Homework 2
EE381-1 Electric & Magnetic Fields (Fall 2017)
Wednesday, September 6, 2017

1) 11.28 In part a), find both Γ_L and Γ_{in}. Hint: Remember $\beta = 2\pi/\lambda$.

2) 11.29 Note that generator voltage is in RMS. Before parts b)-d), find V (i.e., the general phasor voltage $V_S(z)$ leaving as RMS. [Hint: Calculate V_0^+ & V_0^-.]

3) 11.39 Solve this problem analytically, don't use Smith chart.

4) A lossless transmission line ($Z_0 = 50\ \Omega$, $u = 2.4 \times 10^8$ m/s) of some length l is terminated with an unknown load Z_L. Using a vector network analyzer (VNA), an input impedance $Z_{in} = 60 - j40\ \Omega$ is measured. The transmission line is then connected to a generator with a voltage $v_g(t) = 18\cos(\omega t)$ V and impedance $Z_g = 52\ \Omega$ operating at 2.4 GHz. 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 $l = 26$ 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 microwave engineer needs an inductive reactance of $j40\ \Omega$ at a frequency of 2.4 GHz for a filter. The engineer is required to use stubs made from 50 Ω microstrip with a phase velocity of $u = 2.2 \times 10^8$ m/s to achieve this goal. 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 and voltages, and reflection coefficients in the polar/phasor format with angles in degrees (e.g. $10\angle 30°\,\text{V}$, $12\angle 140°\,\text{mA}$, $0.64\angle -20°$). Express impedances in rectangular format (e.g., $Z_L = 10 + j30\Omega$).

Due Wednesday, September 13, 2017.