19P306 (Pages: 2) Name……..

Reg. No…….…….

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CBCSS-PG)

CC19P PHY3 C09 - QUANTUM MECHANICS – II

(Physics)

(2019 Admission Regular)

Time: Three Hours Maximum: 30 Weightage

Section A

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

1. Explain about linear stark effect in hydrogen atom
2. Variational method is used to get an upper limit to one of the higher energy levels of the system. Explain?
3. Briefly explain the validity of WKB approximation.
4. Derive the Fermi Golden rule of time dependent perturbation theory.
5. What are the limitations of K.G equation?
6. Give any 4 properties of Dirac matrix.
7. Explain Optical theorem in scattering.
8. What do you mean by scattering length?

(8 × 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each carries 5 weightage.

9. Briefly explain the theory of WKB approximation. Using WKB approximation obtain the expression for transmission coefficient of a potential barrier.
10. Explain the method of calculating transition probability using time dependent perturbation theory. Derive an expression for transition probability when a system is subjected to harmonic perturbation.
11. Starting from Dirac Hamiltonian, obtain the free particle solution of Dirac Equation.
12. Using the method of partial wave analysis, explain scattering by square well potential.

(2 × 5 = 10 Weightage)

Section C

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

13. For a particle of mass m moving in the potential $V(x) = kx$ for $x>0$ and $V(x) = \infty$ for $x<0$, where k is a constant. Estimate the ground state energy of the system by optimizing the trial wave function $x\, e^{-\alpha x}$.

14. Optimize the trial wave function $e^{-\alpha r}$. Hence obtain the ground state energy of hydrogen atom.
15. Find the energy levels of a particle in a potential $V(x) = V_o|x|$, V_o being positive constant using Bohr-Somerfield quantization rule.
16. A simple harmonic oscillator of mass m_0 and angular frequency ω is perturbed by an additional potential bx^3. Evaluate the second order correction to the ground state energy of the oscillator.
17. Derive the equation of continuity using K.G equation.
18. Show that the matrix $\sigma' = \begin{bmatrix} \sigma & 0 \\ 0 & \sigma \end{bmatrix}$ is not a constant of motion.
19. Show that for zero energy scattering the total scattering cross section is given by $\sigma = 4\pi a^2$.

(4 × 3 = 12 Weightage)

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