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Reg. No.....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, JUNE 2014

(CUCSS)

Physics

PHY 2C 07—STATISTICAL MECHANICS

(2012 Admissions)

Time : Three Hours Maximum : 36 Weightage

Section A

1. Differentiate between microstate and macro state with reference to an ensemble?
2. Explain the postulate of random phases.
3. What is Gibbs paradox?
4. State and explain Liouville's theorem.
5. Show that $S = -k\sum_r (p_r \ln p_r)$
6. Prove that phase space area equivalent to one Eigen state of a linear harmonic oscillator is h?
7. Using equipartition theorem, find c_v of a monoatomic ideal gas?
8. A Bose system consists of 5 particles and 4 available energy states. How many macro states are possible?
9. What is meant by Fermi energy?
10. Bring out the statistical origin of Third law of thermodynamics?
11. How is fugacity of a system related to q potential?
12. Show that number of states in unit volume of phase space is $1/h^3$.

(12 × 1 = 12 weightage)

Section B

Answer any **two** *questions.*

13. Discuss various ensembles in statistical mechanics. Show that for a perfect gas, root mean square fluctuation in number density is proportional to $\frac{1}{\sqrt{N}}$.

Turn over

14. Using grand partition function derive the general form of 'q' potential for M.B, B.E and F.D statistics
15. Outline the thermodynamics of an ideal Bose gas and derive the condition for the onset of Bose-Einstein condensation

16. Obtain the equation of state of an ideal Fermi gas at 1)High temperature and low density 2)Low temperature and high density

(2 × 6 = 12 weighta

Section C

Answer any **four** *questions.*

17.Show that in canonical ensemble formulation, internal energy of the system is $\partial[A\beta]/\partial\beta$ where A is Helmholtz free energy.

18. Average energy of harmonic oscillator is $E=(n+\frac{1}{2})hw/2\pi$ where n=0,1,2.....Find the partition function of the oscillator?

19. Prove that expectation value of a physical quantity G is $\frac{Tr(\rho G)}{Tr(G)}$

20. Two particles are to be distributed in 3 cells. How many micro states are possible if the particles are 1) Bosons 2)Fermions 3)Boltzons

21. Find Helmholtz's free energy of a Bose system of 'N' particles with fugacity 'z' and temperature 'T'?

22. A system has 2 particles, each of which can be in any one of 3 quantam states of energies 0,E and 3E. System is in contact with a heat reservoir at T. Find the partition functions if the particles obey 1)B.E statistics and2) F.D statistics?

(4 × 3 = 12 weighta