

UNIVERSITY OF HYDERABAD  
School of Physics

Jul 2010 - Dec 2010  
M.Sc. III-Semester

Quantum Mechanics-II

Time : 1hr  
MM : 20

Session IV::Tutorial    Perturbation Theory
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- [1] A particle moves in a one dimensional box with rigid boundary at  $x = 0$  and  $x = L$  walls. A small perturbation  $V_1$  given by

$$V_1(x) = \begin{cases} \epsilon V_0 & \text{for } \frac{L}{4} < x < \frac{3L}{4} \\ 0 & \text{otherwise} \end{cases}$$

is applied find the shift in the  $n^{\text{th}}$  energy level.

- [2] A particle moves in two dimensional circular oscillator potential with

$$H_0 = \frac{p_x^2}{2m} + \frac{p_y^2}{2m} + \frac{1}{2}m\omega^2(x^2 + y^2)$$

- (a) What are the quantum numbers of the first excited state? Is it degenerate or not?  
(b) If a small perturbation  $H' = \lambda xy$  is applied compute the lowest order correction to the energy of the first excited state.

- [3] Following the steps given in the class, find eigenvectors and eigenvalues of the matrix

$$\begin{bmatrix} 1 & \epsilon & 0 \\ \epsilon & 1 & -\epsilon \\ 0 & -\epsilon & 2 \end{bmatrix}$$

upto the lowest non-vanishing order in  $\epsilon$ .

Date : Aug 16,2010