

Hoja 1

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$$2) \delta = j\omega\mu(\sigma + j\omega\epsilon) \wedge \delta = \alpha + j\beta$$

$$\Rightarrow \delta^2 = (\alpha + j\beta)^2 = \alpha^2 - \beta^2 + j2\alpha\beta$$

$$\delta^2 = -\omega^2\epsilon\mu + j\omega\mu\sigma$$

$$\Rightarrow \alpha^2 - \beta^2 = -\omega^2\epsilon\mu$$

$$2\alpha\beta = \omega\mu\sigma \Rightarrow \alpha = \frac{\omega\mu\sigma}{2\beta}$$

$$\Rightarrow \left(\frac{\omega\mu\sigma}{2\beta}\right)^2 - \beta^2 = -\omega^2\epsilon\mu$$

$$\Rightarrow \beta^2 - \omega^2\epsilon\mu - \left(\frac{\omega\mu\sigma}{2\beta}\right)^2 = 0$$

Multiplico por β^2

$$\beta^4 - \omega^2\epsilon\mu\beta^2 - \left(\frac{\omega\mu\sigma}{2}\right)^2 = 0$$

Hago $x = \beta^2$, por lo que la ecuación me queda:

$$x^2 - \omega^2\epsilon\mu x - \left(\frac{\omega\mu\sigma}{2}\right)^2 = 0$$

Calculo las raíces:

$$x_{1,2} = \frac{\omega^2\epsilon\mu \pm \sqrt{(\omega^2\epsilon\mu)^2 + 4\left(\frac{\omega\mu\sigma}{2}\right)^2}}{2}$$

$$= \frac{\omega^2\epsilon\mu}{2} \pm \sqrt{\left(\frac{\omega^2\epsilon\mu}{2}\right)^2 + \frac{4}{4}\left(\frac{\omega\mu\sigma}{2}\right)^2}$$

Uso el "+" por tener sentido físico ya que β no puede ser negativo

$$= \frac{\omega^2\epsilon\mu}{2} \pm \sqrt{\left(\frac{\omega^2\epsilon\mu}{2}\right)^2 + \left(\frac{\omega\mu\sigma}{2\omega^2\epsilon\mu}\right)^2} \wedge FD = \frac{\sigma}{\omega\epsilon}$$

$$= \frac{\omega^2\epsilon\mu}{2} \left[\sqrt{1 + FD^2} + 1 \right]$$

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