

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE- SEMESTER-III (NEW) EXAMINATION – WINTER 2020****Subject Code:3130507****Date:04/03/2021****Subject Name:Chemical Engineering Thermodynamics I****Time:10:30 AM TO 12:30 PM****Total Marks:56****Instructions:**

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) What are various units of temperature? Also, mention relations between them on various temperature scales? **03**
- (b) Differentiate between i) State function -Vs- Path function **04**  
ii) Reversible process -Vs- Irreversible process
- (c) Apply first law of thermodynamics to steady state flow process and derive mass and energy balance equation for open system. **07**
- Q.2** (a) Define and explain Ideal gas. **03**
- (b) What is EOS (Equation of State)? List some of them. **04**
- (c) Derive equation of constants of Vander Waal's equation of state in terms of critical constants of a substance. **07**
- Q.3** (a) Mention Statements of second law of thermodynamics. **03**
- (b) Define and explain following : **04**  
(i) Sensible heat (ii) Latent heat  
(iii) Standard heat of formation (iv) Standard heat of reaction
- (c) Derive Carnot equations for a Carnot cycle using an ideal gas **07**
- Q.4** (a) State and explain Hess's law of constant heat summation. **03**
- (b) Explain concept of entropy in brief **04**
- (c) If 10 mol of ethylene is heated from 200 to 1,000 °C in a steady-flow process at approximately atmospheric pressure, what is its entropy change ? **07**  
The heat capacity equation for ethylene is:
- $$\frac{C_p^{ig}}{R} = 1.424 + 14.394 \times 10^{-3} T_m - 4.392 \times 10^{-6} T_m T_m$$
- Q.5** (a) Explain Residual properties in brief. **03**
- (b) Explain Effect of temperature on heat of reaction in detail. **04**
- (c) Derive Maxwell equations using fundamental property relations for a homogeneous fluid of constant composition. **07**
- Q.6** (a) How much heat is required when 200 gm of CaCO<sub>3</sub> is heated at atmospheric pressure from 30 °C to 700 °C? **07**  
Data:  $C_p/R = 12.572 + 2.637 \times 10^{-3} T - 3.12 \times 10^{-5} T^2$ , T is in K
- (b) Explain Various types of thermodynamic diagrams in brief. **07**
- Q.7** (a) With reference to refrigeration, Define following: **03**  
(i) COP (Coefficient of Performance)  
(ii) Ton of refrigeration (iii) Heat Pump
- (b) Compare Vapor Compression refrigeration and Absorption refrigeration cycles. **04**

- (c) Show that the maximum velocity attained by a gas in steady state adiabatic flow in a horizontal pipe of a constant cross-sectional area is equal to the sonic velocity. **07**

- Q.8** (a) Define Mach number and state its significance **03**  
(b) What is a Nozzle? Briefly describe flow through nozzles. **04**  
(c) List the factors affecting the choice of refrigerant and explain vapor pressure of refrigerant in detail. **07**

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