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BIME-023

01553

DIPLOMA MECHANICAL ENGINEERING (DMEVI)

Term-End Examination

December, 2012

BIME-023 : ENGINEERING THERMODYNAMICS

Time : 2 hours *Maximum Marks : 70*

Note : *All questions are* ***compulsory.*** *Use of calculator is permitted. Use of steam tables are also permitted.*

1. Choose the correct answer from the given four alternatives : **7x2=14**

   (a) A closed thermodynamic system manifests when.

   (i) Matter is not allowed to cross the boundary, but energy transfer does occur across the boundary

   (ii) There is transfer of both mass and energy across the system boundaries.

   (iii) There is only transfer of mass, but no heat and work energy are transferred.

   (iv) There is absolutely no interaction of the system with surroundings across its boundaries.

(b) First law of themodynamics refers to conservation of :

(i) mass (ii) momentum

(iii) energy (iv) force

(c) Zeroth law of thermodynamics states that :

(i) two thermodynamic systems are always in thermal equilibrium with each other.

(ii) if two systems are in thermal equilibrium, then the third system will also be in thermal equilibrium.

(iii) two systems not in thermal equilibrium with a third system are also not in thermal equilibrium with each other.

(iv) when two systems are in thermal equilibrium with a third system, they are in thermal equilibrium with each other.

(d) The internal energy of an ideal gas is a function of :

(i) pressure only

(ii) absolute temperature only

(iii) pressure and volume

(iv) pressure, volume and temperature

(e) The processes involved in a Carnot cycle are :

(i) two adiabatic processes and two constant volume processes.

(ii) two adiabatic processes and two isothermal processes.

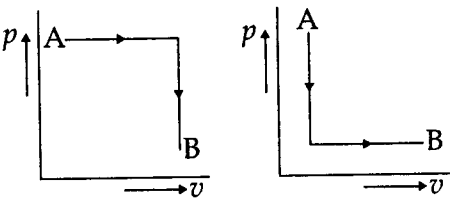
(iii) two isothermals and two constant pressure processes.

(iv) two constant pressure and two constant volume processes.

(f) An ideal gas is made to go from state A to state B in the following two different ways :

(A) an isobaric and then an isochoric process.

(B) an isochoric and then an isobaric process.



The work done by the gas in two cases are W_1 and W_2 respectively. Then :

(i) $W_1 = W_2$ (ii) $W_1 > W_2$

(iii) $W_1 < W_2$ (iv) $W_1 = \frac{1}{4} W_2$

(g) Dryness fraction of wet steam is given by :

(i) ratio of mass of dry steam to the mass of suspended liquid water.

(ii) ratio of mass of suspended liquid water to mass of dry steam.

(iii) ratio of mass of dry steam to the sum of mass of suspended liquid water and dry steam.

(iv) ratio of sum of mass of suspended liquid water and dry steam to the mass of dry steam.

2. Answer *any two* of the following : **2x7=14**

(a) Define the terms 'system', 'surrounding', 'boundary' and 'universe' as related to thermodynamics and distinguish between 'open', 'closed' and 'isolated' system.

(b) If a gas of volume 6000 cm^3, and at pressure of 100 kPa, is compressed according to $PV^2 = C$, until the volume becomes 2000 cm^3, determine the final pressure and work transfer.

(c) A resistance thermometer has a resistance of 6 Ω at ice point and 10 Ω at steam point. What will be the temperature when resistance is 7.5 Ω.

3. Answer *any two* of the following : **2x7=14**

(a) Describe in brief the Clausius and Kelvin - Planck statements being used for second law of thermodynamics.

(b) Air initially at 70 kPa pressure, 900 K temperature and having the volume 0.2 m^3 is compressed isothermally until the volume is halved and then compressed further at constant pressure till the volume is halved again.

Find :

(i) Total work done,

(ii) total heat transfer.

Cp (for air) = 1.005 kJ/kg − K;

R = 287 J/kg − K.

(c) 3 kg of an ideal gas is compressed adiabatically from pressure 150 kPa and temperature 300 K to a final pressure of 500 kPa.

Find :

(i) Work done

(ii) Heat transfer

(iii) Change in internal energy

Cp = 1.1 kJ/kg − K ; Cv = 0.8 kJ/kg − K

4. Answer *any two* of the following : **2x7=14**

(a) What is entropy ? When entropy is defined only in terms of reversible process, how can then it be evaluated for an irreversible process ?

(b) A closed system contains 3 kg of gas at pressure 100 kPa, and temperature 310 K. Heat is supplied to the vessel at constant volume till the gas attains 170 kPa.

Find :

(i) Final temperature

(ii) work done

(iii) heat added

(iv) change in internal energy

Given $Cv = 0.70$ kJ/kg – K.

(c) The temperature of the freezer of a domestic refrigerator is maintained at $-10°C$ where as the ambient temperature is 30°C. If the heat leaks into the freezer at a continuous rate of 3 kJ/sec, what is the minimum power required to pump out this heat leakage from freezer continuously ?

5. Answer *any two* of the following : **2x7=14**

(a) Define the quality of steam. What is Rankine cycle ?

(b) For a steam power plant, following data is given :

Steam supply condition : 60 bar, 450°C

Condenser pressure : 0.1 bar,

Steam flow rate : 5000 kg/hr.

Calculate the following :

(i) Turbine work

(ii) % of pump work compared to turbine work

(iii) Heat addition in the boiler

(iv) Heat rejection in condenser

(v) Thermal efficiency

(c) What is meant by calorific value of a fuel ? Differentiate between H.C.V. and L.C.V. What is the maximum percentage of carbon dioxide in the exhaust gas of boiler using solid fuel ?