Registration No : | | | | | | | | | | |

Total Number of Pages : 02

M.Sc.I
FPYC802

8th Semester Regular / Back Examination 2018-19
STATISTICAL MECHANICS
BRANCH : M.Sc.I(AP)
Time : 3 Hours
Max Marks : 70
Q.CODE : F153

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions :** **(2 x 10)**

a) Consider a binomial distribution for a system for which p=1/3, q=2/3, N=6. Determine the standard deviation.

b) Derive the partition function for a system of two non-interacting particles, which can occupy any of the three energy levels 0, ε, 2ε having degeneracies 2, 2 and 1 respectively.

c) What is meant by density matrix? Discuss its properties

d) What would be the pressure exerted by a Boson gas on the walls of the container at absolute zero? Justify your answer.

e) Find the no. of ways in which 5 identical bosons can be distributed in 2 energy levels.

f) What is De-Hass-van Alphen effect?

g) Define the term Fermi energy.

h) A cavity containing blackbody radiation is in equilibrium at temperature T has internal energy U and entropy S. If temperature of the cavity increases and it comes to equilibrium at 2T, then calculate the new values of internal energy and entropy.

i) Describe Pauli's paramagnetism.

j) What is Ginzberg criteria?

Q2 a) Discuss Gibb's paradox in entropy of mixing in case of identical and non-identical ideal gas particles. **(5)**

b) Explain how the paradoxical situation can be resolved. **(5)**

Q3 a) Write down the characteristics of grand canonical ensemble. Show the equivalence of canonical and grand canonical ensemble using the density fluctuation. **(5)**

b) Calculate the mean values of $\overline{E}$, $\overline{E2}$, $\overline{(\Delta E)^2}$ and $\overline{p}$ for canonical ensemble in terms of partition function. **(5)**

Q4 a) Consider a system consisting of two particles each of which can be in any one of the three quantum states of respective energies 0, E, and 3E. The system is in contact with a heat reservoir at absolute temperature T. Write an expression for the partition function Z **(5)**

(i) if the particles obey classical M.B statistics

(ii) if the particles obey F.D statistics

b) Explain Bose-Einstein condensation. **(5)**

Q5 a) Discuss the variation of specific heat of solids with respect to temperature from the statistics of phonons. **(5)**

b) Show that the value of the single particle momentum corresponding to the Fermi energy which is referred as Fermi momentum is given by, $p_f = h\left(\frac{3N}{4\pi(2s+1)V}\right)^{1/3}$. Where the symbols have their usual meanings. **(5)**

Q6 a) Describe Mean field theory. Discuss Landau theory of phase transition beyond the mean field theory. **(5)**

b) Discuss the discontinuity of specific heat and the change in symmetry for the phase transition of second kind. **(5)**

Q7 What are white dwarf stars? Derive an expression for pressure of white dwarf stars. Hence, discuss Chandrasekhar mass limit. **(10)**

Q8 **Write short answer on any TWO :** **(5 x 2)**

a) Liouville's theorem

b) Ising model

c) Landau diamagnetism

d) Ensembles in quantum mechanics