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

CLASS: MSC **SEMESTER: II**
BRANCH: CHEMISTRY **SESSION: SP/19**

SUBJECT: CH411 EQUILIBRIUM NON EQUILIBRIUM & STATISTIED 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.

Q.1(a) Consider an Ideal gas that occupies 1.00dm^3 at 2.00bar. Calculate the work required to compress the gas isothermally to a volume of 0.667 dm^3 at a constant pressure of 3.00 bar followed by another isothermal compression to 0.500dm^3 at a constant pressure of 4.00 bar. Compare the result with the work of compressing the gas isothermally and reversibly from 1.00 dm^3 to 0.500dm^3 . [5]

Q.1(b) What are Maxwell relations? Show that $\left(\frac{\partial U}{\partial S}\right)_P = T - P\left(\frac{\partial T}{\partial P}\right)_S$ .Using the combined form of the 1st and 2nd law of thermodynamics and appropriate Maxwell's relations derive 1st thermodynamics equation of state as $\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$ [5]

Q.2(a) Define and explain Gibbs free energy? Show and explain the pressure dependence of Gibbs free energy. [5]

Q.2(b) Define chemical potential. Derive Gibbs – Duhem equation. [5]

Q.3(a) Explain the thermodynamic probability (W) and give only the final expression w.r.t. BE statistics only. Define and explain canonical, grand canonical and microcanonical ensembles. [5]

Q.3(b) Explain molecular partition function and multiplication theorem. Calculate electronic partition function for Hydrogen and He atom. [5]

Q.4(a) List the various transport processes and write their phenomenological equations. [5]

Q.4(b) Define and discuss the four electrokinetic effects such as SP, EO, EOP and SC. [5]

Q.5(a) Differentiate between ideal and real gases. What is the virial equation of state? Why the second virial coefficient is the most important? [5]

Q.5(b) Discuss the Debye's theory of heat capacity of solids. What is the significance of Debye temperature? [5]

:::::29/04/2019 M:::::