F.Y.M.SC.(Physics) (CBCS Pattern) Second Semester CBCS

PSCPHYT06-(Core 6) Paper - 6 : Statistical Physics

P. Pages : 2 **GUG/W/18/11221**

Time : Three Hours * 3 3 2 4 * Max. Marks : 80

---

1. Either

a) Explain thermodynamic quantities on the basis of internal energy and Entropy. **8**

b) What is Gibb's Paradox? Show that how it can be removed if **8**

$$S = NK\left(\ell n\left(\frac{V}{N}\right)+\frac{5}{2}+\frac{3}{2}\ell n\left(\frac{2\pi MKT}{h^2}\right)\right)$$

OR

e) What is meant by an ensemble? Discuss microcanonical, canonical and grand canonical ensembles and also derive the expression for the entropy of an perfect gas in microcanonical ensemble. **8**

f) Define partition function and calculate it's value for an diatomic gas Molecule. **8**

2. Either

a) Explain Bose-Einstein condensation. And also explain limiting case of B.E statistics. **8**

b) Obtain an expression for the mean occupation number for the bosons in BE statistics. **8**

OR

e) **8**

Derive the relation $E_{Fo} = \frac{h^2}{2m}\left(\frac{3n}{8\pi}\right)^{2/3}$ where letter have their usual meaning. Find the fermi level at absolute zero for copper.

Given that,

Molar Mass of copper, $M = 63.55x10^{-3} Kg/mole$

Density, $\rho = 8.93x10^3 kg/m^3$

Avogadro's No. $N = 6.023x10^{23}$ per mole

Planck's constant, $h = 6.63x10^{-34} JS$

Mass of electron, $m = 9.11x10^{-31} Kg$.

f) Show that for photons the mean pressure <p> is related to total. energy <E> by the relation, **8**

$$<p> = \frac{1}{3}\ \frac{<E>}{V}$$

3. Either

a) Show that the measure of degeneracy of ideal fermi system is given by **8**

$$z = \frac{1}{D} = \frac{\rho}{g}\left(\frac{h^2}{2\pi MKT}\right)^{3/2}$$

b) Define Fermi function and Fermi energy obtain an expression for Fermi energy of ideal gas at T = O^{o}k. **8**

OR

e) What are cluster integrals. Assuming Cannonical partition function. Obtain grand portition function. **6**

f) Obtain virial equation of state interms of cluster integral. **6**

g) Find Fermi temperature of free electrons in copper of electron density, $8.5x10^{28} Kg/m^3$ & mass of each electron is $9.1x10^{-31}$ kg. (h= 6.62 x 10^{-34} Js, K = 1.38 $x10^{-23}$ J/k) **4**

4. Either

a) Explain the terms. **8**

i) Order parameter.
ii) Critical exponents.
iii) Scaling hypothesis.
iv) Random walk.

b) Explain Landau's theory of phase transition and show that specific heat at constant pressure is discontinuous at transition point in second order phase transition. **8**

OR

e) What is Brownian motion? Explain Langevin's theory for Brownian motion of particles. **8**

f) What is Ising model? Discuss Ising model for phase transition of second order. **8**

5. Attempt all the followings.

a) Discuss briefly the fundamentals of classical mechanism. **4**

b) Obtain condition for B.E. statistics to approached classical M.B. distribution. **4**

c) Write the difference between bosons and fermions. **4**

d) Explain Weiss theory of ferromagnetism. **4**

****