

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-IV • EXAMINATION – SUMMER • 2014

Subject Code: 140502

Date: 20-06-2014

Subject Name: Chemical Engineering Thermodynamics -I

Time: 10:30 am - 01:00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Define: Joule Thomson Coefficient? Derive expression for joule Thomson coefficient and also compute its value for ideal gas? **07**
- (b) Derive Clausius- clapyron equation. calculate the vapour pressure of water 363 K, if the vapour pressure at 373 K is 101.325 KJ/Kmol.K . The mean heat of Vaporization in this temperature range is 2275 KJ/Kg. **07**
- Q.2** (a) Explain P-V-T behavior of pure fluid with neat diagram? **07**
- (b) Define Hess's law of constant heat summation? Using Hess's law, calculate the heat of formation of solid CaCO₃ **07**
- $\text{Ca}_{(s)} + 0.5 \text{O}_{2(g)} \rightarrow \text{CaO}_{(s)} \quad \Delta H_{298}^{\circ} = -635.77 \text{ KJ}$
 $\text{C}_{(s)} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} \quad \Delta H_{298}^{\circ} = -393.77 \text{ KJ}$
 $\text{CaO}_{(s)} + \text{CO}_{2(g)} \rightarrow \text{CaCO}_{3(s)} \quad \Delta H_{298}^{\circ} = -178.15 \text{ KJ}$
- OR**
- (b) Define First Law of thermodynamics? Explain the limitation of first law of thermodynamics? **07**
- Q.3** (a) Derive the expression $dA/du = (A/u) * (M^2 - 1)$ for gas flow through nozzle. **07**
 Where M is Mach Number. A is cross sectional area for flow and u is the velocity.
- (b) With the help of Maxwell relation prove that $C_p - C_v = \beta^2 * V * T / \kappa$ **07**
- OR**
- Q.3** (a) Write a short note on Residual Property. **07**
- (b) A pure gas flowing at a low rate through a well insulated horizontal pipe at high Pressure is throttled to a slightly lower pressure. The gas obeys the equation of State $P(V-b) = RT$, Where b is a positive constant. Does the gas temperature rise Or fall by throttling? **07**
- Q.4** (a) Write a Short note on Second law of thermodynamics. **07**
- (b) Differentiate: Heat engine & Heat pump **07**
- OR**
- Q.4** (a) Write a short note on Third law of thermodynamics. **07**
- (b) Derive the expression for Tc, Vc, Pc, a and b for gas obeying van der waals equation of state ? **07**
- Q.5** (a) Write a Short note on Vapour- Compression cycle. **07**
- (b) Explain: Choice of Refrigerant for Refrigeration. **07**
- OR**
- Q.5** (a) A cold room is maintained at 261K using an air-refrigeration system which Should absorb 1000KJ/min. Cooling water is available at 293 K. Air leaves the Compressor at 506.5 Kpa and later expanded to 101.3 Kpa. Assume air to behave as an ideal gas **07**
 Find : (1) COP of unit. (2) Power Requirement.
 Take Cp= 1.008 KJ/Kg and $\gamma = 1.4$
- (b) Write a Short note on Claude process for gas liquefaction with neat diagram. **07**
