NAME_____ ROLL NO_____

2006 ANNA UNIVERSITY

B.E/B.TECH DEGREE EXAMINATION

THERMODYNAMICS

(MECHANICAL ENGINEERING)

MAY-2006

TIME-3HOUR
MARKS-100

ANSWER ALL QUESTIONS

PART - A [10X2=20]

1. Prove that for an isolated system, there is no change in internal energy.

2. Determine the molecular volume of any perfect gas at 600 N/m2 and 30? C. Universal gas constant may be taken as 8314 J/kg mole – K.

3. State the Second law of thermodynamics. Also write its physical significance.

4. A domestic food freezer maintains a temperature of –15? C. The ambient air is at 30? C. If heat leaks into the freezer at a continuous rate of 1.75 kJ/s, what is the least power necessary to pump this heat out continuously?

5. What is meant by a Virial expansion?

6. Draw the generalised compressibility chart.

7. Draw the P–V–T surface for water and also indicate its salient features.

8. Find the change in entropy of 1 kg of ice which is heated from –5? C to 0? C. It melts into water at 0? C. = 2.093 kJ/kg–K. The pressure during heating is maintained at 1 atm constant. Latent heat of fusion of ice = 334.96 kJ/kg.

9. Find the quantity of oxygen required to convert 1 kg of carbon monoxide into carbondioxide.

10. Define adiabatic flame temperature.

PART - B [5X16=80]

11. Three identical bodies of constant heat capacity are at temperatures 300, 300 and 100 K. If no work or heat is supplied from outside, what is the highest temperature to which any one of the bodies can be raised by the operation of heat engine or refrigerators?

12. (a) A mass of air is initially at 260? C and 700 Kpa and occupies 0.028 m3. The air is expanded at constant pressure to 0.084 m3. A polytropic process with n = 1.5 is then carried out, followed by a constant temperature process. All the processes are reversible.

(i) Sketch the cycle in the and T–S planes.

(ii) Find the heat received and heat rejected in the cycle.

(iii) Find the efficiency of the cycle.

Or

(b) Air at a temperature of 15? C passes through a heat exchanger at a velocity of 30 m/s where its temperature is raised to 800? C. It then enters a turbine with the same velocity of 30 m/s and expands until the temperature falls to 650? C. On leaving the turbine, the air is taken at a velocity of 60 m/s to a nozzle where it expands until the temperature has fallen to 500? C. If the air flow rate is 2 kg/s, calculate :

(i) The rate of heat transfer to the air in the heat exchanger.

(ii) The power output from the turbine assuming no heat loss and

(iii) The velocity at exit from the nozzle, assuming no heat loss. Take the enthalpy of air as h = Cpt, where Cp is the specific heat equal to 1.005 kJ/kg–K and "t" the temperature.

13. (a) Determine the change of internal energy, enthalpy and entropy when the gas obeys van der Waal's equation. (16)

Or

(b) Prove that the difference in specific heat capacities equal to : and .

14. (a) A Vessel of volume 0.04 m3 contains a mixture of saturated water and saturated steam at a temperature of 250? C. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy the entropy and the internal energy.

Or

(b) Explain in detail about the following :

(i) Sensible heating (or) cooling at W = constant.

(ii) Cooling and dehumidification.

(iii) Heating and dehumidification.

15. (a) The petrol used in an engine contains 84% carbon and 16% hydrogen. The air supply is 80% of theoretical requirement for complete combustion. Assuming that all H_2 is burned and that carbon burns partly to CO and partly to CO_2 without any free carbon. Find the volumetric analysis of dry exhaust gases also find the percentage of gross calorific value of the fuel lost due to incomplete combustion. Assume the gross calorific values as :
C to CO_2 = 35,000 kJ/kg ; C to CO = 10,200 kJ/kg
H_2 to H_2O = 1,43,000 kJ/kg. (16)

Or

(b) Write short notes on the following :

(i) Adiabatic peak flame temperature.

(ii) Excess air for combustion.

(iii) Stoichiomentric A/F ratio.

(iv) Enthalpy of formation.