BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: Pre-PhD **SEMESTER : I**

BRANCH: CHEMICAL ENGINEERING **SESSION : SP/2023**

SUBJECT: CL557 ADVANCED THERMODYNAMICS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Distinguish between state function and path function.	[2]	1	1
Q.1(b)	Draw and explain single component Pressure-Temperature diagram	[3]	2	2
Q.1(c)	Explain about Carnot engine and estimate its efficiency.	[5]	1	4
Q.2(a)	Describe the concept of ensemble averaging? Explain subtle characteristics of microcanonical, canonical and grad canonical ensembles in a nutshell.	[5]	2	3
Q.2(b)	Describe fundamental differences between Bose-Einstein, Boltzmann and Fermi-Dirac statistics.	[5]	3	2
Q.3(a)	Explain the concepts behind different phase-space plots and why they are so much important from practical aspects.	[5]	3	3
Q.3(b)	Summarize the fundamental postulates of kinetic theory of gases. Derive the expression of kinetic energy starting from the fundamental postulates of kinetic theory.	[5]	4	2
Q.4(a)	Formulate the phase equilibria criteria for multicomponent present in multiphase system.	[5]	2	3
Q.4(b)	Derive Gibbs-Duhem's equation and summarize different forms of the equation.	[5]	2	3
Q.5(a)	Illustrate the effect of pressure on equilibrium constant and equilibrium composition.	[4]	2	2
Q.5(b)	A mixture of 1 mol CO, and 1 mol water vapour is undergoing the water-gas shift reaction at a temperature of 1100 K and a pressure of 1 bar. $CO\ (g) + H_2O\ (g) = CO_2\ (g) + H_2\ (g)$ The equilibrium constant for the reaction is K = 1. Assume that the gas mixture behaves as ideal gas. Evaluate (a) The fractional dissociation of steam (b) The fractional dissociation of steam if the reactant stream is diluted with 2 mol nitrogen.	[6]	5	5

::::::24/04/2023::::::E