(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0430 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION

2010-11

THERMODYNAMICS

Time : 2 Hours *Total Marks : 50*

Note : (1) Attempt **all** questions.

(2) All questions carry equal marks.

(3) Notations used have usual meanings.

(4) Use of steam tables and Mollier charts is permitted.

(5) Assume any relevant data, if missing.

1. Attempt any **two** out of the following : **(5×2=10)**

(a) What do you mean by an isolated system ? Give the concept of temperature and differentiate among heat, temperature and internal energy.

(b) An insulated rigid tank contains $0.6m^3$ of air at 12 bar and 150°C. This air is allowed to expand to 1 bar. Find the maximum work that can be obtained from the escaping air in a adiabatic process. Take R= 0.277kJ/kgK and C_p=1.005 kJ/kgK for air.

(c) In a vessel. 10 kg of oxygen is heated in a reversible, nonflow constant volume process so that the pressure of oxygen is increased two times that of the initial value. The initial temperature is 20°C. Calculate (i) the final temperature, (ii) the change in internal energy, (iii) the change in enthalpy and (iv) the heat transfer. Take R = 0.259kJ/kgK and C_v=0.652kJ/kgk.

Attempt any **two** out of the following : **(5×2=10)**

(a) The thermal reservoir A is at a constant temperature 600°C and thermal reservoir B is at 250°C. A Carnot heat engine works between thermal reservoirs A and B. Half of the power developed by the Carnot engine is used to drive a generator to produce electricity and the other half is used to drive a heat pump which receives heat from thermal reservoir B and rejects heat to a thermal reservoir C which is at a temperature of 400°C. Calculate the heat rejected to thermal reservoir C by the heat pump as percentage of heat from thermal reservoir A to the Carnot engine. Also calculate the heat rejected per hour to thermal reservoir C if 480 kw are generated by generator assuming 100 percent of generator efficiency.

(b) Discuss the types of irreversibilities.

(c) Prove that No heat engine working in a cycle between two constant temperature reservoirs can be more efficient than a reversible engine working between the same two reservoirs.

3. Attempt any **three** out of the following : **(5×3=15)**

(a) Show that when a perfect gas changes from a state p_1, v_1, T_1 to state p_2, v_2, T_2 the increase in entropy per unit mass is given by :

$$S_2 - S_1 = C_v \ln \frac{p_2}{p_1} + C_p \ln \frac{v_2}{v_1}$$

Find the value of index n so that the gain of entropy during the heating of the gas at constant volume between temperature T_1 and T_2 will be the same as that during an expansion according to the law pv^n=constant between the same temperatures.

(b) State 'Third law of Thermodynamics'. Define Clausius inequality and prove it.

(c) What do you understand by Availability and second law of efficiency ?

(d) Define Helmholtz and Gibbs free energy. What are its physical significance ? Explain.

4. Attempt any **three** out of the following : **(5×3=15)**

(a) 5000 kg of steam enters a surface condenser per hour at pressure 0.07 bar. In one hour, 250000 litres of cooling water are passed through the tubes and its temperature rises from 21°C to 32°C. The condensed steam leaves the condenser with a temperature of 30°C. Calculate the condition of steam entering the condenser. Density of water is 1000 kg/m³. Take C_p for water as 4.18kJ/kgK.

(b) Dry and saturated steam at pressure 11 bar is supplied to a turbine and expanded isentropically to pressure 0.07 bar. Calculate :

(i) heat supplied

(ii) change of entropy during heat rejection

(iii) heat rejected and

(iv) theoretical thermal efficiency.

(c) Differentiate between CI and SI engines.

(d) Describe the parameters that are used to describe the performance of I.C. Engines. Write the different items which constitute the heat balance sheet.