SIGN CONVENTIONS FOR EM WAVES

EE 3321 Electromagnetic Field Theory

Pioneering 21st Century Electromagnetics and Photonics

http://emlab.utep.edu

$-j \leftrightarrow i$

EQUATION(S)	ELECTRICAL ENGINEERING (Negative Sign Convention)	PHYSICS / SCIENCE (Positive Sign Convention)
Wave Propagating in +z Direction	$\cos(\omega t \mp kz)$ – forward wave $\exp(\mp jkz)$ + backward wave	$\cos(-\omega t \pm kz)$ – backward wave $\exp(\pm ikz)$ + forward wave
Maxwell's Equations	$\nabla \times \vec{E} = -j\omega\vec{B}$ $\quad \nabla \bullet \vec{D} = \rho_v$ $\nabla \times \vec{H} = \vec{J} + j\omega\vec{D}$ $\quad \nabla \bullet \vec{B} = 0$ $\vec{D} = \varepsilon\vec{E}$ $\quad \vec{B} = \mu\vec{H}$	$\nabla \times \vec{E} = i\omega\vec{B}$ $\quad \nabla \bullet \vec{D} = \rho_v$ $\nabla \times \vec{H} = -\vec{J} - i\omega\vec{D}$ $\quad \nabla \bullet \vec{B} = 0$ $\vec{D} = \varepsilon\vec{E}$ $\quad \vec{B} = \mu\vec{H}$
Wave Vector	$k = \beta - j\alpha$ $\alpha < 0$ gain (grow) $\quad \beta < 0$ backward $\alpha > 0$ loss (decay) $\quad \beta > 0$ forward	$k = \beta + i\alpha$
Refractive Index	$\tilde{n} = n - j\kappa$ $n < 0$ negative index $\quad \kappa < 0$ gain (growth) $n > 0$ positive index $\quad \kappa > 0$ loss (decay)	$\tilde{n} = n + i\kappa$
Lorentz Model	$\tilde{\varepsilon}_r(\omega) = 1 + \dfrac{\omega_p^2}{\omega_0^2 - \omega^2 + j\omega\Gamma}$ $\Gamma < 0$ gain (grow) $\Gamma > 0$ loss (decay)	$\tilde{\varepsilon}_r(\omega) = 1 + \dfrac{\omega_p^2}{\omega_0^2 - \omega^2 - i\omega\Gamma}$