M.Sc. F.Y. (Physics) (CBCS Pattern) Semester - II

# PSCPHYT06 - Core Paper-VI : Statistical Physics

P. Pages : 2 **GUG/S/23/11221**

Time : Three Hours * 1 3 9 9 * Max. Marks : 80

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**Either:**

**1.** a) State and prove Liouville's theorem. What is the significance of Liouville's theorem? **8**

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

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

**OR**

e) Explain the concept of an ensemble? Discuss micro – canonical, canonical and grand canonical ensembles and also derive the expression for the entropy of perfect gas in micro canonical ensemble. **8**

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

**Either:**

**2.** a) Show that for photon the mean pressure $\langle P \rangle$ is related to total energy E by relation: **8**

$$\langle P \rangle = \frac{1}{3}\frac{\langle E \rangle}{V}$$

b) Explain Bose – Einstein condensation. And also explain limiting case of B.E. Statistics. **8**

**OR**

e) Derive the relation: **8**

$$E_{F_0} = \frac{h^2}{2m}\left(\frac{3n}{8\pi}\right)^{2/3}$$

Where, letters have their usual meaning. Find the fermi level at absolute zero for copper. Given that,

Molar Mass of Copper, $M = 63.55 \times 10^{-3} Kg / mole$

Density, $\rho = 8.93 \times 10^{3} Kg / m^{3}$

Avogadro's No. $N = 6.023 \times 10^{23}$ per mole

Planck's constant, $h = 6.63 \times 10^{-34}$ JS

Mass of electron, $m = 9.11 \times 10^{-31} Kg$

f) Explain in detail symmetry of wave function for quantum particles. **8**

**Either:**

**3.** 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) Discuss the concept of an electronic specific heat in detail. **8**

**OR**

e) What are cluster integrals? Discuss cluster expansion for classical gas system. **8**

f) Explain behaviour of an ideal fermi gas at absolute zero temperature. **8**

**Either:**

**4.** a) 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**

b) Explain the terms. **8**

i) Critical exponents

ii) Order parameter

iii) Scaling hypothesis

iv) Random walk

**OR**

e) Obtain Fokker – Planck equation for Brownian motion. **8**

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

**5.** Attempt all the followings:

a) Explain the terms: **4**

i) microstate and

ii) microstate with the help of an example.

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

c) What do you mean by fermionic condensation? Explain. **4**

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

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