



(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 151409**

Roll No.

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## B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15  
THERMODYNAMICS - I

Time : 2 Hours]

[Total Marks : 50

**Note:** Attempt all questions.

1 Attempt **any four** parts of the following: **3×4=12**

- (a) Explain the concept of First Law of Thermodynamics and law of conservation of energy.
- (b) Given a thermodynamic system, conduct an analysis using the Second Law of Thermodynamics.
- (c) Discuss the virial expressions for compressibility factor  $Z$ .
- (d) Describe triple point and critical point for a pure substance.
- (e) Define ideal solution. What is Lewis/Randall rule?
- (f) What are the effects of the temperature on the heat of reaction ?

2 Attempt **any two** parts of the followings: **6×2=12**

- (a) What is change in entropy when  $0.7 \text{ m}^3$  of  $\text{CO}_2$  and  $0.3 \text{ m}^3$  of  $\text{N}_2$  each at 1 bar and  $25^\circ\text{C}$  blend to form a gas mixture at the same condition? Assume ideal gases.
- (b) A heat engine which rejects waste heat to a sink at 310 K has a thermal efficiency of 36% and a second law efficiency of 60%. Determine the temperature of the source that supplies heat to this heat engine.
- (c) Show T xy and P xy diagram for binary system of immiscible liquids.

3 Attempt **any two** parts of the followings: **7×2=14**

- (a) One cubic meter of an ideal gas at 600 K and 1000 kPa expands to four times its initial volume by a mechanically reversible adiabatic process. Calculate the temperature, pressure and work done by the gas. Take  $C_p = 2.5/\text{mol K}$ .
- (b) A 30 kg steel casting ( $C_p = 0.5 \text{ kJ kg}^{-1} \text{ K}^{-1}$ ) at a temperature of 723 K is quenched in 150 kg of oil ( $C_p = 2.55 \text{ kJ kg}^{-1} \text{ K}^{-1}$ ) at 298 K. If there is no heat losses what is change in' entropy of oil?
- (c) Write short notes on:
  - (i) Enthalpy concentration diagram
  - (ii) Gibbs - Duhem equation.

4 Attempt **any two** parts of the followings: **6×2=12**

- (a) A Carnot engine operates between temperature levels 600 K and 300 K. It drives a Carnot refrigerator, which provides cooling at 250 K and discards heat at 300K. Determine a numerical value for the ratio of heat extracted by the refrigerator to the heat delivered to the engine.
- (b) Derive Fundamental property relation.
- (c) A closed nonreactive system contains species 1 and 2 in vapour/liquid equilibrium. Species 2 is very light gas, essentially insoluble in the liquid phase. The vapour phase contains both species 1 and 2. Some additional moles of species 2 are added to the system, which is then restored to its initial T and P. As a result of process, does the total number of moles of liquid increase, decrease or remains unchanged? Give explanation in support of your answer.
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