(b) Write Planck's quantum postulate and derive Planck's law of black-body radiation. 2+8=10

(c) Write the differences between photon and ideal gas. Starting from B–E statistics distribution law derive Planck's law. 3+7=10

(d) Define Stefan-Boltzmann law and deduce it from thermodynamic consideration. 3+7=10

(e) What is electron gas ? Derive the expression of energy distribution of free electrons in a metal using F–D statistics. 2+8=10

(f) Explain Bose-Einstein condensation. Define critical temperature for B–E condensation. 8+2=10

(g) From Planck's law, derive —

(i) Wien's law;

(ii) Stefan-Boltzmann law. 4+6=10

(h) Compare among three statistics M–B, B–E and F–D. Under what condition classical statistics approaches the quantum statistics ? 8+2=10

Total number of printed pages–4

3 (Sem–6/CBCS) PHY HC 2

2022

PHYSICS

(Honours)

Paper : PHY–HC–6026

(Statistical Mechanics)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer ***any seven*** questions from the following : 1×7=7

(a) What is the minimum volume of the phase cell in quantum statistics ?

(b) What is the dimension of partition function ?

(c) Write *one* limitation of Maxwell-Boltzmann statistics.

(d) Name the statistics where Pauli's exclusion principle is used.

(e) State Kirchhoff's law of heat radiation.

Contd.

(f) What is Fermi energy ?

(g) What is Chandrasekhar mass limit ?

(h) What is the absorptive power of a perfectly black body ?

(i) Write *one* difference between B–E and F–D statistics.

(j) The temperature of a black body is increased from 27°*C* to 327°*C*. By how many times the emission of energy will be increased ?

2. Answer ***any four*** of the following : 2×4=8

(a) Define microstate and macrostate.

(b) Define phase space and phase line.

(c) What is ultraviolet catastrophe ?

(d) The wavelength of maximum emissive power of sun's heat radiation is 4750 Å. Find the surface temperature of the sun. [Wien's displacement constant = 0.2892 *cm-K*]

(e) Three particles are to be distributed in four energy levels. Calculate all possible ways of distribution when particles are

(i) fermions;

(ii) classical particles.

(f) What is degenerate Bose gas ?

(g) What is white dwarf star ?

(h) Define ensemble.

3. Answer ***any three*** of the following : 5×3=15

(a) Write a short note on Gibbs paradox.

(b) Derive the relation $S = k \ln W$, where $S \rightarrow$ entropy, $k \rightarrow$ Boltzmann constant, $W \rightarrow$ probability.

(c) Derive the distribution law of M–B statistics.

(d) Derive the distribution law of F–D statistics.

(e) Show that Fermi energy of electron gas is independent of shape and size of the material.

(f) Derive Rayleigh-Jeans radiation law from Planck's radiation law.

(g) Derive Sackur-Tetrode equation.

(h) What is radiation pressure ? Derive an expression of diffused radiation pressure.

4. Answer ***any three*** questions of the following : 10×3=30

(a) State the law of equipartition of energy and prove it. 2+8=10