Homework 2
EE 381 Electric & Magnetic Fields (Fall 2026)
Wednesday, September 9, 2026

1) 11.40 Solve this problem analytically, don't use Smith chart. Hint: $\beta = 2\pi/\lambda$.

2) 11.46 First, find Γ_L, SWR, $R_{\min}$, and $R_{\max}$. Solve this problem analytically, don't use Smith chart. [Hints: The desired answer is the shortest length required to arrive at either $R_{\min}$ or $R_{\max}$. Calculate input reflection coefficients associated with these resistances. Use equation relating Γ_{in} and Γ_L.]

3) A lossless transmission line (Z_0 = 75 Ω, $u = 2.4 \times 10^8$ m/s) of some length ℓ is terminated with an unknown load Z_L. Using a vector network analyzer (VNA), an input reflection coefficient $\Gamma_{in} = 0.6\angle 30°$ is measured. The transmission line is connected to a generator operating at 400 MHz with voltage $v_g(t) = 32\cos(\omega t)$ V and 50 Ω impedance. Draw the transmission line circuit. For this transmission line, calculate: a) the phase constant β & wavelength λ, b) input impedance Z_{in}, c) the total input phasor current I_0 & voltage V_0, and d) the time-average power input to the transmission line.

4) For the previous problem, if ℓ = 110 cm, determine: a) the phasor forward V_0^+ & backward V_0^- voltage wave coefficients, b) equations for the phasor current $I_s(z)$ & voltage $V_s(z)$, c) equations for the time-domain current $I(z,t)$ & voltage $V(z,t)$, d) the phasor load current I_L & voltage V_L, and e) the time-average power P_L delivered to the load.

5) For the previous problems, find: a) the electrical length of the transmission line $\beta\ell$ in degrees & radians, b) the length of the transmission line in wavelengths, c) SWR, d) the load reflection coefficient Γ_L, and e) the load impedance Z_L.

6) For a matching network, a radar engineer needs a capacitive reactance of $-j40$ Ω at a frequency of 4 GHz. To achieve this goal, they are required to use stubs made from 50 Ω coaxial transmission line with a phase velocity of 2.5×10^8 m/s. To allow connectors to be attached, the stubs must have a minimum length of 2 cm. Find the length of the shortest possible stubs with (a) open-circuit and (b) short-circuit terminations and sketch the resulting equivalent circuits.

Due Monday, September 14, 2026.

Note: Express phasor quantities (e.g., currents and voltages) and reflection coefficients in polar/phasor format with angles in degrees (e.g., $6\angle 60°$ V, $3\angle 30°$ mA, & $0.2\angle -20°$). Express impedances in rectangular format (e.g., $Z = 10 - j40\,\Omega$).