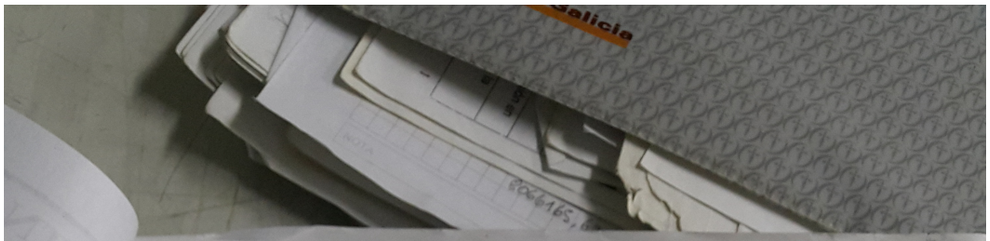

Hoja 1

Perez Rodrigo
Leg: 54573
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2) $\gamma^2 = j\omega\mu(\sigma + j\omega\varepsilon) \quad \wedge \quad \gamma = \alpha + j\beta$

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

$\gamma^2 = -\omega^2\varepsilon\mu + j\omega\mu\sigma$

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

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

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

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

Multiplico por β^2

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

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

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

Calculo las raices:

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

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

Uso el "+" porque tiene sentido físico ya que β no puede ser negativo

$= \frac{\omega^2\varepsilon\mu}{2} + \sqrt{\left(\frac{\omega^2\varepsilon\mu}{2}\right)^2\left[1 + \left(\frac{\omega\mu\sigma}{2}\frac{2}{\omega^2\varepsilon\mu}\right)^2\right]} \quad \wedge \quad FD = \frac{\sigma}{\omega\varepsilon}$

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