is expanded to the condenser pressure of 0.2 bar. (10)

ii. Explain the significance of wet and super heated steam and how their quality can be represented. (6)

(OR)

13 b) Find the condition of steam (whether wet , dry or superheated steam) and find its quality (dryness fraction or Degree of superheat) for the following conditions :

i. steam at a pressure of 10.5 bar and enthalpy of 2577 kJ /kg ; ii. Steam at pressure of 14 bar and entropy of 6.596 kJ / kg k; iii. Steam at a pressure of 120 bar and internal energy of 2801.84 kJ / kg; iv. Steam at pressure of 15 bar and specific volume of 0.15267 m^3 / kg.

14 a) i. Deduce the Maxwell's relations and from the third relation deduce the Clausius- Clayperon equation. Also apply this equation to the vaporization process for a pure substances. (10)

ii. What is Viral equation of state for real gases? Indicate its usefulness. (6)

(OR)

14 (b) Prove that the difference in specific heat capacity is equal to :

$$C_P - C_V = \frac{T V \beta^2}{K_T}$$

15 a) i. Explain the adiabatic saturation process using T-s diagram and derive an expression to determine the specific humidity of unsaturated air entering the adiabatic saturator. (8)

ii. An air-water vapour mixture at 0.1 M Pa, 30° C, 78 % R H has a volume 70 m^3. Calculate the specific humidity , dew point , Wbt , mass of dry air and mass of water vapour. If the mixture is cooled at constant pressure to 5° C , Calculate the amount of water vapour condensed. (8)

(OR)

15 b) i. Define Specific humidity, Relative humidity, Degree of Saturation, Wet Bulb Depression and Dew point. (8)

ii. Air at 40° C dbt and 27° C wbt is to be cooled and dehumidified by passing it over a refrigerant – filled coil to give a final condition of 15° C and 90 % R H . Find the amounts of heat and moisture removed per kg of dry air. (8)

*******THE END*******