Give the significance of London's equation.

We know, the magnetic properties of a superconductor can be explained in general terms by considering the superconductor to be a perfect diamagnetic.

According to Meissner effect, a superconductor will completely eject out the magnetic flux yet we should account for the penetration of magnetic field into the surface of conductor. It has ~~really~~ really been found that the penetration depths are much larger than the atomic distances. In order to explain this penetration, it is desirable to modify a ~~conse~~ constitutive equation of electrodynamics, say ohm's law, rather than to modify the Maxwell's equations. We already know that Maxwell's equations are inadequate to explain the electrodynamics of superconductors i.e to account for the conditions $E=0$ and $B=0$

together. London, in 1935, derived two field equations to explain the superconducting state of matter by modifying ohm's law.

London basing on the assumption that there are two types of conduction electrons in a superconductor - namely the super-electrons and normal electrons, put forward the idea that at any temperature the sum of super electrons and normal electrons is equal to the conduction electron density in the material in the normal state.

Further the super electrons are not subjected to any lattice scattering and are merely accelerated in an electric field. London deduce the following two equations

$$\frac{d\vec{J}_s}{dt} = \frac{n_s e^2}{m}\vec{E} \rightarrow (1)$$

which describes the absence of resistance

$$2 \quad \text{curl}\,\vec{J}_s = -\frac{\mu_0 n_s e^2}{m}\vec{H}$$

which explains Meissner effect.