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06ME33

Third Semester B.E. Degree Examination, December 2010
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Use of thermodynamics data handbook is permitted.

PART – A

1 a. What do you understand by microscopic and macroscopic view points? **(04 Marks)**

b. Explain mechanical, chemical and thermal equilibrium by mean s of example. **(06 Marks)**

c. With suitable examples, distinguish between :
i) Closed and open system ;
ii) Path function and point function.
iii) Intensive and extensive properties. **(06 Marks)**

d. Explain Zeroth law of thermodynamics. **(04 Marks)**

2 a. Differentiate between work and heat. **(04 Marks)**

b. What is meant by displacement work? Explain the same with reference to the quasi – static process. **(06 Marks)**

c. A balloon of flexible material is to be filled with air from a storage bottle unit. It has a volume $0.7m^3$. The atmospheric pressure is 1.013 bar. Determine the work done by the system comprising the air initially in the bottle, given that the balloon is light and requires no stretching. **(10 Marks)**

3 a. State the I^{st} law of thermodynamics. for cyclic process and show that internal energy is a property of a system. **(08 Marks)**

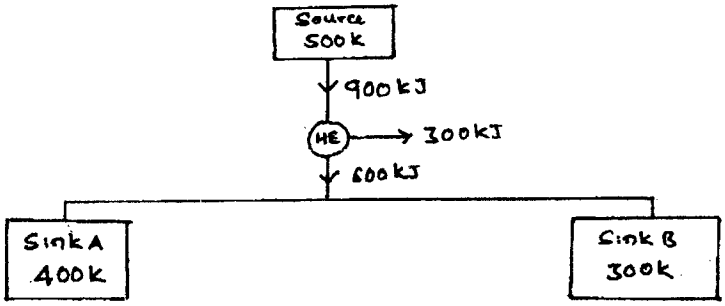
b. In a non–flow reversible process, the pressure and volume are related by $P = V^2 + \frac{20}{V}$, where P – is pressure in bar and V in m^3. During a process, the volume changes from $2m^3$ to $6m^3$ and heat added is 9000 kJ. Determine change in internal energy. **(06 Marks)**

c. Starting from the common state point, draw the following expansion processes on P–V diagram and write expression for the work in the case :
i) Isochoric process ; ii) Isobaric process ;
iii) Isentropic process ; iv) Isothermal process. **(06 Marks)**

4 a. Show that COP of the heat pump is greater than COP of a refrigerator by unity. **(06 Marks)**

b. A reversible heat engine is supplied 900 kJ of heat from a heat source at 500 K. The engine develops 300 kJ of net work and rejects heat to two heat sinks at 400 K and 300 K. Determine the engine thermal efficiency and magnitude of heat interaction with each of sink. **(10 Marks)**

Fig.Q.4(b).



c. Give the Clausius and Kelvin – Planks statements of the second law. **(04 Marks)**

PART – B

5 a. Show that the entropy is a property of a system. **(08 Marks)**

b. 'm_1' kg of water at T_1 is isobarically and adiabatically mixed with m_2 kg of water at T_2 ($T_1 > T_2$). Show that for equal masses of water, the entropy change of the mixture is given by $(ds)_{universe} = 2mc_p \log e\left[\frac{T_1 + T_2}{2\sqrt{T_1 T_2}}\right]$ and prove that the change is necessarily positive.

(12 Marks)

6 a. With a T-S diagram, briefly explain the available energy and unavailable energy. **(08 Marks)**

b. Derive an expression for availability analysis for steady flow open system and prove that $W_{rev} = m(\psi_1 - \psi_2)$. **(12 Marks)**

7 a. Define the following terms with reference to the pure substance.

i) Heat of fusion
ii) Latent heat of vaporization
iii) Sensible heat
iv) Saturation temperature
v) Tripple point
vi) Enthalpy
vii) Wet steam
viii) Dryness fraction. **(08 Marks)**

b. A pressure cooker contains 1.5 kg of saturated steam at 5 bar. Find quantity of heat which must be rejected so as to reduce quality to 60% dry. Determine the pressure and temperature at new state. **(12 Marks)**

8 a. Explain the Vander Walls equation of state. **(08 Marks)**

b. 5g of argon gas undergoes a change of state at constant internal energy. Initial pressure and temperature are 6 atm and 300 K respectively. The final volume occupied by the gas is 3 times that occupied initially. Assume ideal gas behaviour, determine :

i) The final temperature of the gas.
ii) The final pressure of the gas.
iii) The entropy change of the gas due to change of state. **(12 Marks)**

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