SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2021
(Improvement/Supplementary)
PHYSICS
FPHY2C07: STATISTICAL MECHANICS

Time: 3 Hours   **Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries 1 weightage

1.   Name & explain statistics obeyed by free electrons in metals.

2.   Draw and explain the pressure temperature variation of an ideal Bose gas.

3.   Define Chemical potential.

4.   State and explain equipartition theorem.

5.   What is meant by ensemble? Discuss Microcanonical, Canical and Grand Canonical
      ensembles.

6.   Discuss the statistics of occupation number for fermions.

7.   Obtain the density matrix in canonical ensemble.

8.   A particle of unit mass is executing simple harmonic motion. Determine its trajectory in
      phase space.   **(8 × 1 = 8 Weightage)**

Part B: Essay questions. Answer any *two* questions. Each carries 5 weightage

9.   Discuss Pauli theory of paramagnetism.

10.   Explain Bose-Einstein Condensation in detail.

11.   Give the details about density and energy fluctuation in grand canonical ensemble.

12.   What is Gibbs Paradox? Show how Sackur -Tetrode equation is obtained, and how it
      proves entropy as an extensive property.   **(2 × 5 = 10 Weightage)**

Part C: Problems. Answer any *four* questions. Each carries 3 weightage.

13.   Three distinguishable particles have total energy 9. But the particles are restricted to
      energy levels 0 to 4. Calculate number of macrostates and microstates.

14.   Considering the atomic nucleus as an ideal Fermi gas, show that Fermi energy is 28Mev.

15.   Obtain the expression for Helmholtz free energy of Fermi gas.

16.   Show how specific heat capacity of solid depends on temperature.

17.   Thermodynamic parameters of an ideal gas derived through canonical ensemble were
      same as derived by micro canonical ensemble. Why?

18.   Derive the quantum mechanical analogue of classical equation of Liouville.

19.   Find all thermodynamic parameters of a system consist of N independent quantum
      mechanical harmonic oscillators.

                                                        (4 × 3 = 12 Weightage)