PG Odd Semester (CBCS) Exam., December—2017

PHYSICS

(3rd Semester)

Course No. : PHYCC–302

(Statistical Physics)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. *(a)* Define phase cell. Discuss its size in classical and quantum mechanical approaches. 4

(b) Show that Kelvin-Planck and Clausius statements of the second law of thermodynamics are equivalent to each other. 5

(c) State and prove Boltzmann's entropy relation. 5

2. *(a)* Define and explain the significance of the following : 2½×4=10

(i) Enthalpy

(ii) Gibbs free energy

(iii) Chemical potential

(iv) Fugacity

(b) Show that many different microstates may correspond to the same macro-state. 4

UNIT—II

3. *(a)* State and prove equipartition theorem. 10

(b) In a system in thermal equilibrium at absolute temperature T, two states with energy difference $4\ 83\ 10^{21}$ joule occur with relative probability e^{2}. Deduce the temperature T. (Boltzmann's constant $k\ \ 1\ 38\ \ 10^{23}$ joule/K) 4

4. Distinguish between different ensembles highlighting their features. Show that in canonical ensemble almost all systems have the same energy, the internal energy of a system at given temperature. 6+8=14

UNIT—III

5. *(a)* If ˆ is the density operator and $\hat{H}$ is Hamiltonian of a system, then show that

$$i\hbar \dot{\hat{}} \quad [\hat{H}, \hat{}]$$ 8

(b) Deduce grand canonical partition function for ideal Bose and Fermi gases. 6

6. *(a)* Derive the expressions for most probable distribution functions in B-E and F-D statistics using grand canonical partition functions. 8

(b) Evaluate the entropy, Helmholtz free energy and average energy under quantum mechanical treatment for a system of N, linear harmonic oscillators in canonical ensemble. 6

UNIT—IV

7. *(a)* Explain Pauli's theory of para-magnetism. 7

(b) Describe Landau's theory of liquid helium. 7

8. *(a)* Discuss the variation of specific heat of an ideal Fermi system. 7

(b) Write a note on B-E condensation. 7

UNIT—V

9. Write short notes on the following : 7×2=14

(a) Mean field theory

(b) Phase transitions

10. *(a)* Obtain critical constants of a real system obeying van der Waals equation of state. 7

(b) What do you mean by critical exponents? 3

(c) For a physical quantity u, show that

$$\overline{u^2} \quad \bar{u}^2$$ 4

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