Sr. No. 752302

Jan 2022

M.Sc(PHYSICS) III SEMESTER

Statistical Mechanics (PHL-302)

Time: 90 Minutes **Max. Marks:25**

Instructions: 1. *It is compulsory to answer all the questions (1 marks each) of Part -A in short.*
2. *Answer any three questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART -A

Q1 (a) Write the significance of Gibb's paradox. (1)

(b) Define phase space in statistical mechanics? (1)

(c) Explain the consequence of symmetry of wave functions. (1)

(d) What do you mean by an isolated system? Give an example. (1)

(e) Differentiate between quantum and classical statistics. (1)

(f) What do you mean by Density matrix? (1)

(g) Define degeneracy. (1)

(h) Write down limitations of Mayer cluster expansion. (1)

(i) Does He-3 show Bose-Einstein condensation? Explain your answer in one line. (1)

(j) Write two points which need to be taken into account to understand imperfect gases. (1)

PART -B

Q2 (a) Plot the behavior of Mayer function w.r.t. inter-particle distance and explain. (2)

(b) Describe the exchange interaction and Ising model to explain ferromagnetism in materials. (3)

Q3 (a) Write postulates of London's theory and discuss how it is different from Landau's theory. (2)

(b) What are some peculiar properties of Liquid Helium II? Explain. (3)

Q4 Derive the value of grand potential in Grand canonical ensemble using classical ideal gas as an example. (5)

Q5 (a) Explain Joule Thomson effect. Describe the conditions under which it can be used to cool or heat the gas. (3)

(b) How are the temperatures below 1 K measured? Comment on validity of these measurements. (2)

entropy at absolute zero in a canonical ensemble can be expressed as $S=k \log g_0$ where g_0 is the statistical weight of ground state. (2)

(b) Derive the expression for Bose Einstein condensation temperature and discuss its dependence on various factors. (3)

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