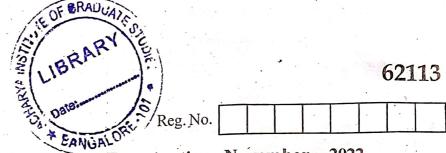
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II Semester M.Sc. Degree Examination, November - 2022

PHYSICS

Statistical Mechanics

(CBCS Scheme 2019-20)

Paper: PHY203

Time: 3 Hours Maximum Marks: 70

Instructions to Candidates:

Answer all the questions.

 $(3 \times 1.5 = 45)$

- 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) b)	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) Establish the relation between dissipation and fluctuating force.
	,	(OR)
6.	a)	State and Derive Wiener-Khintchine relation for random process. (7)
0.	b)	Derive the expression for mean square fluctuation of energy in the case of canonical ensemble. (8)
7.	Ans	swer any five of the following. $(5\times5=25)$
	a)	State and prove equi-partition theorem.
	b)	Find the temperature at which average speed of molecules of Nitrogen gas is $\sqrt{7}$
		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 for a metal at 0K, whose density is 10500kg m ⁻³ ,

atomic weight is 107.9 and it has one conduction electron per atom.

f) State and explain Nyquist theorem.

