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OR

Consider a system of particles (each having charge e) confined within some finite volume. The particles might, for example, be ions in a gas or ions in a solid like NaCl. The particles are in thermal equilibrium at the temperature T in the presence of an electric field E in the z direction. By making use of the fact that in equilibrium the net particle flux J_D+J must vanish, find a relation between D and .

(Here D and are diffusion coefficient and mobility respectively.)

---x---

μ

Roll No.....

Total No. of Sections : 03
Total No. of Printed Pages : 04

Code No. : 02/201(A)

Second Semester Examination, May-2018

M.Sc. PHYSICS

Paper - II

STATISTICAL MECHANICS

Time : 3 Hrs. **Max.Marks : 80**

Note : Section 'A' consists of 10 very short-answer-type-questions, all of which are compulsory and should be attempted first. Section 'B' consists of four short-answer-type-questions with internal options. Section 'C' consists of four long-answer-type-questions with internal choice.

Section - 'A'

Answer the following very short-answer-type questions in one or two sentences : (2×10=20)

Q.1 Define phase space.

Q.2 Define 'Statistical Ensemble'.

Q.3 What do you mean by Accessible Microstates?

Q.4 Define statistical distribution function.

Q.5 Write the statement of Liouville theorem.

Q.6 What do you mean by i) Distinguishable and ii) Indistinguishable particles

Q.7 Write the virial equation of state.

Q.8 What is Ising Model?

Q.9 What are fluctuations?

Q.10 What is Markov process?

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Section - 'B'

Answer the following short-answer-type questions with word limit 200-250 : (5 4=20)

Q.1 What is the canonical partition function? How are thermodynamic functions related to it?

OR

Find the grand partition function of an ideal gas and hence obtain its equation of state.

Q.2 What is Gibb's paradox? How it is resolved?

OR

Compare and contrast the M-B, B-E and F-D statistics.

Q.3 Distinguish between first and second order phase transitions.

OR

Show that the one-dimensional Ising model does not explain the spontaneous magnetization.

Q.4 Derive Fokker-Planck equation representing the motion due to a fluctuating force.

OR

Write short note on fluctuation dissipation theorem.

Section - 'C'

Answer the following long-answer-type questions with word limit 400-450 : (10 4=40)

Q.1 For an ideal gas of N identical particles in microcanonical ensemble, find the entropy, the equation of state, and the specific heat.

OR

Discuss the relation between entropy & probability? Derive Sacker-Tetrode equation for entropy of a perfect gas.

Q.2 Explain Bose-Einstein condensation. How does it differ from ordinary condensation? Derive an expression for the critical temperature at which this phenomenon sets in.

OR

Give a detailed introduction of BE and FD statistics in comparison to MB statistics.

Q.3 Discuss Landau theory of second order phase transition. How is the discontinuity in the specific heat related to the discontinuity in isothermal compressibility and the discontinuity in thermal expansion coefficient?

OR

Derive the cluster expansion of pressure of a classical gas and hence relate the virial coefficients with the cluster integrals.

Q.4 Explain the phenomenon of Brownian movement. Setup and solve Langevin equation to obtain the mean square displacement of the particles undergoing Brownian motion.