$$\nabla^2 \vec{E} + k_o^2 n^2 \vec{E} + \nabla(\ln\mu) \times (\nabla \times \vec{E}) + \nabla(\nabla \ln\varepsilon \cdot \vec{E}) = 0 \qquad \star$$

since $\nabla \times \nabla \times \vec{A} = \nabla(\nabla \cdot \vec{A}) - \nabla^2 \vec{A}$ (7)

$\nabla^2 \vec{A} = \nabla(\nabla \cdot \vec{A}) - \nabla \times \nabla \times \vec{A}$ (rearranging (7))

$\therefore \nabla^2 \vec{E} = \nabla(\nabla \cdot \vec{E}) - \nabla \times \nabla \times \vec{E}$

since $\nabla \ln\varepsilon$ gives a vector ($\ln\varepsilon$ is scalar), we can use

$\nabla(\vec{A} \cdot \vec{B}) = (\vec{A} \cdot \nabla)\vec{B} + (\vec{B} \cdot \nabla)\vec{A} + \vec{A} \times (\nabla \times \vec{B}) + \vec{B} \times (\nabla \times \vec{A})$ (4)

in the following expression: $\nabla(\nabla \ln\varepsilon \cdot \vec{E})$, which turns to

$\nabla(\nabla \ln\varepsilon \cdot \vec{E}) = (\nabla \ln\varepsilon \cdot \nabla)\vec{E} + (\vec{E} \cdot \nabla)\nabla \ln\varepsilon + \nabla \ln\varepsilon \times (\nabla \times \vec{E}) + \vec{E} \times (\nabla \times \nabla \ln\varepsilon)$

The last term, $\vec{E} \times (\nabla \times \nabla \ln\varepsilon)$, can be neglected since

$\nabla \times (\nabla \phi) = 0$ where ϕ is a scalar (like $\ln\varepsilon$) (8)

$\therefore \nabla(\nabla \ln\varepsilon \cdot \vec{E}) = (\nabla \ln\varepsilon \cdot \nabla)\vec{E} + (\vec{E} \cdot \nabla)\nabla \ln\varepsilon + \nabla \ln\varepsilon \times (\nabla \times \vec{E})$

Next, consider $\nabla(\ln\mu) \times (\nabla \times \vec{E})$

$\nabla \ln\mu$ gives a vector, so we have:

$\vec{A} \times (\nabla \times \vec{B})$ where $\vec{A} = \nabla \ln\mu$ and $\vec{B} = \vec{E}$

So we can use (4) again,

$\nabla(\vec{A} \cdot \vec{B}) = (\vec{A} \cdot \nabla)\vec{B} + (\vec{B} \cdot \nabla)\vec{A} + \vec{A} \times (\nabla \times \vec{B}) + \vec{B} \times (\nabla \times \vec{A})$

and rearrange to solve for $\vec{A} \times (\nabla \times \vec{B})$

$\vec{A} \times (\nabla \times \vec{B}) = \nabla(\vec{A} \cdot \vec{B}) - (\vec{A} \cdot \nabla)\vec{B} + (\vec{B} \cdot \nabla)\vec{A} + \vec{B} \times (\nabla \times \vec{A})$

$\therefore \nabla(\ln\mu) \times (\nabla \times \vec{E}) = \nabla(\nabla \ln\mu \cdot \vec{E}) - (\nabla \ln\mu \cdot \nabla)\vec{E} + (\vec{E} \cdot \nabla)\nabla \ln\mu + \vec{E} \times (\nabla \times \nabla \ln\mu)$