**18P210** (Pages: 2) Name:……..

Reg. No:……..

**SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2019**

(Regular/Supplementary/Improvement)

(CUCSS - PG)

**CC15P PHY2 C07 / CC17P PHY2 C07 - STATISTICAL MECHANICS**

(Physics)

(2015 Admission onwards)

Time: Three Hours Maximum: 36 Weightage

## Section A

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

1. Define the term "equal a priori probability".
2. Write a short note on statistical ensembles.
3. Explain the concept of microstate and macrostate.
4. State and explain the Equi-partition theorem.
5. Write down the partition function of a two level system of energies 0 and $\varepsilon$
6. Define the density matrix in quantum statistics.
7. Obtain the expectation value of the spin $\sigma_z$ of an electron in a magnetic field.
8. What is meant by phase space?
9. Mention any four implications of the formula $S = k\ln\Omega$
10. Differentiate between Bose Einstein Condensation and ordinary condensation.
11. Comment on the statement "Fermi system has a non zero energy even at absolute zero".
12. Give the expression for specific heat of electron gas in a metal.

**(12 × 1 = 12 Weightage)**

## Section B

Answer any ***two*** questions. Each question carries 6 weightage.

13. Explain the thermodynamic behaviour of an ideal Bose gas.
14. Discuss in detail about Pauli's paramagnetism.
15. Describe the density and energy fluctuations in grand canonical ensemble.
16. Obtain thermodynamics of classical ideal gas considering the system as the member of microcanonical ensemble.

**(2 × 6 =12 Weightage)**

## Section C

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

17. Prove that the phase trajectory of a harmonic oscillator is an ellipse.
18. State and prove Liouville's theorem.
19. Show that the pressure of a non-relativistic gas is $\frac{2}{3}$ of its energy density.
20. Explain Gibb's paradox. How it is resolved?
21. Calculate the probabilities for an electronic state to be occupied at $20^{o}$C, if the energy of these states lies 0.11eV above and 0.11eV below the fermi level.
22. In a Bose - Einstein Condensation experiment, $10^{7}$ rubidium-87 atoms were cooled down to a temperature of 200nK. The atoms were confined to a volume of approximately $10^{-15}$ $m^{3}$.Calculate the Bose temperature. Determine how many atoms were there in the ground state at 200nK.

**(4 × 3 = 12 Weightage)**

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