316(7): The Faraday Law of Induction in the New Era of ECE Theory (ECE2)

From eqs (2), and (12) to (15) of the previous note:

$$\frac{1}{cA^{(0)}}\frac{\partial \underline{B}^a}{\partial t}+\frac{1}{cA^{(0)}}\underline{\nabla}\times\underline{E}^a=\frac{cq_0^b}{W^{(0)}}\underline{B}^a{}_b+\frac{q\underline{v}^b}{cW^{(0)}}\times\underline{E}^a{}_b$$
$$-\left(\frac{\omega^a{}_{0b}}{A^{(0)}}\underline{B}^b+\frac{\underline{\omega}^a{}_b}{cA^{(0)}}\times\underline{E}^b\right) \quad -(1)$$

where

$$\frac{A^{(0)}}{W^{(0)}}=\frac{1}{r^{(0)}} \quad -(2)$$

as in previous notes, so:

$$\frac{\partial \underline{B}^a}{\partial t}+\underline{\nabla}\times\underline{E}^a=c\left(\frac{q\underline{v}_0^b}{r^{(0)}}\underline{B}^a{}_b-\omega^a{}_{0b}\underline{B}^b\right) \quad -(3)$$
$$+\frac{1}{r^{(0)}}\underline{v}^b\times\underline{E}^a{}_b-\underline{\omega}^a{}_b\times\underline{E}^b$$

Now restore the a index using:

$$\underline{B}=-e_a\underline{B}^a \quad -(4)$$

and so on to give the following equation with summation over b index:

2)

$$\frac{\partial \underline{B}}{\partial t} + \underline{\nabla} \times \underline{E} = c\left(\frac{q v_0^b}{r^{(0)}} \underline{B}_b - \omega_{0b} \underline{B}^b\right)$$

$$+ \frac{1}{r^{(0)}} q \underline{v}^b \times \underline{E}^b - \underline{\omega}_b \times \underline{E}^b \quad -(5)$$

Finally remove the b indices as in previous notes to give:

$$\frac{\partial \underline{B}}{\partial t} + \underline{\nabla} \times \underline{E} = 2\left(\left(\omega_{0b}^* - c\frac{q v_0^{b*}}{r^{(0)}}\right)\underline{B} + \left(\underline{\omega}^* - \frac{1}{r^{(0)}}\underline{v}^*\right) \times \underline{E}\right) \quad -(6)$$

This can be written as:

$$\frac{\partial \underline{B}}{\partial t} + \underline{\nabla} \times \underline{E} = \underline{J}_m \quad -(7)$$

where magnetic current density in tesla s^{-1} is:

$$\underline{J}_m = 2\left(\left(\omega_{0b}^* - c q v_0^{b*}\right)\underline{B} + \left(\underline{\omega}^* - \frac{1}{r^{(0)}}\underline{v}^*\right) \times \underline{E}\right)$$

$$-(8)$$

3) The Gauss law from Note 316(4) is:

$$\underline{\nabla} \cdot \underline{B} = 2\underline{B} \cdot \left(\underline{\omega}^* - \frac{1}{r^{(0)}} \underline{v}^* \right) - (9)$$

$$= J_{om}$$

The magnetic magnetic is units of tesla per metre is:

$$J_{om} = 2\underline{B} \cdot \left(\underline{\omega}^* - \frac{1}{r^{(0)}} \underline{v}^* \right) - (10)$$