Reg. No ..... Name **25P309**

M. Sc. DEGREE END SEMESTER EXAMINATION - OCTOBER 2025

SEMESTER 3 : PHYSICS

COURSE : **24P3PHYT09 ; QUANTUM MECHANICS - II**

(For Regular - 2024 Admission)

Time : Three Hours Max. Weights: 30

PART A

Answer any 8 questions **Weight: 1**

1.	In scattering theory, when can the Born Approximation be applied?	(A)
2.	If H, H_0 are the total Hamiltonian and the unperturbed Hamiltonian respectively then write down the equation of motion in the Interaction picture.	(U)
3.	Show that the transition probability is the same in Schrodinger and Interaction picture.	(An)
4.	What is WKB approximation?	(U)
5.	Write down the Dirac matrices.	(R)
6.	In scattering theory,if $f(0)$ is the scattering amplitude for forward scattering, then write the total scattering crossection.	(A)
7.	In WKB approximation what does the first power of $\hbar$ give?	(An)
8.	ψ_{sc} and ψ_{inc} denotes the scattered and incident wave function then write the condition for the validity of Born approximation.	(A)
9.	In relativistic quantum mechanics, find γ_4^2 .	(U)
10.	In the case of a two state system which is initially in the ground state, interacting with the sinusoidal oscillating potential $V(t)$ on resonance with the system, With $c_g(t)$ and $c_e(t)$ denoting the coefficients for the ground state and the excited state respectively, Draw a plot to show that the system undergoes emission and absorption cycles.	(A)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11.	Discuss S wave scattering in the case of a hard sphere and arrive at the S-wave total cross section.	(A)
12.	Use S wave scattering to derive the scattering amplitude for scattering from a square well potential, $V(r)=-V_0$ for $0<r<r_0$ and $V(r)=0$ for $r>0$.	(U)
13.	A particle of mass m is moving in a one dimentional box defined by the potential $V = 0$ for $0 \leq x \leq a$ and $V = \infty$ otherwise. Estimate the ground state energy using the trial function $\psi(x) = Ax(a - x)$ for $0 \leq x < a$.	(A)
14.	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.	(A)
15.	Show that Klein Gordon equation leads to negetive probability density.	(A)

16. For the time dependent two state problem, draw the dependence of $|c_2(t)|^2$ with the perturbing frequancy ω. Also draw $c_2(t)$ and $c_1(t)$ with time t for the resonance condition. (An)

17. Determine the current density and the charge density on the basis of Klein Gordon equation. (A)

18. Write the Dyson series and explain its significance. (R)

(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19. Obtain the solution of the free particle Dirac equation. Explain their significance. (A)

20. Obtain the expression for the differential scattering crosssection when the energy of the incident particle is small compared to the energy of the scattering potential. (An)

21. Discuss time dependent Perturbation theory and deduce Fermi's Golden Rule. (E)

22. Discuss the first order time independent perturbation theory for non degenerate stationary case. Obtain the corrected eigenvalues and Eigen vectors. (R)

(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;