Exam.Code:0473
Sub. Code: 3710

2071
M.Sc. (Physics)
Second Semester
PHY-8022: Statistical Mechanics

Time allowed: 3 Hours Max. Marks: 80

NOTE: *Attempt five questions in all, including Question No. IX (Unit-V) which is compulsory and selecting one question each from Unit I - IV.*

x-x-x

UNIT - I

I. a) What is entropy of mixing? Discuss how the entropy of mixing of samples of two dissimilar gases is different from zero and leads to Gibb's paradox.

b) State and prove Liouville's theorem. Discuss its consequences. How do they lead to the description of microcanonical and a canonical ensemble? (2x8)

II. a) State and prove equipartition theorem.

b) Define the phase space of classical system. Describe how microstate of a system is represented in phase-space. (2x8)

UNIT - II

III. a) Derive the expression for energy and density fluctuation in a grand canonical ensemble.

b) What is an ensembles? Discuss various types of ensembles. (2x8)

IV. a) Evaluate partition function of ideal gas in quantum mechanism ensemble. Generalize it for different ensembles.

b) Analyse the problem of solid-vapours equilibrium by using grand partition function. (2x8)

UNIT - III

V. a) Set up the equation of state for an ideal Fermi-gas. Establish the condition leading to the complete degeneracy of the system. Also calculate the zero point energy of the Fermi gas.

b) Draw a labeled diagram to show the isotherms of an ideal Bose gas. (12,4)

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VI. a) Define the mean thermal wavelength of a particle? Discuss the phenomenon of Bose-Einstien condensation.

b) Show that in the limit of $T \to 0$. Fermi gas follows the third law of thermodynamics. (2x8)

UNIT - IV

VII. a) Discuss an experimental observation on spontaneous magnetization of ferromatnetic materials, which shows that the phenomenon of ferromagnetism is associated only with spins of electrons and not with their orbital motion.

b) Discuss the Ising and Heisen Berg models of interaction energy of a lattice. (2x8)

VIII. a) Discuss the Enstein-Smoluchowski theory of Brownian motion and show that the ensembles of Brownian particles, initially concentrated at the origin diffuses out as the time progresses.

b) Write a note on non-equilibrium processes. (2x8)

UNIT - V

IX. Attempt the following:-

a) What is a classical ideal gas?

b) Give the statement of virial theorem.

c) What is isothermal compressibility? Under what condition accompanying phase transitions, it become excessively large.

d) What is thermodynamic Limit? Explain its importance.

e) In context of white dwarf stars, what is Chander-Shekhar Limit? And how it is related to the mass of sun.

f) Compare graphically the specific heats of a classical ideal gas as a function of temperature and Bose gas.

g) What is relationship between Ω(N,V,E) and Σ (N,V,E)?

h) Define critical opalescence. What are the conditions leading to it? (8x2)

x-x-x