

B.Sc 6 th Semester (Honours) Practical Examination, 2021

PHYSICS

(Statistical Mechanics Lab)

Course ID: 62422

Course Code: SHPHS/602/C-14

Time: 1 hour

Full Marks: 15

Answer any three questions

$5 \times 3 = 15$

- (a) A system contains two identical particles and each of them can be arranged in three possible single particle states. Calculate the possible number of states for three separate situations when the particles obey Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics.

(b) If a Fermi gas is kept at a temperature $> 0 K$, what will be $f(E_F)$ At $E = E_F + x$, find the fraction of occupation levels. 3+2
- (a) why is the chemical potential of photon zero?

(b) Consider photon gas enclosed in a volume V and in equilibrium at temperature T . The photon is massless particle. Show that total number of photons in the volume is proportional to T^3

(c) What is the Planck's quantum postulate to explain the black body radiation? 1+3+1
- (a) If c is the velocity of sound in a solid crystal of density ρ and atomic weight M , show that the Debye frequency of the solid is given by $\nu_D = c \left(\frac{3N_A \rho}{4\pi M} \right)^{\frac{1}{3}}$

(b) Write down the reason of failure of Einstein's model of specific heat at low temperature?

(c) What are the assumptions of Debye's model of specific heat? 2+1+2
- (i) Draw the Fermi function curve at $T = 0 K$ and temperatures T_1, T_2 and T_3 ($T_1 > T_2 > T_3$) showing clearly the position of Fermi energy E_F .

(ii) Show that at high temperature and low particle density quantum statistics merge with classical statistics. 2+3