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BTECH
(SEM III) THEORY EXAMINATION 2021-22
THERMODYNAMICS

Time: 3 Hours**Total Marks: 70****Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.**SECTION A****1. Attempt all questions in brief.****2 x 7 = 14**

a.	Define the terms, 'Unit of Refrigeration', 'refrigerating effect'.
b.	Explain PMM I and PMM II.
c.	Define the dead state and second law efficiency.
d.	Explain the term entropy.
e.	Describe the availability and irreversibility
f.	Define Coefficient of volume expansion (α) and coefficient of isothermal compressibility (β).
g.	Draw p-t diagram for Phase transformation process of water and define triple point.

SECTION B**2. Attempt any three of the following:****7 x 3 = 21**

a.	Define intensive and extensive properties of thermodynamics. For some substance relation $p v = B T$ exists where p, v, T and B are pressure, specific Volume, temperature and constant respectively. The quantity S is given by $dS = \frac{c dT}{T} - \frac{v dP}{T}$ Where, c is constant. Check whether S is property or not.
b.	Two insulated tank are connected through a pipe with closed valve in between. Initially one tank having volume of 1.8 m ³ has argon gas at 12 bar, 40 °C and other tank having volume of 3.6 m ³ is completely empty. Subsequently valve is opened and the argon pressure gets equalized in two tanks. Determine (i) the final pressure and temperature (ii) the change of enthalpy and (iii) the work done considering argon as a perfect gas and gas constant is 0.208 kJ/kg K
c.	Setup the Tds relation in the following form: (a) $T ds = C_v dT + T (\partial p / \partial T)_v dv$ (b) $T ds = C_p dT - T (\partial v / \partial T)_p dp$
d.	Explain simple Rankine cycle with neat schematic diagram and also show different processes involved in it on T-s, h-s and p-v diagram.
e.	Describe a Bell Coleman or reverse Joule air refrigeration cycle with a neat sketch. Derive an expression for COP of an air refrigeration system working on Bell Coleman cycle.

SECTION C**3. Attempt any one part of the following:****7 x 1 = 7**

(a)	An evacuated cylinder fitted with a valve through which air from atmosphere at 760 mm Hg and 25°C is allow to fill it slowly. If no heat interaction is involved, what will be the temperature of air in the bottle when the pressure reaches 760 mm Hg? Consider the internal energy of air $u = u_0 + 0.718T$ kJ/kg where, T is temperature in °C and $R = 0.287$ kJ/kg K
(b)	Air expands from 3 bar to 1 bar in a nozzle. The initial velocity is 90 m/s. the initial temperature is 150°C. Calculate the velocity of air at the exit of the nozzle. Consider C_v for air = 0.718 kJ/kg°C and $R = 287$ J/kg K.



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4. Attempt any *one* part of the following: 7 x 1 = 7

(a)	One kg of water at 77°C is mixed adiabatically with 2 kg of water at 27°C in a constant pressure process of 1 atmosphere. Find the increase in the entropy of the total mass of water due to the mixing process (C_p of water = 4.187 kJ/kg K).
(b)	Three reversible engines operate in series between two heat reservoirs of extremities being at 1000K and 300K. Considering the work produced by each engine to be in the proportion of 4:3:1 determine temperature of intermediate reservoirs.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Explain Clausius-Clapeyron equation with p-T diagram.
(b)	Explain inversion curve? With help of this define Joule Thomson coefficient. What are the applications of inversion curve and Joule Thomson coefficient?

6. Attempt any *one* part of the following: 7 x 1 = 7

(a)	What is the importance of psychrometric chart and how different psychrometric processes are represented on it? Draw the following process on psychrometric chart describing them in brief: (i) Sensible heating and Sensible cooling (ii) Latent heating and latent cooling (iii) Cooling and dehumidification (iv) Heating and humidification. Room air having DBT of 40°C and WBT of 25°C is cooled through sensible cooling process upto a temperature of 25°C show it on a psychrometric chart and evaluate the amount of heat removed (in KJ/Kg of dry air).
(b)	Explain P-h chart for refrigerant and h-s diagram for pure substance

7. Attempt any *one* part of the following: 7 x 1 = 7

(a)	An air refrigeration cycle has pressure ratio of 8, temperature of air at beginning of compression is -30°C and air is cooled up to 27°C after compression. Compression and expansion processes have isentropic efficiency of 85% and 90% respectively. Evaluate the refrigeration capacity and coefficient of performance. Consider $C_p = 1.005$ kJ/kg·K, $\gamma = 1.4$ and air flow rate of 1 kg/s.
(b)	Illustrate with neat sketch the working of simple Ammonia Water Vapour Absorption system