1) 85(3): Basic Equations of Photon / Electron / Positron Interaction

These are:

Electron: $$\left(\gamma^\mu\left(i\partial_\mu + \frac{e}{\hbar}A_\mu\right) - \frac{m_e c}{\hbar}\right)\psi = 0 \quad -(1)$$

Positron: $$\left(\gamma^\mu\left(i\partial_\mu - \frac{e}{\hbar}A_\mu\right) - \frac{m_e c}{\hbar}\right)\psi = 0 \quad -(2)$$

Photon: $$\left(\Box + \left(\frac{mc}{\hbar}\right)^2\right)A^a_\mu = \mu_0 J^a_\mu \quad -(3)$$

For the free photon:
$$\left(\Box + \left(\frac{mc}{\hbar}\right)^2\right)A^a_\mu = 0 \quad -(4)$$

where m is the photon mass. The latter is defined by the de Broglie equation:
$$\hbar\omega = mc^2 \quad -(5)$$

so eq. (4) is:
$$\left(\Box + \frac{m\omega}{\hbar}\right)A^a_\mu = 0 \quad -(6)$$

i.e. $$\left(\frac{1}{c^2}\frac{\partial^2}{\partial t^2} - \nabla^2 + \frac{m\omega}{\hbar}\right)A^a_\mu = 0 \quad -(7)$$

i.e. $$\left(-\nabla^2 + \frac{m\omega}{\hbar}\right)A^a_\mu = -\frac{1}{c^2}\frac{\partial^2 A^a_\mu}{\partial t^2} \quad -(8)$$

Now use: $$E = i\hbar\frac{\partial}{\partial t}, \quad E^2 = -\hbar^2\frac{\partial^2}{\partial t^2} \quad -(9)$$

2) to obtain:

$$\left(-\frac{\hbar^2\nabla^2}{2m}+\frac{\hbar\omega}{2}\right)A_\mu^a=\left(\frac{E^2}{2mc^2}\right)A_\mu^a \quad -(10)$$

$$:= E A_\mu^a \quad -(11)$$

This is a harmonic oscillator type of equation:

$$\left(-\frac{\hbar^2\nabla^2}{2m}+\frac{1}{2}kx^2\right)\phi = E\phi. \quad -(12)$$

The energy levels of eq. (12) are:

$$E = \left(n+\frac{1}{2}\right)\hbar\omega \quad -(13)$$

where $\omega = \left(\frac{k}{m}\right)^{1/2}$. $\quad -(14)$

Comparing eqns. (10) and (12):

$$kx^2 = \hbar\omega. \quad -(15)$$

Now use: $\quad x = \frac{1}{\kappa} = \frac{c}{\omega} \quad -(16)$

so: $\quad k = \frac{\hbar\omega^3}{c^2} = \left(\frac{\omega}{c}\right)^2\hbar\omega. \quad -(17)$

In eq. (14):

$$\omega = \left(\frac{\hbar\omega^3}{mc^2}\right)^{1/2} = \omega \quad ✓✓ \quad -(18)$$

using $\quad \hbar\omega = mc^2. \quad -(19)$

It is seen that the free electromagnetic field consists of n photons of quantum $\hbar\omega$. When there are no photons the vacuum consists of zero point energy:

$$\boxed{E_0 = \frac{1}{2}\hbar\omega} \quad - (20)$$

This gives rise to all the methods of QED, in which the zero point energy leads to vacuum fluctuations and the electron interacts with virtual photons. QED then proceeds by asserting that when an electron is subjected to electric and magnetic fields it can: a) emit and reabsorb a virtual photon, b) emit and reabsorb a virtual electron – positron pair. This is the first order contribution to the Lamb shift in H. The method of QED is perturbation theory in which the infinite integral is curtailed.

However, all the information of QED is contained within eqns. (1) to (3) of ECE theory, in fact ECE theory contains much more information than QED, which is special relativity, and an ununified field theory.

New Method

This is to solve eqns (1) to (3) numerically, without using any perturbation theory.