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

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

B.Tech.

(SEM. III) THEORY EXAMINATION 2011-12

THERMODYNAMICS

Time : 2 Hours *Total Marks : 50*

Note :— Attempt **all** questions. Use of steam table and properties charts are allowed. All symbols have usual meaning.

1. Attempt any **four** of the following : **(3½×4=14)**

   (a) Describe thermodynamic equilibrium of a system.

   (b) Define the following : thermodynamic properties, path, process, open system, continuum.

   (c) An insulated tank is divided in two equal parts by a thin membrane. Air at 1 bar pressure and 300° C is contained in one half of the tank and other half is completely evacuated. Membrane gets punctured and fills the entire volume. Calculate the final pressure and temperature of air in the vessel.

   (d) Explain how the Zeroth law of thermodynamics can be used for temperature measurement.

In an unknown temperature scale freezing point of water is 0° X and boiling point of water is 1000° X. Obtain a conversion relation between degrees X and degree celsius. Also determine the absolute zero in degree X.

(e) The initial volume of 0.18 kg of a certain gas was 0.15 m^3 at a temperature of 15° C and a pressure of 1 bar. Find the adiabatic expansion index (v) if after adiabatic compression to 0.056 m^3, the pressure was found to be 4 bar.

Find : (i) gas constant (ii) molecular mass of the gas (iii) specific heat at constant pressure and at constant volume (iv) change in internal energy.

(f) What are the assumption for steady flow process ? Write the general energy equation for steady flow process.

2. Attempt any **two** of the following : **(6×2=12)**

(a) Shows that efficiency of an irreversible engine is always less than the efficiency of reversible engine operating between same temperature limit.

(b) A reversible heat engine operates between two reservoirs at temperature of 600° C and 40° C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40° C and – 20° C. The heat transfer to the engine is 2 MJ and the net work output of the combined engine and refrigerator plant is 360 kJ. Find the heat transfer

to the refrigerant and the net heat transfer to the reservoir at 40° C. Also find these values if the efficiency of the heat engine and cop of the refrigerator are each 40% of their maximum possible values.

(c) Why carnot cycle is a theoretical cycle ? Explain three reversible engines of carnot type are operating in series as shown between the limiting temperatures of 1100 K and 300 K. If the work output from engines is in proportion of 3 : 2 : 1, determine the intermediate temperature.

3. Attempt any **two** of the following : **(6×2=12)**

(a) Explain why the slope of constant volume line is more than the slope of constant pressure line.

(b) One kg of air occupies 0.084 m^3 at 12.5 bar and 537° C. It is expanded at constant temperature to a final volume of 0.336 m^3. Calculate :

(i) Pressure at the end of expansion

(ii) Work done during expansion

(iii) Heat absorbed by the air

(iv) Change of entropy.

(c) Describe the Gibbs function. How does it differ from the availability function ?

Two tanks A and B contain 1 kg of air at 1 bar, 50° C and 3 bar, 50° C when atmosphere is at 1 bar 15° C. Identify the tank in which stored energy is more. Also find the availability of air in each tank.

4. Attempt any **two** of the following : **(6×2=12)**

(a) Give a neat sketch of "separating and throttling calorimeter" for dryness measurement.

In a throttling calorimeter the steam is admitted at a pressure of 10 bar. If it is discharged at atmospheric pressure and 110° C after throttling, determine the dryness fraction of steam. Assume specific heat of steam is 2.2 kg/kg K.

(b) Compare 2-stroke SI and 4-stroke SI engines. An engine with 85% mechanical efficiency has rating of 37.9 KW brake power. Estimate its indicated power and frictional power loss. Also determine the mechanical efficiency at quarter load assuming frictional power to remain same.

(c) Draw simple Rankine cycle on P-V, T-S and h-s diagram. Steam enters at 80 bar and 450° C in a steam turbine and expends isentropically up to condenser pressure of 0.1 bar. Find the state of steam at turbine exist and power developed by the turbine if the mass flow rate of steam is 5 kg/sec.

(2+4)