(7 pages) **Reg. No. :** .....

Code No. : 9386 **Sub. Code : HPHM 41**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2015.

Fourth Semester

Physics

QUANTUM MECHANICS — II

(For those who joined in July 2012 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The change in the energy levels of an atom caused by a uniform external magnetic field is called the

   (a) Zeeman effect

   (b) Stark effect

   (c) Thomson effect

   (d) Compton effect

2. The variation method can be used for the approximate determination of

   (a) The highest state energy level of a system

   (b) The lowest or ground state energy level of a system

   (c) The first state energy level of a system

   (d) The second state energy level of a system

3. WKB method is

   (a) A classical approximation

   (b) A semi-classical approximation

   (c) A quantum approximation

   (d) A semiquantum approximation

4. In the case of very short variation of Hamiltonian in a finite interval of time ϵ_0.

   (a) Energy eigen value becomes zero

   (b) Energy eigen value becomes infinity

   (c) Wave function becomes antisymmetric

   (d) Sudden approximation is applied

5. The solutions derived from any "is" by means of permutation of its arguments and degenerate with the original "u" and it is called

   (a) Degeneracy

   (b) Permutation degeneracy

   (c) Argument Degeneracy

   (d) Exchange degeneracy

6. The eigen value of S^2 for the eigen functions $V\left(\frac{1}{2}\right)$ and $V\left(\frac{-1}{2}\right)$ will be

(a) $\frac{3}{4}\hbar^2$ and $\frac{-3}{4}\hbar^2$ (b) $\frac{3}{4}\hbar^2$

(c) $\hbar^2$ (d) $\frac{\hbar^2}{4}$

7. The probability of finding a system in the final state is

(a) $|A_0|^2 = I(\omega)\Delta(\omega)$

(b) $|A_0|^2 = \frac{2\pi C}{\omega^2} I(\omega)\Delta(\omega)$

(c) $|A_0|^2 = \frac{1}{\omega^2} I(\omega)\Delta(\omega)$

(d) $|A_0|^2 = 2\pi C\, I(\omega)\Delta(\omega)$

8. The change in scalar and potentials with out changing the electric and magnetic fields is called a

(a) Gauge transformation

(b) Lorentz transformation

(c) Newtonian transformation

(d) Galilean transformation

9. The matrices α and β are

(a) Skew - Hermitian

(b) Hermitian

(c) Non-Hermitian

(d) Unitary

10. Dirac's Hamiltonian for a central field is

(a) $H = \beta mc^2 + V$

(b) $H = c\vec{\alpha}\cdot\vec{p} + \beta mc^2$

(c) $H = c\vec{\alpha}\cdot\vec{p} + \beta mc^2 + V$

(d) $H = T + V$

PART B — ($5 \times 5 = 25$ marks)

Answer ALL the questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Obtain the first order correction for the eigen function of a non-degnorate case using stationary perturbation theory.

Or

(b) Explain briefly the variation method.

12. (a) Give the asymptotic connection formulas for WKB solution.

Or

(b) Discuss the applicability of Bohr – Sommer feld quantization rule to the WKB solutions.

13. (a) Explain the collision of identical particles.

Or

(b) Write the electron spin functions and the spin eigen value for a two electron system.

14. (a) Deduce the electric dipole transition probabilities.

Or

(b) Derive the expressions for the exact calculation of the radiated angular momentum.

15. (a) Discuss the inclusion of electromagnetic potentials in the wave equation.

Or

(b) Write a note on negative energy states.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Explain the perturbation method of calculation of the energy in the change value due to first order stark effect in Hydrogen.

Or

(b) Obtain an upper limit for the energy of the ground state of the Helium atom using variation method.

17. (a) Discuss the tunneling through a barrier on the basis of WKB method.

Or

(b) Obtain the transition probability for a harmonic perturbation.

18. (a) Explain the connection of identical particle wave functions with statistical mechanics.

Or

(b) Obtain the spin eigen functions and spin eigen values of a three electron systems.

19. (a) Discuss the absorption and induced emission quantum mechanically.

Or

(b) Derive the Planck distribution formula.

20. (a) Deduce the schrodinger's relativistic equation for a particle in electromagnetic field. Obtain the solutions of the equation.

Or

(b) Deduce the Dirac's equation for a central field.
