Mid-West University

Examinations Management Office

End Semester Examinations-2080

Master level/ M.Sc.(Physics)/1st Semester
Time: 3 hours
Subject: Quantum Mechanics-I (PHY513)

Full Marks: 37.50
Pass Marks: 18.75

Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks.

Attempt all the questions

1. What do you understand about Perturbation theory? Explain about the time independent Perturbation theory. Also discuss how the time dependent Schrodinger wave equation helps to explain the transition between continuum states. [10]

2. Explain the quantum mechanical treatment of H-atom. Also discuss about the magnetic moment and current density of Hydrogen atom. [10]

OR

What do you mean by Harmonic Oscillator? Discuss the energy and wave function of Harmonic oscillator. Also explain how the creation and annihilation operator introduced in quantum mechanics. Are they commute each other or not?

3. What do you mean by matter waves? Discuss about the wave aspects of matter based on de-Broglie theory. Also explain about the diffraction of matter waves. [5]

OR

State and explain the Compton Scattering of light.

4. Consider the cavity as a container of photons and calculate the spectral distribution $\frac{1}{V}dE(\omega)/d\omega)$ of the black body radiation that escapes from a tiny hole in the cavity. Consider that photons are spin 1 particles (bosons) and that the number of photons in a state of energy 'E' at temperature T is given by $f_{BE} = \left(e^{E/K_BT} - 1\right)^{-1}$ *(the Bose Einstein distribution)* . Compare the result with Planck's law. Also show that the total electromagnetic energy in the cavity with walls kept at temperature T is proportional to T^4 and evaluate the factor of proportionality. [5]

5. Determine the eigenvalues and Eigen functions of the Hamiltonian for the three dimensional, spherically symmetric harmonic oscillators. [5]

6. Explain the Heisenberg's Uncertainty relations for arbitrary observables. [2.5]

OR

State and explain the Ritz Variational Principle.

THE END