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BME-019

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BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

June, 2010

BME-019 : ENGINEERING THERMODYNAMICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **any five** questions. All questions carry **equal** marks. Assume suitable missing data, if any. Use of calculator is permitted. Use of steam table, and moiler chart is permitted.*

1. (a) What do you understand by thermodynamic properties ? How the properties of a system can be classified ? Cite atleast 3 examples of each class of property.

(b) State the Zeroth law of thermodynamics. Explain how this law is applied for measuring temperature of any body.

(c) Define absolute pressure, atmospheric pressure, gauge pressure and vacuum pressure. **5+5+4**

2. (a) Discuss any three similarities and any three differences between work and heat. 6+8

(b) When a system is taken from state *l* to state *m*, in figure 1 along path *lqm*, 168 kJ of heat flows into the system, and the system does 64 kJ of work.

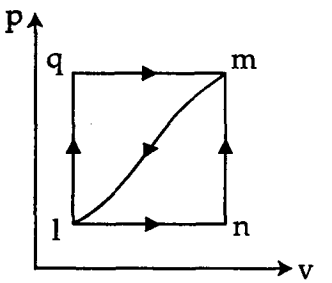

figure - 1

(i) How much will be heat that flows into the system along path *lnm*, if the work done is 21 kJ ?

(ii) When the system is returned from *m* to *l* along the curved path, the work done on the system is 42 kJ. Does the system absorb or liberate heat, and how much of the heat is absorbed or liberated ?

(iii) If $U_l = 0$, and $U_n = 84$ kJ, find the heat absorbed in the process *ln* and *nm*.

3. (a) Discuss why it is not possible to have a thermodynamic cycle in which all the heat transferred to the system gets completely converted to work.

(b) Enumerate the conditions which must be fulfilled by a reversible process. Give two examples of ideal reversible processes.

(c) In an internal combustion engine, during the compression stroke the heat rejected to the cooling water is 50 kJ/kg and the work input is 100 kJ/kg. Calculate the change in internal energy of the working fluid stating whether it is a gain or loss. **5+4+5**

4. (a) "All reversible heat engines operating between two given temperature limits do not have the same efficiency." Do you agree with this statement ? Give justification to your answer.

(b) Define the term 'absolute zero temperature' and show how a scale of temperature can be devised from the operation of reversible heat engines.

(c) Find the coefficient of performance and heat transfer rate in the condenser of a refrigerator in kJ/hr which has a refrigeration capacity of 12000 kJ/hr when power input is 0.75 kW. **5+4+5**

5. (a) If 1 kg of gas at pressure p_1, volume v_1, absolute temperature T_1, and entropy s_1 is heated such that its final pressure, volume, absolute temperature, and entropy are p_2,v_2 T_2 and s_2 respectively, derive the equation for the change in entropy. **7+7**

(b) Series combination of three carnot engines A, B, C operate between temperature of 1000 K and 3000 K. Calculate the intermediate temperatures if the amount of work produced by the engines is in the proportion of 5 : 4 : 3.

6. (a) What is refrigeration ? Name atleast four methods used for providing refrigeration. List out any two important industrial and commercial applications of refrigeration. **7+7**

(b) A carnot refrigerator requires 1.3 kW per tonne of refrigeration to maintain a region at low temperature of $-38°$ C. Determine :

(i) C.O.P. of carnot refrigerator

(ii) Higher temperature of the cycle

(iii) The heat delivered and C.O.P. when this device is used as heat pump.

7. (a) Explain the Rankine vapour cycle on P - V and T - S diagram. Make a comparison between Rankine cycle and Carnot cycle. Discuss the effect of operating conditions on Rankine cycle efficiency. **6+8**

(b) A simple Rankine cycle works between pressure of 30 bar and 0.04 bar. The initial condition of steam is dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption. Relevant steam table extract is given below :

Pressure (bar)	Specific Enthalpy (kJ/kg)			Specific Entropy (kJ/kg k)			Specific volume (m^3/kg)	
	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g	v_f	v_g
30	-	-	2802	-	-	6.2104	-	-
0.04	151.5	2415.9	-	0.521	7.809	-	0.001	-

8. (a) Discuss the significance of energy for national economic development. **3+3+5+3**

(b) Differentiate between renewable resources and non - renewable resources of energy.

(c) Define waste heat. What is Waste Heat Recovery (WHR) ? List at least six industry having potential for WHR.

(d) Give two explicit reasons for seeking high efficiency in power plant practice.