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Reg. No. | | | | | | | | | |

II Semester M.Sc. Degree Examination, November - 2022

PHYSICS

Statistical Mechanics

(CBCS Scheme 2019-20)

Paper : PHY203

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

Answer all the questions. **(3×15=45)**

1. a) Describe canonical ensemble and derive the expressions for entropy and internal energy of ideal gas. Explain how the equation of state can be derived? **(8)**

   b) What is Gibbs paradox? Explain how can you resolve the Gibbs paradox? **(7)**

(OR)

2. a) Discuss in detail the Einstein's theory of specific heat. Mention the salient features of the theory. **(8)**

   b) Explain Maxwell velocity distribution for molecules and hence obtain the expressions for root mean square speed and the most probable speed. **(7)**

3. a) Explain Fermi-Dirac statistics. Deduce the Fermi-Dirac distribution function for system of indistinguishable Fermions. **(8)**

   b) By applying Fermi-Dirac statistics, show that the electronic specific heat is: **(7)**

   $C_{el} = \frac{\pi^2}{2} N k_B \left(\frac{T}{T_F}\right)$, Where the notations have usual meaning.

(OR)

4. a) Apply Bose-Einstein statistics to photons and obtain Planck's law for spectral distribution of black body radiation. Hence obtain Stefan-Boltzmann law. **(8)**

   b) What is Bose-Einstein condensation? Show how a system of Bosons condenses, when cooled below critical temperature. **(7)**

5. a) Obtain the expressions for the mean square velocity and mean square displacement of Brownian particle employing Langevin theory. Graphically represent the variation of these quantities with time. **(8)**

b) Establish the relation between dissipation and fluctuating force. **(7)**

(OR)

6. a) State and Derive Wiener-Khintchine relation for random process. **(7)**

b) Derive the expression for mean square fluctuation of energy in the case of canonical ensemble. **(8)**

7. Answer any **five** of the following. **(5×5=25)**

a) State and prove equi-partition theorem.

b) Find the temperature at which average speed of molecules of Nitrogen gas is $\frac{1}{\sqrt{7}}$ times the average speed of Oxygen molecules.

c) Find the possible arrangements when two particles are to be distributed among three cells according to:

i) Fermi-Dirac statistics

ii) Bose-Einstein statistics

d) Calculate the Fermi Energyine V fora metal at 0K,whose density is 10500kg m^{-3}, atomic weight is 107.9 and it has one conduction electron per atom.

e) Write a note on Onsager relations.

f) State and explain Nyquist theorem.