Roll No. .....

74621

M. Sc. Physics 2nd Semester CBCS Scheme (w.e.f. 2018-2019) Examination – May, 2024

STATISTICAL MECHANICS

Paper : 18PHY22C1/22PHY22C1

Time : Three hours] *[Maximum Marks : 80*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : The question paper consist of nine questions. You have to attempt *five* questions in total ***one*** from each Unit. Question No. 1 is ***compulsory***.

1. Write short notes on : $4 \times 4 = 16$

(i) Postulate of equal a priori probability

(ii) Helmholtz free energy

(iii) Thermionic emission

(iv) Concentration fluctuations

UNIT – I

2. What do you mean by (i) thermal equilibrium, (ii) mechanical equilibrium, and (iii) particle equilibrium ? Derive the conditions for each of them. Show that the particles tend to move from regions of higher chemical potential to lower chemical potential as the system approaches equilibrium. 16

3. What is density of phase points ? Describe cellular nature of phase space and prove conservation of density in phase space. Show that the phase trajectory of the representative point for a one dimensional harmonic oscillator is an ellipse. 16

UNIT – II

4. Derive expression for partition function for a perfect gas in Gibb's canonical ensemble and discuss the effect of shifting of zero level of energy. Explain the connection between microcanonical and canonical ensembles, if any. 16

5. What is meant by an ensemble ? Discuss the importance of a grand canonical ensemble over other types of ensembles. Derive the grand canonical distribution function and use it to derive thermodynamic properties of an ideal gas. 16

UNIT – III

6. Define occupation number and compare it in different statistical distributions. As an application of BE statistics, explain the phenomenon of condensation in momentum space. How it is related to the properties of liquid Helium ? 16

7. Deduce the necessary conditions for a system obeying quantum statistics to start following the approximately the laws of classical statistics. Define Fermi energy and derive the expression for an ideal Fermi-Dirac gas. Discuss its relation with chemical potential. 16

UNIT – IV

8. Discuss Bragg William approximation and its application to the Ising model. Explain spontaneous magnetization in ferromagnetic substances on the basis of this approximation. 16

9. Define the concept of equilibrium and present an account for energy fluctuations. Explain the concept of one dimensional random walk. Describe Brownian motion as an example of fluctuating force. 16
