

U.G. 6th Semester Examination - 2021

PHYSICS

Course Code : BPHSCCHC602

Course Title : Statistical Mechanics

Full Marks : 30

Time : 2 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **ten** questions: $1 \times 10 = 10$
- What is thermodynamic probability? What is its minimum value?
 - State the basic assumptions of Bose- Einstein statistics.
 - Under what conditions do the Bose-Einstein and Fermi-Dirac distribution approach Maxwell Boltzmann distribution? Represent graphically.
 - Define phase space.
 - Calculate the number of ways of arranging four Bosons in seven different states.
 - Define Fermi energy.
 - What is Gibb's paradox.

- Does MB-statistics obey Pauli's exclusion principle? Explain.
- State the law of equipartition of energy.
- At what temperature the probability of occupation of an electron in Fermi level is 0.5?
- Calculate the probability of tossing a coin 10 times we get 5 heads and 5 tails.
- Write down the expression for the average energy of Planck's oscillator.
- State the Wien's displacement law.
- What is Bose-Einstein condensation?
- What is classical limit of quantum statistics?

2. Answer any **five** questions: $2 \times 5 = 10$
- From Planck's formula of radiation, establish the Stefan-Boltzmann law.
 - Derive the relation $S = k \ln \Omega$, where the letters have their usual meaning.
 - Draw the phase trajectory of a free particle moving in a one-dimensional box.
 - State and prove Stirling formula for factorial of very large number.

- e) Find out the possible arrangements of two particles P_1 and P_2 in three cells according to MB-statistics.
- f) Write down FD distribution function. Sketch it for $T=0$ K and $T > 0$ K.
- g) If Fermi energy of copper is 7eV. Find out the value of Fermi velocity and Fermi-temperature.
- h) What do you mean by an ensemble? Which type of ensemble would be used to describe the behaviour of a photon gas?

3. Answer any **two** questions: 5×2=10

- a) Show that average speed of the electron at 0 K is $\frac{3}{4}$ th of the Fermi velocity $v_f(0)$ at $T=0$ k. State Wien's displacement law.
- b) What do you understand by partition function? Derive expressions for internal energy (U), entropy (S) and specific heat (C_v) in terms of partition function.
- c) From Maxwell-Boltzmann law of energy distribution establish law of equipartition of energy.
