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Exam. Code : 103203
Subject Code : 1322

B.A./B.Sc. 3rd Semester

PHYSICS

Paper—A

(Statistical Physics and Thermodynamics)

Time Allowed—Three Hours] [Maximum Marks—35

Note :—Attempt **FIVE** questions in all, selecting **ONE** question from each Section B, C, D and E. Section A is compulsory. Log tables can be asked for if necessary.

SECTION—A

1. (a) Calculate the probability, that in tossing a coin 10 times we get all heads up.
   (b) What is the minimum size of a phase space cell in classical and quantum mechanical system ?
   (c) Define phase space.
   (d) What do you understand by Fermi energy level of a metal ?
   (e) How does entropy vary during the isothermal and adiabatic process ?
   (f) Discuss heat death of universe.
   (g) Write Clapeyron's Equation. 1×7=7

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SECTION—B

2. Taking the case of n particles distributed in 2 compartments with equal a priori probability, discuss the variation of probability of a macro state on account of small deviation from the state of maximum probability. 7

3. If 12 particles are distributed randomly between two boxes with equal probability, then calculate :
   (a) Probability of distribution (8, 4)
   (b) Probability of most probable distribution
   (c) Probability of least probable distribution. 7

SECTION—C

4. The probability distribution function for a gas molecule having speed ν is given by :

$$P(\nu) = \sqrt{2\pi}\left(\frac{m}{\pi kT}\right)^{3/2} \nu^2 e^{-m\nu^2/2kT}$$

   Using this relative derive :
   (i) Most probable speed
   (ii) Average speed
   (iii) Root mean square speed of the molecules. 7

5. Apply the Fermi-Dirac distribution law to derive the energy distribution of free electrons inside a conductor. Get the value of Fermi Energy and Mean Energy of electron at 0K. 7

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SECTION—D

6. Discuss the thermodynamics of a thermocouple. Derive an expression for (dE/dT) and (d^2E/dT^2) for a thermocouple, where E and T have their usual meanings. 7

7. What is entropy ? Prove that the entropy of a thermodynamical system remains constant in any reversible process. Also discuss law of increase of entropy in natural process, giving suitable example. 7

SECTION—E

8. Discuss four thermodynamic potentials U, F, H, G and hence derive Maxwells thermodynamic relations. 7

9. What is Clausius-Clapeyron's equation of latent heat. Deduce this equation from Maxwell's relations and explain the change of ice to water on the basis of it. 7

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