Exam 1 Crib Sheet

Lossless Transmission Line Properties

Telegrapher's Equations	Voltage Wave Phasor
$\frac{\partial}{\partial x} V(x,t) = -L \frac{\partial}{\partial t} I(x,t)$ $\frac{\partial}{\partial x} I(x,t) = -C \frac{\partial}{\partial t} V(x,t)$	$v(z) = V^+ e^{-j\beta z} + V^- e^{+j\beta z}$ $v(z) = V^+ e^{-j\beta z} + \Gamma_L V^+ e^{+j\beta z}$
Characteristic Impedance	**Reflection Coefficient**
$Z_0 = \frac{V_0^+}{I_0^+} = -\frac{V_0^-}{I_0^-} = \sqrt{\frac{l}{c}}$	$\Gamma_L = \frac{V_0^-}{V_0^+} = -\frac{I_0^-}{I_0^+} = \frac{Z_L - Z_0}{Z_L + Z_0}$
Standing Wave Ratio	**Wave Velocity**
$SWR = \frac{\lvert V_{max}\rvert}{\lvert V_{min}\rvert} = \frac{\lvert I_{max}\rvert}{\lvert I_{min}\rvert} = \frac{1+\lvert\Gamma\rvert}{1-\lvert\Gamma\rvert}$	$u = \frac{1}{\sqrt{lc}}$
Input Impedance	**Average Power**
$Z_{in} = Z_0 \frac{Z_L + jZ_0 tan(\beta L)}{Z_0 + jZ_L tan(\beta L)}$	$P_{av} = P_{av}^i + P_{av}^r = \frac{\lvert V_0^+\rvert^2}{2Z_0}[1 - \lvert\Gamma\rvert^2]$

Basic Wave Properties

$\beta = \frac{\omega}{u}$	$\lambda = \frac{2\pi}{\beta} = \frac{u}{f}$

Lossy Transmission Line Properties

Voltage Wave Phasor	Gamma
$v(z) = V^{+}e^{-\gamma z} + V^{-}e^{+\gamma z}$ $v(z) = V^{+}\left(e^{-\gamma z} + \Gamma_L e^{+\gamma z}\right)$	$\gamma = \alpha + j\beta$ $e^{-\gamma z} = e^{-\alpha z} \cdot e^{-j\beta z}$
Characteristic Impedance	**Heaviside Condition**
$Z_0 = \sqrt{\frac{r + j\omega l}{g + j\omega c}}$	$\frac{r}{l} = \frac{g}{c}$
Low-Loss Condition	**Low-Loss Attenuation**
$r << j\omega l, g << j\omega c$	$\alpha = \frac{r}{2Z_0}$

Bounce Diagram