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BIME-023

DIPLOMA IN MECHANICAL ENGINEERING (DMEVI)

00544

Term-End Examination

June, 2011

BIME-023 : ENGINEERING THERMODYNAMICS

Time : 2 hours *Maximum Marks : 70*

Note : *Attempt **any five.** First question is **compulsory.** Use of steam - tables and Mollier's chart is allowed.*

1. Fill in the blanks :

(a) A system consisting of single phase is called _____ system. **2**

(b) The _____ law provides that basis for temperature measurement. **2**

(c) A perfect gas obey the law _____. **2**

(d) Internal energy is a _____ of a system. **2**

(e) The processes involved in carnot cycle are _____ and _____. **2**

(f) Entropy of an isolated system either _____ or _____. **2**

(g) A mixed phase of liquid and gas is called _____. **2**

2. (a) What is meant by thermodynamic equilibrium ? 7

(b) The relationship between pressure and volume in a non - flow process is prescribed by the expression $p = \left(\frac{3}{v} + 2\right)$, where pressure p is in bar and volume is in m^3. During the process 1600 kJ of heat is added to the gas and the volume changes from 1.2 m^3 to 4 m^3. Determine the change in internal energy. 7

3. (a) State the limitations of first law of thermodynamics. 7

(b) In a certain heat exchanger 50 kg of water is heated per minute from 50°C to 110°C by hot gases which enter the heat exchanger at 250°C. If the flow rate of gases is 100 kg/min, estimate the net change in entropy 7

C_p for water = 4.186 kJ/kgK

C_p for gas = 1 kJ/kgK

4. (a) A centrifugal pump delivers 2750 kg of water per minute from initial pressure of 0.8 bar (absolute) to a final pressure of 2.8 bar (absolute). The suction is 2 m below and the delivery is 5 m above the centre of the pump. If the suction and delivery pipes are of 15 cm and 10 cm diameter respectively. Make calculations for power required to drive the pump. 7

(b) Explain the Carnot cycle with p-v and T-s diagrams. Derive the expression for efficiency of Carnot Heat Engine. 7

5. (a) A steam turbine working on Rankine cycle is supplied with dry saturated steam at 25 bar and the exhaust takes place at 0.2 bar. For a steam flow rate of 10 kg/sec. Calculate 7
   (i) quality of steam of the end of expansion
   (ii) turbine shaft work
   (iii) Efficiency of cycle

   (b) Explain the working of throttling calorimeter. 7

6. (a) A lump of 800 kg of steel at 1250 K is to be cooled to 500 K. If it is desired to use the steel as source of energy, calculate the available and unavailable energies. Take specific heat of steel as 0.5 kJ/kgK and ambient temperature as 300 K. 7

   (b) Explain the loss of available energy due to heat transfer through a finite Temperature difference. 7

7. (a) The percentage analysis by mass of a solid fuel is : 7
   $C = 87\%$, $H_2 = 3\%$, $O_2 = 3\%$, $N_2 = 1\%$, $S = 1\%$ and the remainder is ash. If 50% excess air is supplied. Find
   (i) the theoritical amount of air required to complete the combustion of fuel.
   (ii) volumetric analysis of wet flue gases and the mass of flue gas per kg of fuel.

   (b) Derive Availability function for a non - flow system. 7