

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER– III (New) EXAMINATION – WINTER 2019****Subject Code: 3130507****Date: 30/11/2019****Subject Name: Chemical Engineering Thermodynamics I****Time: 02:30 PM TO 05:00 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) Write short note on “Gibb’s phase rule”. **03**
 (b) Distinguish between intensive and extensive properties with suitable example. **04**
 (c) Explain the P-V-T behavior of pure fluids with the help of neat diagram. **07**
- Q.2** (a) Distinguish between state function and path function. **03**
 (b) Explain about principle of corresponding states. **04**
 (c) State first law of thermodynamics? Derive the expressions for 1st law of thermodynamics for non-flow process. **07**
- OR**
- (c) Heat is transferred to 10 kg of air which is initially at 100 kPa and 300 K until its temperature reaches 600 K. Determine the change in internal energy and change in enthalpy, amount of heat supplied and the work done for a Constant volume process. Assume air as an ideal gas. Given that: $R=8.314 \text{ kJ / kmol K}$, $C_p=29.099 \text{ kJ / kmol K}$, $C_v =20.785 \text{ kJ / kmol K}$ and molecular weight of air =29 **07**
- Q.3** (a) State various equations of state for real gases. **03**
 (b) Define the following **04**
 i. Sensible heat
 ii. Latent heat
 iii. Standard heat of combustion
 iv. Standard heat of formation
 (c) Explain about Van- Der-Waals equation of state. **07**
- OR**
- Q.3** (a) Discuss Virial equations and their applications. **03**
 (b) Define the statements for the second law of thermodynamics **04**
 i. Clausius Statement
 ii. Kelvin – Planck Statement
 (c) Discuss effect of temperature on heat of reaction and derive necessary equation. **07**
- Q.4** (a) Write a short note on Third law of thermodynamics. **03**
 (b) Describe absorption refrigeration cycle. **04**
 (c) Explain and prove Carnot’s principle with neat sketch. **07**
- OR**
- Q.4** (a) Write a short note on Jet ejector. **03**
 (b) Using Maxwell’s equation prove that : **04**
 $dH = C_p dT + V(1 - \beta T)dP$
 Where β is coefficient of volume expansion

- (c) Derive the expression for change in entropy when an ideal gas changes its state from (P_1, V_1, T_1) to (P_2, V_2, T_2) for following process- **07**
- 1) Constant volume process.
 - 2) Constant pressure process.
 - 3) Isothermal process.

- Q.5** (a) Assuming air is mixture of 21 % oxygen and 79% nitrogen by volume calculate entropy of 1 kmol air relative to pure oxygen and nitrogen, all at the same temperature and pressure. **03**
- (b) Discuss briefly about single and multistage compressors. **04**
- (c) What is the criterion of exactness? Using the criterion of exactness derive the Maxwell equation. **07**

OR

- Q.5** (a) Discuss any three major desirable properties of good refrigerant. **03**
- (b) Write a short note on Thermodynamic Diagrams. **04**
- (c) A refrigeration machine operating at a condenser temperature at 290 K needs 1 kW of power per ton of refrigeration. **07**
- Determine:
- 1) Coefficient Of Performance(COP)
 - 2) Heat rejected to the condenser
 - 3) The lowest temperature that can be maintained.
- Given that: 1 Ton of refrigeration = 12660 kJ/h=3516.67 W
