

B.Tech. 3rd Semester Exam., 2014

THERMODYNAMICS

Time : 3 hours akubihar.com Full Marks : 70

Instructions :

- (i) All questions carry equal marks.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.
- (v) Use of Tables and Charts permitted.

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1. State whether the following statements are True or False (any seven) :

- (a) Zeroth law of the thermodynamics defines temperatures.
- (b) Characteristic equation of gas is given by (v = specific volume, m = mass of gas) $pv = mRT$.
- (c) Otto cycle consists of two constant volumes and two adiabatic processes.
- (d) Internal energy of ideal gas is a function of temperature and volume.

(e) One of the Tds equations has the form F
 $Tds = du - vdp$

(f) The entropy of fixed amount of ideal gas increases in every isothermal compression. T

(g) At tripple point, ice occupies maximum specific volume.

(h) The specific volume of water when heated from 0 °C, first increases then decreases.

(i) The relationship between $(COP)_{\text{Heat pump}}$ and $(COP)_{\text{Refrigerator}}$ for the same range of temperature operation is

$$(COP)_{HP} = (COP)_{R+1}$$

(j) Standard Barometric pressure is 1013.25 M bar.

2. What do you mean by closed system and open system? Explain.

3. (a) What do you mean by temperature? What are the common scales used for measuring the temperature of human body?

(b) What do you mean by thermodynamic equilibrium? What is equality of temperatures?

4. (a) 0.5 kg of a perfect gas is heated from 100 °C to 300 °C at a constant pressure of 2.8 bar. It is then cooled to 100 °C at constant volume. Find the overall change in entropy. Take $C_p = 1$ kJ/kg K, $C_v = 0.72$ kJ/kg K.
- (b) An inventor claims to have heat engine which is capable of developing 19 kW while working between the temperature limits 30 °C and -40 °C. It receives only 1000 kJ/min of heat. Discuss the possibility of the claim.

5. What are Helmholtz function and Gibb's function?

6. (a) List the assumptions made in the analysis of air-standard cycle.

(b) With the help of p - V and T - S diagrams show that for the same compression ratio and same heat input

$$\eta_{\text{Otto}} > \eta_{\text{Dual}} > \eta_{\text{Diesel}}$$

7. In a thermal power plant operating on an Ideal Rankine cycle, steam of 15 bar and 250 °C enters a turbine which generates 40 kW indicated power. If the steam consumption is 300 kg/hr and condenser is maintained at 0.15 bar, determine the final condition of steam, Rankine efficiency and relative efficiency. Neglect pump work. Also determine the fuel to be supplied/hr if its C_{vf} is 41850 kJ/kg.

8. Define and explain the terms in relation to psychrometry.

(a) Dry bulb, wet bulb and dew point temperature

(b) Relative humidity and specific humidity

9. A mixture of 1 kg of oxygen and 2 kg of nitrogen occupies 1.2 m³ volume of temperature 300 K. Assuming perfect gas behaviour, determine the following :

(a) Specific volume

(b) Pressure

(c) Gas constant
