# Perturbation Theory II

## ADDENDUM

In the lectures we have derived formulae for non-degenerate perturbation theory. The assumption of a non-degenerate energy spectrum guarantees that the quantity $\sum_{k \neq n} \frac{\langle \psi_k^{(0)} | \hat{V} | \psi_n^{(0)} \rangle}{E_n^{(0)} - E_k^{(0)}}$ appearing in various equations, is not divergent which would happen in a degenerate spectrum because $E_n^{(0)} - E_k^{(0)} = 0$ even if $k \neq n$, for certain values of $k$ and $n$.

There is, however, an important caveat. If it so happens that the quantity $\langle \psi_k^{(0)} | \hat{V} | \psi_n^{(0)} \rangle = 0$ for any 2 different degenerate states $|\psi_k^{(0)}\rangle$, $|\psi_n^{(0)}\rangle$, then infact the formulae we have

derived are perfectly applicable.

So there are a special class of degenerate models and choice of $\hat{V}$, where we can still use the formulae we derived.

An example of this is found in Ex2. of the final Homework 9.

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