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PHY-502

Statistical Mechanics and Quantum Mechanics

M.Sc. PHYSICS (MSCPHY-16/17)

Ist Year Examination, 2022 (June)

Time : 2 Hours] **Max. Marks : 80**

Note : This paper is of Eighty (80) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein.

SECTION–A

(Long Answer Type Questions)

Note : Section 'A' contains Five (05) long answer type questions of Twenty (20) marks each. Learners are required to answer any Two (02) questions only.

(2×20=40)

1. Derive Sackur Tetrode equation for the entropy of an ideal monoatomic gas. How does it resolves the Gibb's Paradox ?

2. The average occupation number per state for bosons can be derived using the microcanonical ensemble :

(a) State the three quantities that are fixed in microcanonical ensemble.

(b) Show $\Omega_j = \dfrac{(n_j + g_i - 1)!}{n_j!(g_j - 1)!}$

(c) Show the entropy is

$$S = kB \sum g_j \left[(1 + \bar{n}_j)\ ln\ (1 + \bar{n}_j) - \bar{n}_j\ ln\ \bar{n}_j \right]$$

Where $\bar{n}_j = \dfrac{n_j}{g_j}$.

3. Deduce Schrodinger's time dependent equation. Obtain the solution of wave equation for a particle moving in one dimensional potential barrier.

4. Formulate the Schrondiger equation for Hydrogen atom and separate the angular and radial parts.

5. Explain Klein-Gordon relativistic equation. Give its covariant form. Discuss some applications of Klein Gordon equation.

SECTION–B

(Short Answer Type Questions)

Note : Section 'B' contains Eight (08) short answer type questions of Ten (10) marks each. Learners are required to answer any Four (04) questions only. (4×10=40)

1. Distinguish between micro canonical, canonical and grand canonical ensembles.

2. State and prove Liouville's theorem.

3. State about the conditions for the two systems to be in thermal, mechanical and chemical equilibrium.

4. Compare the three statistics Bose-Einstein, Fermi-Dirac and Maxwell Boltzmann statistics.

5. What is meant by an operator? Explain about different types of operators that are used in quantum mechanics.

6. Define the term eigen values and eigen functions. What should be the eigen functions and eigen values for the operator $\frac{\partial^2}{\partial x^2}$.

7. What do you understand by Pauli Spin operator? Explain Pauli spin function in the form of 2×2 matrices.

8. Explain α-decay by WKB approximation method.
