ECE 311 – Exam 1.

Score = _______ / 100

You may use a calculator, straight edge, and compass on this exam. No other tools, notes, or textbooks are permitted. Below is a list of relevant formulas which you may or may not need for the exam. These are sufficient to solve all the problems.

Physical Constants

$\mu_0 = 4\pi\times10^{-7}\,H/m$ $\quad\varepsilon_0 = 8.85\times10^{-12}\,F/m$ $\quad c = 3.0\times10^{8}\,m/s$

Transmission Line Theory

$$-\frac{\partial\tilde V(z)}{\partial z} = \left(R' + j\omega L'\right)\tilde I(z) \qquad -\frac{\partial\tilde I(z)}{\partial z} = \left(G' + j\omega C'\right)\tilde V(z)$$

$$\gamma = \alpha + j\beta = \sqrt{\left(R' + j\omega L'\right)\left(G' + j\omega C'\right)} \qquad \tilde Z_0 = \sqrt{\frac{\left(R' + j\omega L'\right)}{\left(G' + j\omega C'\right)}}$$

$$\lambda = 2\pi/\beta$$

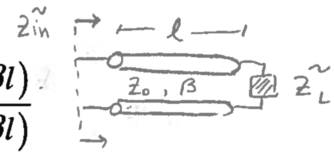
Lossless lines

$$\gamma = 0 + j\beta = j\omega\sqrt{L'\cdot C'} \qquad Z_0 = \sqrt{L'/C'}$$

Input Impedance

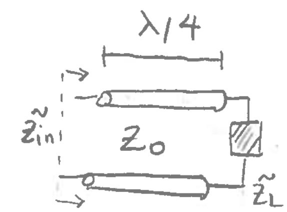
$$\tilde Z_{in}(-l) = Z_0 \times \frac{\tilde Z_L + j\cdot Z_0\cdot\tan(\beta l)}{Z_0 + j\cdot\tilde Z_L\cdot\tan(\beta l)}$$

general case



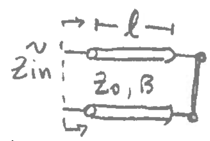
$$\tilde Z_{in} = \frac{Z_0^{\,2}}{\tilde Z_L}$$

λ/4 section



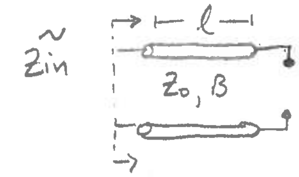
$$\tilde Z_{in}(-l) = j\cdot Z_0\cdot\tan(\beta l)$$

short load



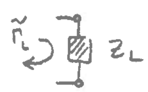
$$\tilde Z_{in}(-l) = -j\cdot Z_0\cdot\cot(\beta l)$$

open load

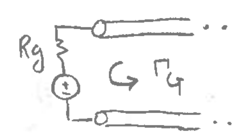


Voltage Reflection Coefficients

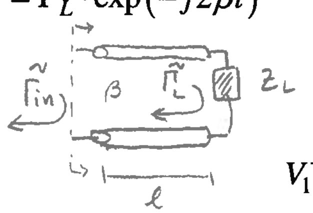
$$\tilde\Gamma_L = \frac{\tilde Z_L - Z_0}{\tilde Z_L + Z_0}$$



$$\Gamma_G = \frac{R_G - Z_0}{R_G + Z_0}$$



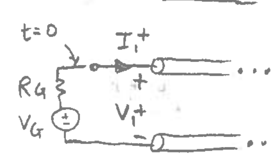
$$\tilde\Gamma_{in}(-l) = \frac{\tilde Z_{in}(-l) - Z_0}{\tilde Z_{in}(-l) + Z_0} = \tilde\Gamma_L\cdot\exp(-j2\beta l)$$



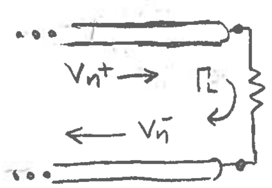
Transient Analysis

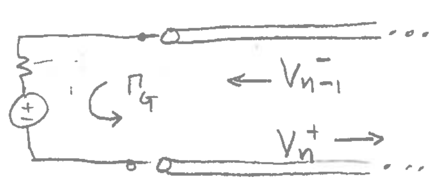
$$u_p = \frac{\Delta z}{\Delta t} = c\big/\sqrt{\varepsilon_r}$$

$$V_1^+ = V_g\frac{Z_0}{Z_0 + R_G}$$



$$V_n^- = V_n^+\cdot\Gamma_L \quad for\ n = (1..\infty) \qquad V_n^+ = V_{n-1}^-\cdot\Gamma_G \quad for\ n = (2..\infty)$$





$$I_n^+ = V_n^+/Z_0 \qquad I_n^- = -V_n^-/Z_0$$