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**DEPARTMENT: MATHEMATICAL AND PHYSICAL SCIENCES**

**PROGRAMME: PHYSICS WITH ELECTRONICS**

**PHY 402: QUANTUM MECHANICS II**

1. For time-independent perturbation theory, show that the perturbed energy is the expectation value of the perturbed Hamiltonian in the unperturbed state.

Solution:

Suppose we have a Hamiltonian that’s only slightly different from one for which we know the exact solution.

Ĥ = Ĥ0 + Ĥ1

Where:

Ĥ = Full Hamiltonian

Ĥ0 = Hamiltonian we can solve

Ĥ1 = Small perturbation

Let us assume the perturbed energy levels and the new quantum states can be treated as superpositions of terms in a kind of series solution to the full problem i.e.

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From

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* terms (0th) as:
* terms (1st) as:
* terms (2nd) as:

This implies that the perturbed energy is the expectation value of the perturbed Hamiltonian in the unperturbed state.

1. Find the first-order correction to the energy of a particle in an infinite square well if the ‘’floor’’ of the well is raised by a constant value V0

Solution:

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unperturbed wave function be:

perturbation Hamiltonian be H1 = V0

first-order energy correction:

But =