Total No. of Printed Pages—4

6 SEM TDC PHY M 1

phy = 601, 602, 603, 604
Geo = 601, 603, 605, 607
Bot = 601, 603, 604, 606
Zoo = 601, 603, 604, 606
Math = 602, 603
Stat = 601, 602
Che = 601, 603, 605, 607

2017

(May)

PHYSICS

(Major)

Course : 601

(Statistical Mechanics)

(With Ge)

Full Marks : 60
Pass Marks : 24/18

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct option (any *five*) : 1×5=5

(a) The statistical condition of equilibrium of two systems in thermal contact is

(i) $T_1 = T_2$

(ii) $S_1 = S_2$

(iii) $\Omega_1 = \Omega_2$

(iv) $\frac{\partial}{\partial E_1} \log \Omega_1(E_1) = \frac{\partial}{\partial E_2} \log \Omega_2(E_2)$

(b) The relative probability between two different energy states having difference $1 \cdot 1 \times 10^{-20}$ joules at 40 K temperature is

(i) e^{-1} (ii) e^{-2}

(iii) e (iv) e^{2}

(c) If Z_1, Z_2, Z_3 are independent partition functions of a system, the total partition function of the combined system is

(i) $Z = Z_1 + Z_2 + Z_3$

(ii) $Z = Z_1 \cdot Z_2 \cdot Z_3$

(iii) $\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}$

(iv) None of the above

(d) In Bose-Einstein statistics, the number of particles condensing into ground state is

(i) zero

(ii) all

(iii) $\eta \left[1 - \left(\frac{T}{T_0} \right)^{3/2} \right]$

(iv) $\eta \left[1 - \left(\frac{T}{T_0} \right)^{1/2} \right]$

(Continued)

(e) The Fermi function $f(\varepsilon) = \frac{n(\varepsilon)}{g(\varepsilon)}$ has value ½, when

(i) $\varepsilon < \varepsilon_f$

(ii) $\varepsilon > \varepsilon_f$

(iii) $\varepsilon = \varepsilon_f$ at absolute zero

(iv) $\varepsilon = \varepsilon_f$ at any temperature

(f) Which gas at absolute zero temperature possesses energy and exerts pressure?

(i) Oxygen gas

(ii) Photon gas

(iii) Electron gas

(iv) No gas

2. (a) Derive Liouville theorem. 6

(b) Give thermodynamic interpretation of the Lagrange's undetermined multipliers appearing in the distribution laws. 6

3. Derive Boltzmann relation between entropy and probability. 5

4. Express internal energy in terms of partition function. 5

Or

Establish the relation $S = kN \log Z + \frac{3}{2} kT$. 5