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**NA—238—2023**

**FACULTY OF SCIENCE**

**B.Sc. (Third Year) (Fifth Semester) EXAMINATION**

**NOVEMBER/DECEMBER, 2023**

**(CBCS/New Pattern)**

**INDUSTRIAL CHEMISTRY**

**Paper-XIII**

**(Chemical Engineering Thermodynamics)**

**(Wednesday, 27-12-2023)**

**Time : 10.00 a.m. to 12.00 noon**

*Time—2 Hours*

*Maximum Marks—40*

*N.B. :— (i) Attempt all questions.*

*(ii) Scientific calculator and log tables are allowed.*

*(iii) Figures to the right indicate full marks.*

1. Explain thermodynamics term and variable and extensive and intensive properties of thermodynamic process. 15

*Or*

(a) Solve the problem : 8

One mole of the van der Waals gas at 300 K and 10 atm pressure isothermally compressed to 510 atm. What would be the enthalpy change for the process ?

The Joule-Thomson coefficient is given.

P.T.O.

- (b) Solve the problem : 7

An ideal gas ( $C_{p,m} = 29.1 \text{ Jk}^{-1} \text{ mol}^{-1}$ ) is expanded reversibly and adiabatically from a volume of  $1.43 \text{ dm}^3$  at a pressure of  $303975 \text{ P}$  and temperature  $298 \text{ K}$  until the volume is  $2.86 \text{ dm}^3$ .

Calculate :

- (i) The final temperature and pressure of a gas.  
(ii)  $q$ ,  $W$ ,  $\Delta E$  and  $\Delta H$  for the process.

2. Explain first law applied to cyclic process in detail and calculate a steam engine operates between  $400$  and  $300 \text{ K}$  under high pressure. What is the minimum amount of heat that must be withdrawn from the hot reservoir to obtain  $1000 \text{ joules}$  of work ? 15

Or

- (a) Explain thermodynamic relation based on second law. 8  
(b) Solve the problems : 7

$0.1 \text{ kg}$  nitrogen gas at  $298 \text{ K}$  held by piston undergoes  $30 \text{ atm}$  pressure. The pressure is suddenly released to  $10 \text{ atm}$  and the gas expands adiabatically. If  $C_{v,m} = 20.8 \text{ JK}^{-1} \text{ mol}^{-1}$ , what is the final temperature and volume ? Calculate  $\Delta S$  of system for this expansion. What would be the value of  $\Delta S$  (surrounding) and explain entropy.

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3. Write short notes on any *two* :

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- (a) Clausius Clapeyron equation
- (b) Gibbs free energy
- (c) Carnot cycle
- (d) Joule-Thomsonporous plug experiment.

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