17P309 (Pages: 2) Name: ……..……..

Reg. No…...…….…….

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2018

(CUCSS-PG)

CC15P PHY3 C09 / CC17P PHY3 C09 - QUANTUM MECHANICS - II

(Physics)

(2015 Admission onwards)

Time: Three Hours Maximum: 36 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. Show that the variational method always gives an upper limit to the ground state energy of the system.
2. Discuss briefly the condition for the validity of WKB approximation.
3. Bring out the difficulties in the probability interpretation of the klein gordan wave equation.
4. What do you mean by electric dipole approximation?
5. Explain briefly the principle behind time independent perturbation theory.
6. Deduce the covariant form of dirac equation.
7. What are Dirac matrices? Give any two its properties.
8. What is Zeeman Effect?
9. What is second quantization? Explain how it can be applied to a system of Bosons.
10. Explain Bohr-Sommerfeld quantistion theory.
11. Deduce an expression for transition probability when a constant perturbation is acting on the system.
12. Obtain the classical field equation in terms of lagrangian density.

(12 × 1 = 12 Weightage)

Section B

Answer any ***two*** questions. Each question carries 6 weightage.

13. (i). Briefly explain the variational method used for obtaining approximate value of ground state energy of a system.

    (ii). Obtain the ground state energy for heium atom using variational method.
14. Applying time independent perturbation theory, account for stark splitting in the first excited state of Hydrogen atom
15. Starting from Dirac hamiltonian obtain the free particle solution of Dirac Equation.
16. Explain the method of calculating transition probability using time dependent perturbation theory. Derive an expression for transition probability when a system is subjected to constant perturbation.

(2 × 6 = 12 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

17. Use variational method to find the ground state energy of one dimensional harmonic oscillator using the trial wave function $\Psi = A\, e^{-\alpha x^2}$

18. If A and B are operators whose components commute with α; show that $(\alpha.A)(\alpha.B) = (A.B) + i\sigma^D(AxB)$ where $\sigma^D = \begin{pmatrix} \sigma & 0 \\ 0 & \sigma \end{pmatrix}$

19. For a Dirac particle moving in a central potential, show that the orbital angular momentum is not a constant of motion.

20. Starting from K.G equation, derive the equation of continuity.

21. A system in an unperturbed state "n" is suddenly subjected to a constant perturbation H(r). Find the transition probability from the initial state "n" to the final state "k".

22. Using WKB method solve the one dimensional potential well given by

    $V(x) = 0$ for $a<x<a$;

    $V(x) = \infty$ for $x>a$.

(4 × 3 = 12 Weightage)

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