Homework 2
EE381-1 Electric & Magnetic Fields (Fall 2018)
Friday, September 7, 2018

1) PE11.5a Γ means Γ_L. Hint: Remember $\beta = 2\pi/\lambda$.

2) An 80 m long lossless transmission line ($Z_0 = 80\,\Omega$, $\beta = 3.6$ rad/m) is terminated with a load $Z_L = 75 + j45\,\Omega$. It is connected to a generator with $V_g = 60\angle 0°$ V and $Z_g = 75 - j20\,\Omega$. Calculate the input impedance and phasor voltage at (a) the input, (b) the load, (c) 8 m from the input, and (d) 4 m from the load. Hint: Find an expression for $V_S(z)$.

3) A lossless transmission line ($Z_0 = 75\ \Omega$, $u = 2.2 \times 10^8$ m/s) of some length l is terminated with a load $Z_L = 40 - j40\,\Omega$. Find (a) the load reflection coefficient Γ_L, (b) the standing wave ratio S, (c) the minimum input impedance $Z_{\min}$ along the transmission line and the nearest location from the load (in terms of λ), and (d) the maximum input impedance $Z_{\max}$ along the transmission line and the nearest location from the load (in terms of λ). Hint: Reflection coefficient.

4) A lossless transmission line ($Z_0 = 50\ \Omega$, $u = 2.5 \times 10^8$ m/s) of some length l is terminated with an unknown load Z_L. An input impedance $Z_{in} = 110 + j60\,\Omega$ is measured. It is connected to a generator with $V_g = 36\angle 0°$ V and $Z_g = 60\,\Omega$ operating at 860 MHz. Draw the transmission line circuit. Then, determine (a) the phase constant β & wavelength λ for the transmission line, (b) the phasor current I_0 & voltage V_0 at the input, (c) the input reflection coefficient Γ_{in}, (d) the phasor forward V_0^+ & backward V_0^- voltage waves, (e) the equations for the phasor current $I_s(z)$ & voltage $V_s(z)$ along the transmission line, and (f) the time-domain equations for the current $I(z,t)$ & voltage $V(z,t)$ along the transmission line.

5) For the previous problem, if l = 80 cm, determine: (a) the electrical length of the transmission line βl in degrees, radians & wavelengths, (b) the load reflection coefficient Γ_L, (c) the standing wave ratio S, (d) the load impedance Z_L, (e) the phasor load voltage V_L & current I_L, and (f) the power P_L delivered to the load.

6) A CATV engineer needs a capacitive reactance of $-j60\,\Omega$ at a frequency of 860 MHz for a matching network. The engineer is required to use stubs made from lossless 75 Ω coax with a phase velocity of $u = 2.5 \times 10^8$ m/s. Find the length of the shortest realizable stubs with (a) open-circuit and (b) short-circuit terminations and sketch equivalent circuits for the resulting stubs.

Note: Express all phasor quantities, e.g. currents, voltages, and reflection coefficients in polar/phasor format w/ angles in degrees (e.g. $10\angle 30°\,\text{V}$ or $0.64\angle -20°$). Express impedances in rectangular format (e.g., $Z_L = 10 + j30\,\Omega$).

Due Wednesday, September 12, 2018.