1. Two microstrip lines are fabricated end-to-end on a 2mm-thick wafer of lithium niobate ($\epsilon_r' = 4.8$). Line 1 has a width of 4mm; Line 2 (due to fabrication error) has a width of 5mm. Determine the power loss in dB for waves transmitted through the junction.

2. Find R, L, C, and G for a coaxial cable with

$$\text{inner radius} \quad a = 0.25mm, \quad \text{Shield inner radius} \quad b = 2.50mm, \quad \text{Outer radius} \quad c = 3.30mm,$$

$$\epsilon_r = 2.0, \quad \mu_r = 1, \sigma_c = 1.0 \times 10^7 \text{ S/m}, \quad \sigma = 1.0 \times 10^{-5} \text{ S/m}, \quad f = 300MHz.$$

3. A transmission line constructed from perfect conductors and an air dielectric is to have a maximum cross-section dimension of 8mm. The line is to be used at high frequencies. Specify the dimensions if it is
   (a) a two-wire line with $Z_0 = 300$,
   (b) a planar line with $Z_0 = 15$,
   (c) a 72 coax having a zero-thickness outer conductor.

   Note: Refer Transmission lines with arbitrary cross section (any reference textbook)

4. Each conductor of a two-wire transmission line has a radius of 0.5mm; their center-to-center separation is 0.8cm. Let $f = 150MHz$ and assume $\sigma = \sigma_c = 0$. Find the dielectric constant of the insulating medium if
   (a) $Z_0 = 300$,
   (b) $C = 20pF/m$,
   (c) $v_p = 2.6 \times 10^8$ m/s.

5. The parameters of a certain transmission line operating at $\omega = 6 \times 10^8$ rad/s are

$$L = 0.350\ \mu\text{H/m}, \quad C = 40\ \text{pF/m}, \quad G = 0, \quad R = 15.0\ \Omega/\text{m}.$$

   Find the attenuation constant α, the phase constant β, the wavelength λ, and the characteristic impedance Z_0.

6. A 50 lossless line of length 0.4λ is operated at 300MHz. A load $Z_L = 40 + j30\ \Omega$ is connected at $z = 0$, and the Thevenin-equivalent source at $z = -l$ is $12\angle 0°$ V in series with $Z_{\text{Th}} = 50\ \Omega$. Find:
   (a) the reflection coefficient Γ,
   (b) the standing-wave ratio s,
   (c) the input impedance Z_{in}.

7. Let $Z_L = 100 + j150\ \Omega$ and $Z_0 = 100\ \Omega$. Find the shortest length d_1 of a short-circuited stub and the shortest distance d that it may be located from the load to provide a perfect match on the main line to the left of the stub. Repeat for an open-circuited stub. Express all answers in wavelengths. (Refer Reading assignment: Smith chart)

8. Two lossless transmission lines having different characteristic impedances are to be joined end-to-end. The impedances are $Z_{01} = 100\ \Omega$ and $Z_{03} = 25\ \Omega$. The operating frequency is 1GHz.
   (a) Find the required characteristic impedance Z_{02} of a quarter-wave section that will impedance-match the joint.
   (b) The capacitance per unit length of the intermediate line is 100pF/m. Find the shortest length in meters of this line that satisfies the matching condition.
   (c) The frequency is now doubled to 2GHz. Find the input impedance at the line-1–line-2 junction, seen by waves incident from line 1.
   (d) Under these conditions, evaluate the standing-wave ratio measured in line 1 and the fraction of incident power reflected back to the input.

9. A voltage pulse propagates within a lossless transmission line of characteristic impedance $Z_0 = 50\ \Omega$. The pulse is Gaussian in shape, with voltage envelope

$$V(t) = V_0 e^{-t^2/(2T^2)}$$

where $V_0 = 10V$ and $T = 20ns$. The pulse is incident on a 100 load at the far end of the line. Determine the energy in joules that is dissipated by the load.

10. In the transmission line as shown in figure, $Z_0 = 50\ \Omega$, and $R_L = R_s = 25\ \Omega$. The switch is closed at $t = 0$ and is opened again at time $t = l/(4v)$, thus creating a rectangular voltage pulse in the line. Construct an appropriate voltage reflection diagram for this case and use it to make a plot of the voltage at the load resistor as a function of time for $0 < t < 8l/v$ (note that the effect of opening the switch is to initiate a second voltage wave, whose value is such that it leaves a net current of zero in its wake).