B.Sc. Second Year (CBCS Pattern) Sem-III

USPHT06 - Physics Paper-II (Radiation and Statistical Physics)

P. Pages : 3 **GUG/W/23/11617 (S)**

Time : Three Hours * 8 3 1 3 * Max. Marks : 50

Either :

1. A) i) State and explain Rayleigh - Jeans law and its drawbacks. **4**

ii) State Wein's law and its limitations. **4**

iii) What is the wavelength at which human body radiates maximum energy? Temperature of human body 37ºC and Wein's constant is 2.898×10^{-3} mK. **2**

OR

B) a) State the Planck's law for black body radiation and write the postulate of Planck's Quantum theory. **2½**

b) Derive Wein's law from Planck's law. **2½**

c) Explain the distribution of energy of black body at different temperature by drawing graphs. **2½**

d) A body at 1500K emit maximum energy of wavelength 20,000Aº. If a star emits maximum energy of wavelength 6666Aº. Estimate the temperature of star. **2½**

Either :

2. A) i) Define phase space. Show that minimum volume of phase space is h^3. **4**

ii) Derive Boltzmann entropy probability relation $S = k\log_e W$. **4**

iii) Four molecules to be distributed in 2 cells. Find number of macrostate and microstate. **2**

OR

B) a) Explain position space and momentum space. **2½**

b) Explain types of constraints with examples. **2½**

c) Explain probability and state its basic rule. **2½**

d) Three particles are distributed in three compartment of equal size find the number of microstate in **2½**
   i) Macrostate (003)
   ii) Macrostate (120)

Either :

3. A) i) State the fundamental postulates of M-B statistics. **3**

ii) Derive Maxwell – Boltzmann distribution relation $n_i = g_i\ e^{-\alpha}\ e^{-\beta E_i}$ **5**

iii) Calculate the most probable velocity of a hydrogen at 27ºC. **2**
($K = 1.38\times10^{-23} J/deg$ and mass of hydrogen $= 3.34\times10^{-27} kg$)

OR

B) a) State the limitations of MB statistics. **2½**

b) Using MB distribution law, obtain an expression for root mean square speed of ideal gas. **2½**

c) Using MB statistics, derive the relation $B = \frac{1}{KT}$. **2½**

d) At what temperature will the average speed of molecules of hydrogen gas be double the average speed of oxygen at 300K? **2½**

Either :

4. A) i) State the basic postulate of Bose – Einstein statistics. **3**

ii) Derive an expression $n_i = \frac{g_i}{\left(e^{\alpha+BE_i} - 1\right)}$ for most probable distribution obeying BE statistics. **5**

iii) Calculate the number of ways of distribution of 3 bosons in 4 phase cells. **2**

OR

B) a) Define fermi energy and give its interpretation at T = 0 and at room temperature. **2½**

b) Compare BE and FD statistics. **2½**

c) Derive the relation for fermi energy at absolute zero temperature. **2½**

d) Find fermi energy of copper. **2½**
(Density of copper = $8.94\times10^{3} kg/m^{3}$
Mass of electron = $9.11\times10^{-31} kg$
Number of electron per unit volume $= 8.48\times10^{-28} electron/m^{3}$)

5. Attempt **any ten** questions from the following:

a) Define absorptive power of black body. **1**

b) Write any two applications of Planck's law. **1**

c) State Stefan's – Boltzmann law of radiation. **1**

d) Define microstate. **1**

e) Define thermodynamic probability. **1**

f) Define μ-space. **1**

g) Calculate the average speed of four particle having speed 2, 3, 6 and 5 cm/s. **1**

h) What is average speed of molecule in MB. **1**

i) Define root mean square speed of gas. **1**

j) Define fermi temperature. **1**

k) What are Bosons? **1**

l) Define occupation index. **1**

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