2018/ODD/08/21/PHY–302/223

PG Odd Semester (CBCS) Exam., December—2018

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 temperature and entropy of a thermodynamic system. 4

(b) Differentiate between microstate and macrostate. 2

(c) State and prove Liouville's theorem. 2+6=8

2. *(a)* Define intensive and extensive variables citing examples. 3

(b) Let us consider a gas which is allowed to expand adiabatically. Find the work done in this process. 3

(c) Prove that two macrostates $A_1(N_1, V_1, T_1)$ and $A_2(N_2, V_2, T_2)$ will be in equilibrium when $T_1 \quad T_2$, $P_1 \quad P_2$ and $_1 \quad _2$. 8

UNIT—II

3. *(a)* For a microcanonical ensemble, find entropy and specific heat. 9

(b) What is negative temperature? What is its origin? 5

4. *(a)* What is Gibbs' paradox? How can it be resolved? 7

(b) In case of a canonical ensemble, show that the average energy per system (U)

$$U \quad \frac{}{N} \quad \frac{\sum_r E_r e^{\ \ E_r}}{\sum_r e^{\ \ E_r}}$$

where the parameter and variables have their usual meanings. 7

UNIT—III

5. *(a)* How do you define density matrix? Using density matrix formalism, show that $i\hbar\dot{}$ $[H, \;\;]$, where , H and $\hbar$ have their usual meanings. 8

(b) Compare between M–B, B–E and F–D statistics. 6

6. *(a)* What are the conditions for applicability of the Maxwell-Boltzmann statistical law? 3

(b) What are the assumptions of B-E statistics? 3

(c) Derive the expression of Bose-Einstein distribution law. 8

UNIT—IV

7. *(a)* What is B-E condensation? Find the condition for the onset of Bose-Einstein condensation. 10

(b) Calculate the Fermi energy in eV of sodium assuming that it has one free electron per atom. Given density of sodium = 0·97 gm/cc. 4

(Turn Over)

8. *(a)* Show that when the number of substates g_i n_i the number of particles in the ith state, the F–D distribution function reduces to M–B distribution. 4

(b) Discuss the variation of specific heat of an ideal Fermi system. 6

(c) Describe the phenomena of second sound. 4

UNIT—V

9. *(a)* Discuss first and second order phase transitions in detail. 7

(b) Derive Fokker-Planck equation for a particle executing Brownian motion. 7

10. *(a)* What are critical exponents? 4

(b) Discuss Ising model in one-dimension. 10

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