

B.Sc. S. Y. (CBCS Pattern) Semester-III
USPHT06 - Physics Paper-II : Radiation and Statistical Physics

P. Pages : 3

Time : Three Hours



GUG/S/25/11617

Max. Marks : 50

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- Notes : 1. All the questions are compulsory.
2. Draw neat labelled diagram wherever necessary.

Either :

1. A) i) Derive the Planck's law for distribution of energy in black body radiation. 5
ii) Obtain Wein's displacement law from Planck's law. 3
iii) Calculate the surface temperature of sun if the wavelength of maximum intensity in solar Spectrum is 4753 AU and Wein's constant is 0.2884×10^{-2} mK. 2

OR

- B) a) Derive Rayleigh-Jean's law. 2½
b) Explain the temperature dependence of black body radiation. 2½
c) Derive Stefan – Boltzmann's law from Planck's radiation formula. 2½
d) The wavelength corresponding to the maximum energy emitted by the moon is 14μ . 2½
Calculate the temperature of moon. Given Wein's constant $b = 2.884 \times 10^{-3}$ mK.

Either :

2. A) i) Derive the condition of equilibrium between two systems in thermal contact. 5
ii) Discuss the constraints in thermodynamic system. 3
iii) Assuming that in a six faced die, the probability of getting any face uppermost is equal. 2
If 5 dice are tossed simultaneously, calculate the probability of getting number 2 uppermost in any one die.

OR

- B) a) Define accessible and inaccessible microstates. Give its examples. 2½
b) Explain the concept of μ space and phase space. 2½
c) Distinguish between mathematical probability and thermodynamic probability. 2½
d) Calculate the probability that in tossing a coin 10 times, we get 6 heads and 4 tails. 2½

Either :

3. A) i) Draw the Maxwell-Boltzmann velocity distribution curve and state any three features of distribution curve. 3
- ii) Derive an expression for (i) Most probable speed and (ii) Root mean square speed. 5
- iii) At absolute temperature 400 K, calculate the most probable speed of molecules of hydrogen gas. Given $k = 1.38 \times 10^{-23}$ and mass of hydrogen atom $= 1.6 \times 10^{-27}$ Kg. 2

OR

- B) a) Derive Maxwells' law of distribution of speed for the molecule of an ideal gas using MB energy distribution formula. 2½
- b) Obtain an expression for mean speed of molecule of an ideal gas. 2½
- c) State the postulates of classical statistical mechanics. 2½
- d) Calculate the r.m.s. value of v_x for the molecule of hydrogen gas at 500 K. 2½
- Given $k = 1.38 \times 10^{-23}$ and mass of hydrogen atom $= 1.6 \times 10^{-27}$ Kg.

Either :

4. A) i) What are Fermions? State the basic postulates of Fermi – Dirac statistics. 3
- ii) Derive an expression for most probable distribution of FD statistics. 5
- iii) Fermi energy of conduction electrons in silver is 5.48 eV. Calculate the number of such electrons per cm^3 . Given that, $h = 6.62 \times 10^{-27}$ erg. sec and $1\text{eV} = 1.62 \times 10^{-12}$ erg. 2

OR

- B) a) Derive an expression for Fermi energy of electron in a metal at absolute zero. 2½
- b) What is Bose-Einstein statistics? What are its basic postulates? 2½
- c) Explain comparison between M-B and F-D statistics. 2½
- d) Calculate the number of different arrangements of 10 indistinguishable particles in 15 cells of Equal a priori probability considering that one cell contains only one particle. 2½

5. Attempt **any ten** questions from followings.

- a) State Planck's postulates. 1
- b) What is emissive power of body? 1
- c) What is perfectly black body? 1

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| d) Define probability. | 1 |
| e) State the relation between entropy and thermodynamic probability. | 1 |
| f) Define most probable microstate. | 1 |
| g) Write the possible arrangement of three particles in two cells for MB statistics. | 1 |
| h) According to Maxwell's law of distribution of speed, the number of molecules corresponding to zero speed is zero. Is it right statement? | 1 |
| i) State the limitations of MB statistics. | 1 |
| j) What do you mean by Bosons? Give examples. | 1 |
| k) Define occupation index in BE statistics. | 1 |
| l) Write down the Fermi – Dirac distribution function. | 1 |
