**21P208** (Pages: 2) Name: .....

Reg.No: .....

**SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2022**

(CBCSS - PG)

(Regular/Supplementary/Improvement)

**CC19P PHY2 C07 - STATISTICAL MECHANICS**

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

## Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. Explain the concept of microstate and macrostate.
2. What is the minimum volume required by a particle to occupy in two dimensional space.
3. Bring out the statistical origin of IIIrd law of thermodynamics.
4. Explain the virial theorem of Clausius. How can it be applied to classical ideal gas?
5. Explain the postulate of random phases.
6. Discuss the statistics of the occupation numbers.
7. Give the condition for onset of Bose Einstein condensation. Discuss about the physical state of the system below characteristic temperature.
8. Explain Landau diamagnetism.

**(8 × 1 = 8 Weightage)**

## Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. (a) Explain the concept of microcanonical ensemble.
   (b) State liouville's theorem and discuss its consequences.
10. Discuss the extend of fluctuation in energy and number density in Grand canonical ensemble and deduce the empirical relation for rms fluctuations in number density and energy.
11. Obtain Debye's law for phonons.
12. Discuss the magnetic behaviour of an ideal Fermi gas.

**(2 × 5 = 10 Weightage)**

## Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. Show that $\ln\Gamma = \ln\sum$ for a classical ideal gas.

14. For a system of independent non interacting one-dimensional quantum harmonic oscillators, what is the value of the Helmholtz free energy per oscillator, in the limit temperature tends to zero?

15. How can an essential link be provided between the thermodynamics of a given system and the statistics of the corresponding grand canonical ensemble?

16. Prove that the expectation value of a physical quantity G, $\langle G \rangle = \frac{Tr\,(\hat{\rho}\hat{G})}{Tr\,(\hat{\rho})}$

17. Show that the q potential, $\boldsymbol{q = a^{-1}\sum_i g_i \ln\left(1 + a\, e^{-\alpha-\beta\varepsilon_i}\right)}$ and hence derive $\boldsymbol{PV = NKT}$

18. Show that radiation pressure exerted by the photons is equal to one third of its energy density.

19. Atomic weight of Lithium is 6.94 and density 0.53 g/cm$^3$ . Calculate Fermi energy and Fermi temperature of electrons.

**(4 × 3 = 12 Weightage)**

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