Reg. No ..... Name **22P325**

M. Sc. DEGREE END SEMESTER EXAMINATION : OCTOBER 2022

SEMESTER 3 : PHYSICS

COURSE : **21P3PHYT09 : QUANTUM MECHANICS - II**

(For Regular - 2021 Admission)

Duration : Three Hours Max. Weights: 30

PART A

Answer any 8 questions **Weight: 1**

1.	Write the optical theorem in scattering theory.	(R)
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.	In the presence of $V(t)$ a time dependant potential, write the experssion for the probability of finding the system in the state $\|n\rangle$ if the system was initialy in the state $\|i\rangle$.	(U)
4.	Find the matrix $\sigma \cdot \boldsymbol{p}$ where $p = p_1\hat{i} + p_2\hat{j} + p_3\hat{k}$	(U)
5.	In WKB approximation what does the first power of $\hbar$ give?	(An)
6.	What is stark effect?	(R)
7.	What are the physical interpretation of Klein - Gorden wave equation?	(U)
8.	Sate Fermis golden rule.	(R)
9.	What do you mean by scattering cross section.	(R)
10.	What are Bosons and fermions. Give examples.	(A)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11.	Outline the variational method of approximation.	(U)
12.	Show that Klein Gordon equation leads to negetive probability density.	(A)
13.	For a Dirac particle moving in a central potential show that the orbital angular momentum is not a constant of motion.	(A)
14.	A system in an unperturbed state n is suddenly subjected to a constant perturbation H'(r) which exists during time t $\rightarrow$ 0. Find the probability for the transition from state n to state k and show that it varies harmonically.	(An)
15.	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)
16.	In the case of Yukawa potential arrive at the differential scattering cross section.	(A)

17. 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)

18. 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)

(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19. In relativistic quantum mechanics derive the approximate hamiltonian for an electrostatic problem. (A)

20. Describe the s wave scattering by a rectangular potential. (A)

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

22. Discuss the first order time independent perturbation theory for no 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;