M.Sc.S.Y. (Physics) (CBCS Pattern) Sem-III

# PSCPHYT09 - Core Paper-IX - Quantum Mechanics-II

P. Pages : 1 **GUG/W/22/11295**

Time : Three Hours * 2 0 2 0 * Max. Marks : 80

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Either

**1.** a) Explain the application of perturbation theory to ground state energy. **8**

b) Give first order perturbation theory of non-degenerate system and find the expression of energy and wave function. **8**

**OR**

c) Define Stark effect. Explain first order stark effect in the ground state and first excited state of the H-atom. **8**

d) Define normal and anomalous Zeeman effect. Explain these effects with neat energy diagram. **8**

Either

**2.** a) Discuss time dependent perturbation theory and derive the expression of Fermi-Golden rule of probability transition. **8**

b) What are Einstein A and B coefficients. Derive equation for them. **8**

**OR**

c) What is mean by barrier penetration? Explain use of WKB method in barrier. **8**

d) Explain the variational principle. Calculate the ground state energy of He atom using variational principle. **8**

Either

**3.** a) Explain Born approximation in scattering and discuss its validity. **8**

b) Derive the expression of wave function and energy of the ortho and parastates of the Helium atom and their perturbation by coulomb repulsion. **8**

**OR**

c) Discuss scattering from an exponential potential of the form $V(r) = -V_o e^{-r/a}$ . **8**

d) Discuss scattering cross-section in laboratory and centre of mass system. **8**

Either

**4.** a) What are the short comings of Klein-Gordon relativistic equation of free particle? **8**

b) Explain spin-orbit interaction for Dirac's particles. **8**

**OR**

c) Write down the Dirac equation for a free particle construct matrices for $\alpha_x, \alpha_y, \alpha_z$ and $\beta$ . **8**

d) Discuss the solution for hydrogen atom in Dirac's theory. **8**

**5.** Attempt all the followings.

a) Explain second order Stark effect in an harmonic oscillator. **4**

b) Explain Yukawa potential in deuteron. **4**

c) Write a note on identical particles. **4**

d) Give the physical significances of negative energy states. **4**

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