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

CLASS: IMSC **SEMESTER : II**
BRANCH: CHEMISTRY **SESSION : SP/2022**

SUBJECT: CH114 PHYSICAL CHEMISTRY-II

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*. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

Q.1(a) Show that $C_P - C_v = nR$ where the symbols have their usual significance. [5]

Q.1(b) Calculate ΔU and ΔH for the process: [5]
2.5 mole ideal gas (monoatomic) at (1.5 atm, 400 K) ⟶ 2.5 mole ideal gas (monoatomic) at (3 atm, 600 K) [C_V = 1.5 R]

Q.2(a) Given the following data [5]
$0.5H_2(g) + 0.5F_2(g) = HF(g)$ ΔH° = -273.3 kJ/mol
$H_2(g) + 0.5O_2(g) = H_2O(l)$ ΔH° = -285.8 kJ/mol
Calculate the value of ΔH° for the following reaction
$2F_2(g) + 2H_2O(l) = 4HF(g) + O_2(g)$

Q.2(b) Derive the temperature dependent variation of ΔH° (Kirchhoff's equation). [5]

Q.3(a) Calculate the amount of work produced, heat absorbed and efficiency of a Carnot engine operating between temperature T_1 and T_2 where, $T_1 > T_2$. [5]

Q.3(b) Define and derive Clausius Inequality. [5]

Q.4(a) What is meant by the chemical potential? [2]

Q.4(b) Derive and show the relationship between the chemical potential and A and U, where the terms have their usual thermodynamic significance. [5]

Q.4(c) Explain what the Gibbs-Duhem equation signifies. [3]

Q.5(a) Derive and establish a relationship between K_p and K_c, where the terms have their usual thermodynamic significance. [5]

Q.5(b) For the reaction: [5]
$CH_4(g) + 2H_2S(g) = CS_2(g) + 4H_2(g)$, $K_p = 2.05 \times 10^9$ at 25° C. Using this information, calculate K_p and K_c for the following reaction:
$2H_2(g) + 0.5CS_2(g) = H_2S(g) + 0.5CH_4(g)$.

:::::18/07/2022:::::