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Total Number of Pages : 2

B.TECH

2nd Semester Regular Examination-April-May 2019
BBSES1032- BASICS OF THERMODYNAMICS
(Regulations 2018) CSE/MECH ENGG.

Time : 3 Hours

Maximum : 100 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) 10 x 2=20 Mark**Q.1. Answer ALL Questions.**

- a. Thermodynamic properties are [CO1] [PO1]
a) point function b) path function c) depends on the state d) none of the mentioned
- b. In an open system, for maximum work, the process must be entirely [CO1] [PO1]
a) irreversible b) reversible c) adiabatic d) none of the mentioned
- c. Heat flow into a system is taken to be ____, and heat flow out of the system is taken as ____ [CO1] [PO2]
a) positive, positive b) negative, negative c) negative, positive d) positive, negative
- d. By first law of thermodynamics, [CO2] [PO1]
a) $Q=\Delta E-W$ b) $Q=\Delta E+W$ c) $Q=-\Delta E-W$ d) $Q=-\Delta E+W$
- e. In the differential form, the SFEE becomes [CO2] [PO2]
a) $dQ+dW=dh+VdV+gdZ$ b) $dQ-dW=dh+VdV+gdZ$
c) $dQ+dW=dh-VdV-gdZ$ d) $dQ-dW=dh-VdV+gdZ$
- f. What does a diffuser do? [CO2] [PO1]
a) increases the pressure of the fluid at the expense of its KE
b) decreases the pressure of the fluid and also increases its KE
c) increases the pressure of the fluid and also its KE
d) decreases the pressure of the fluid and also its KE
- g. In the equation, $dQ=TdS$ [CO3] [PO2]
a) dQ is an inexact differential b) dS is an exact differential
c) S is an extensive property d) all of the mentioned
- h. Which of the following is known as the inequality of Clausius? [CO3] [PO2]
a) cyclic integral of $dQ/T \leq 0$ b) cyclic integral of $dQ/T \geq 0$
c) cyclic integral of $dW/T \leq 0$ d) cyclic integral of $dW/T \geq 0$
- i. Which of the following curves meet at triple point? [CO4] [PO1]
a) fusion curve and vaporization curve
b) fusion curve and sublimation curve
c) vaporization curve and sublimation curve
d) fusion curve and vaporization curve and sublimation curve
- j. The internal energy of saturated water at the triple point is [CO4] [PO2]
a) 1 b) 0 c) -1 d) infinity

PART – B: (Short Answer Questions) 10X2=20 Marks**Q.2. Answer ALL questions**

- a. Differentiate between point function and path function? [CO1] [PO1]
- b. What is meant by quasi-static process in thermodynamics? [CO1] [PO1]
- c. Define Zeroth law of thermodynamics? [CO1] [PO1]
- d. What is C_p and C_v ? [CO2] [PO1]
- e. Define the term enthalpy. [CO2] [PO2]
- f. State Clausius statement of the second law of thermodynamics. [CO3] [PO1]
- g. What is the difference between a heat pump and refrigerator? [CO3] [PO1]
- h. Define latent heat of vaporization. [CO4] [PO1]
- i. Define critical point for pure substance. [CO4] [PO1]
- j. Define dryness fraction of steam? [CO4] [PO1]

**PART – C: (Long Answer Questions) 4 X 15=60 Marks**Answer ALL questions**Q.3**

- a. Compare microscopic and macroscopic approaches. 5 [CO1] [PO1]
- b. The temperature t on a thermometric scale is defined in terms of a property K by the relation $t = a \ln K + b$ Where a and b are constants. The values of K are found to be 1.83 and 6.78 at the ice point and the steam point, the temperatures of which are assigned the numbers 0 and 100 respectively. Determine the temperature corresponding to a reading of K equal to 2.42 on the thermometer. 10 [CO1] [PO2]

OR

- c. Air at 5 bar and 20°C flows into an evacuated tank until the pressure in the tank is 5 bar. Assume that the process is adiabatic and the temperature of the surroundings is 20°C. What is the final temperature of the air? 5 [CO1] [PO2]
- d. A mass of gas is compressed in a quasi-static process from 80 kPa, 0.1 m³ to 0.4 MPa, 0.03 m³. Assuming that the pressure and volume are related by $pv^n = \text{constant}$, find the work done by the gas system. 10 [CO1] [PO2]

Q.4

- a. State the first law of thermodynamics and prove that for a non-flow process, it leads to the energy equation $Q = \Delta U + W$. 5 [CO2] [PO1]
- b. A mass of 8 kg gas expands within a flexible container so that the $p-v$ relationship is of the form $pv^{1.2} = \text{constant}$. The initial pressure is 1000 kPa and the initial volume is 1 m³. The final pressure is 5 kPa. If specific internal energy of the gas decreases by 40 kJ/kg, find the heat transfer in magnitude and direction. **OR** 10 [CO2] [PO2]
- c. What do you mean by “Perpetual Motion Machine of first kind-PMM 1”? 5 [CO2] [PO1]
- d. A gas undergoes a thermodynamic cycle consisting of three processes beginning at an initial state where $p_1 = 1 \text{ bar}$, $V_1 = 1.5 \text{ m}^3$ and $U_1 = 512 \text{ kJ}$. The processes are as follows: (i) Process 1–2: Compression with $pV = \text{constant}$ to $p_2 = 2 \text{ bar}$, $U_2 = 690 \text{ kJ}$ (ii) Process 2–3: $W_{23} = 0$, $Q_{23} = -150 \text{ kJ}$, and (iii) Process 3–1: $W_{31} = +50 \text{ kJ}$. Neglecting KE and PE changes, determine the heat interactions Q_{12} and Q_{31} . 10 [CO2] [PO2]

Q.5

- a. State the limitations of first law of thermodynamics. 5 [CO3] [PO1]
- b. A heat engine is used to drive a heat pump. The heat transfers from the heat engine and from the heat pump are used to heat the water circulating through the radiators of a building. The efficiency of the heat engine is 27% and the COP of the heat pump is 4. Evaluate the ratio of the heat transfer to the circulating water to the heat transfer to the heat engine. 10 [CO3] [PO2]

OR

- c. What do you mean by the term “Entropy” and what are the characteristic of it? 5 [CO3] [PO1]
- d. A heat engine operating between two reservoirs at 1000 K and 300 K is used to drive a heat pump which extracts heat from the reservoir at 300 K at a rate twice that at which the engine rejects heat to it. If the efficiency of the engine is 40% of the maximum possible and the COP of the heat pump is 50% of the maximum possible, what is the temperature of the reservoir to which the heat pump rejects heat? What is the rate of heat rejection from the heat pump if the rate of heat supply to the engine is 50 kW? 10 [CO3] [PO2]

Q.6

- a. Explain the neat sketch of $p-v-T$ surface. 5 [CO4] [PO1]
- b. A vessel of volume 0.04 m³ contains a mixture of saturated water and steam at a temperature of 250°C. The mass of the liquid present is 9 kg. Find the pressure, mass, specific volume, enthalpy, entropy and internal energy. 10 [CO4] [PO2]

OR

- c. Mention the various thermodynamics properties of steam. 5 [CO4] [PO1]
- d. Find the internal energy of 1kg of steam at 20bar when, (i) it is superheated, its temperature being 400°C, (ii) it is wet, its dryness being 0.9. Assume superheated steam to behave as a perfect gas from the commencement of superheating and thus obeys Charle’s law. Specific heat for steam = 2.3 kJ/kg K. 10 [CO4] [PO2]

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