JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2024

MSc-III Semester (PMS)

COURSE CODE (CREDITS): 3   MAX. MARKS: 35

COURSE NAME: Advanced Quantum Mechanics (18MS1PH312)

COURSE INSTRUCTORS: HSR   MAX. TIME: 2 Hours

Note: (a) All questions are compulsory.

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Q.No	Question	Marks
Q1.	We perturb the particle in an infinite potential well of width a with a constant potential V_0 spread in the region $\frac{a}{2} \leq x \leq a$. Find the first order correction the energies. $\left(\psi_n^0(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi x}{a}\right)\right)$	6
Q2.	Find the correction to energies using WKB approximation in the problem in Q1.	5
Q3.	Why ordinary perturbation theory fails in the case of degeneracy in the system. Derive the correction to the unperturbed energy in the doubly degenerate system.	6
Q4.	Find an upper bound on the ground state energy of the one-dimensional infinite square well using the "triangular" trial wave function $$\psi(x) = \begin{cases} Ax, & 0 \leq x \leq \frac{a}{2} \\ A(a-x), & \frac{a}{2} \leq x \leq a \\ 0, & otherwise \end{cases}$$	6
Q5.	(a) Write the dirac equation and show that the gamma matrices in the equation satisfy Clifford algebra $[\gamma^\mu, \gamma^\nu]_+ = 2\,\eta^{\mu\nu}\mathbb{1}$. (b) Prove that least dimension of the gamma matrices satisfying clifford algebra can only be 4.	12