

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III (NEW) EXAMINATION – SUMMER 2021****Subject Code:3130507****Date:11/09/2021****Subject Name:Chemical Engineering Thermodynamics I****Time:10:30 AM TO 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.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1** (a) Define and explain “Reversible Process”. **03**
 (b) Differentiate between (i) Macroscopic Vs Microscopic approach **04**
 (ii) Intensive Vs Extensive Properties
 (c) State and explain first law of thermodynamics. Also, derive energy balance equation for closed system. **07**
- Q.2** (a) What is Cubic EOS? List some of them. **03**
 (b) Explain Virial expansions, Virial coefficients and compressibility factor. **04**
 (c) Explain PVT behavior of a pure substance with the help of PT and PV diagram in brief. **07**
- OR**
- (c) One kmol of an ideal gas, initially at 30⁰C and 1 bar undergoes the following mechanically reversible changes. It is compressed isothermally to a point such that when it is heated at constant volume to 120⁰C its final pressure is 12 bar. Calculate Q, W ΔU and ΔH for the process. Take $C_p = (7/2)R$ and $C_v = (5/2)R$. **07**
- Q.3** (a) Mention various statements of the second law of thermodynamics. **03**
 (b) Explain various equations proposed for predicting latent of pure substances. **04**
 (c) Derive Carnot equations for a Carnot cycle using an ideal gas. **07**
- OR**
- Q.3** (a) State Carnot theorem and its corollary. **03**
 (b) Explain effect of temperature on heat of reaction. **04**
 (c) A steel casting [$C_p = 0.5 \text{ kJ kg}^{-1} \text{ K}^{-1}$] weighing 40 kg and at a temperature of 450⁰C is quenched in 150 kg of oil [$C_p = 2.5 \text{ kJ kg}^{-1} \text{ K}^{-1}$] at 25⁰C. If there are no heat losses, what is the change in entropy of (i) the casting (ii) the oil, and (iii) both considered together? **07**
- Q.4** (a) Define heat capacity and explain its temperature dependency. **03**
 (b) Explain heat effects of some industrial reactions. **04**
 (c) Write down Maxwell’s equations and derive one of them. **07**
- OR**
- Q.4** (a) What are residual properties? Explain. **03**
 (b) Explain thermodynamic diagrams. **04**
 (c) Define and explain following with examples of each: **07**
 (1) Sensible heat (2) latent heat
 (2) Standard heats of formation, reaction and combustion.
- Q.5** (a) What are the factors (properties) affects the choice of a refrigerant? **03**

- (b) Derive an equation for the Co-efficient of performance (COP) of Carnot refrigeration cycle. **04**
- (c) Starting from energy balance equation and the continuity relation, 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: - **07**

$$u_{\max}^2 = - V^2 \left(\frac{\partial P}{\partial V} \right)_s$$

OR

- Q.5** (a) Explain “Critical Pressure Ratio” in case of a fluid flowing through nozzle. **03**
- (b) Write a short note on ejectors. **04**
- (c) Describe Vapor compression refrigeration cycles with neat diagrams. **07**