Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University) Coimbatore-641043.

Master's Degree Examination – November 2018

III – Semester

Class : II PG **Time: 3 hours**
Major : Physics **Max. Marks: 60**

17MPHC15 QUANTUM MECHANICS – II

Part A **10 x 1/2 = 5**

Choose the correct answer

1. ------ equation is said to be the wave equation of unperturbed system.

   a. $H^0\psi^0+E^0\psi^0=0$ b. $H^0\psi^0-E^0\psi^0=0$ c. $H^0\psi^0-E^0\psi^0 \neq o$ d. $H^0\psi^0*E^0\psi^0=0$

2. The behaviour of hydrogen atom in first excited state is like a permanent electric dipole moment of magnitude

   a. $3ea_0$ b. $6ea_0$ c. $9ea_0$ d. ea_0

3. When a system is isolated & the Hamiltonian is independent of ------, the eigen states of the system are true stationary states.

   a. energy b. wave c. time d. frequency

4. The method of variation of constant is also referred as

   a. WKB method b. Fermi golden rule

   c. time independent perturbation theory d. time dependent perturbation theory

5. The use of general theory of relativity is not essential due to negligible ------- in atomic systems.

   a. gravitational field b. magnetic field c. electric field d. electromagnetic field

6. The Klein-Gordon equation will describe particles of zero spin like -------

   a. baryons b. bosons c. π-mesons d. fermions

7. The unoccupied negative energy states are called

   a. holes b. electrons c. positrons d. both a & c

8. The eigen values of $\vec{\alpha}$ & β are

   a. 1 & 0 b. 0 & 1 c. +1 & -1 d. 1 & 2

9. When the energy of a particle is altered after its interaction, the scattering is called

   a. collisions b. inelastic scattering c. elastic scattering d. scattering amplitude

10. The plane wave is equivalent to the superposition of a number of -------- waves.

    a. spherical b. circular c. square d. None of the above

Part B 5 x 4 = 20

Answer ALL questions

Each answer should not exceed 200 words or one page

11.a. What is Stark effect? Explain. (Or)

11.b. Derive an expression for first order perturbation by using stationary perturbation theory.

12.a. Prove that the transition probability per unit time is $\frac{2\pi}{\hbar}\rho(k)|H'_{km}|^2$ where ρ(k) denotes the density of final states & H'_{km} is the matrix element of the perturbation term.

(Or)

12.b. Discuss the zeroth order time dependent perturbation theory.

13.a. What do you mean by charge density and current density?

(Or)

13.b. Write short notes on development of relativistic quantum mechanics.

14.a. Write a note on matrices for $\vec{\alpha}$ & β. (Or)

14.b. Give the theory of development of Dirac equations.

15.a. Formulate scattering theory in terms of Green's function. (Or)

15.b. Write short notes on phase shifts.

Part C 5 x 7 = 35

Answer ALL questions

Each answer should not exceed 600 words or three pages

16.a. Show that variation principle can be used to obtain the ground state of helium atom.

(Or)

16.b. Give an account on physical application to non-degenerate perturbation theory of ground state of harmonic oscillator.

17.a. State and explain Fermi-Golden rule. (Or)

17.b. Discuss the first order time dependent perturbation theory

18.a. Derive the Klein-Gordon equation. (Or)

18.b. Obtain the Klein-Gordon equation in the presence of electromagnetic field.

19.a. Establish Dirac equation for an electron and calculate its magnetic moment.

(Or)

19.b. Deduce the solutions of Dirac equation for free particle.

20.a. Give the theory of scattering by a screened Coulomb potential.

(Or)

20.b. Find the condition of validity of Born approximation for scattering by a square well potential.