Indian Institute of Information Technology, Kalyani

Dept. of Electronics and Communications

RF And Microwave Engineering

Laboratory Assignments

Timing: 02:00 to 05:00 PM   Autumn 2024, 7th Semester   Max marks: 40

Softwares Allowed: Scilab/MATLAB

1. (a) Determine the input impedance, reflection coefficient, and VSWR of a lossless transmission line for a given characteristic impedance, load impedance, phase constant and length.

   (b) Plot the normalized input impedance of a lossless transmission line terminated with a short-circuit and open-circuit.

2. (a) Determine the impedance and length (in cm) at the operating frequency f0 of the single-section quarter-wave transformer to match a real load ZL to a lossless transmission line with a characteristic impedance Z0.

   (b) Plot the magnitude of the reflection coefficient versus normalized frequency f/f0 for a single-section quarter-wave transformer where f/f0 varies from 0 to 4.

   (c) Plot the magnitude of the reflection coefficient versus electrical length l for a single-section quarter-wave transformer where l varies from 0 to .

   (d) Plot the magnitude of the reflection coefficient versus normalized frequency f/f0 for a single-section quarter-wave transformer for ZL/Z0 = 2, 5, and 10 where f/f0 varies from 0 to 2.

   (e) Determine the percent fractional bandwidth of a single-section quarter-wave transformer network where the maximum acceptable SWR is Sm.

3. (a) An L-section impedance matching network is inserted between a transmission line with a characteristic impedance Z0 and a load impedance ZL = RL + jXL. The frequency of operation is f0. Determine the values of the lumped elements L and C. Note that there are two possible solutions.

(b) A short-circuited single-stub impedance matching network is inserted between a transmission line with a characteristic impedance Z0 and a load impedance ZL = RL + jXL (RL Z0). Determine the stub distance d from the load and the stub length l. Note that there are two possible solutions.

4. (a) Determine the ABCD-matrix of the T-network. Determine if the network is a reciprocal and symmetrical network.

   (b) Write a MATLAB program to determine the ABCD-matrix of the -network. Determine if the network is a reciprocal and symmetrical network.

   (c) Determine the S-matrix of the T-network. The network is matched with a characteristic impedance of Z0 = 50 .

   (d) The S-matrix of a three-port network is given below. Determine if the network is a reciprocal and lossless network. Determine the return loss (RL) at port 1 when all other ports are terminated with matched loads, and the insertion loss (IL) between port 2 and port 3 when all other ports are terminated with matched loads.

5. (a) Write a MATLAB program to determine the cutoff frequency fc and phase constant of the TEmn/TMmn mode of a rectangular waveguide having dimensions a and b (a ¿ b) along x- and y- axis, respectively. The waveguide is filled with a medium with permeability and permittivity .

   (b) Write a MATLAB program to plot the wave impedance of the TEmn and TMmn modes versus normalized frequency f/fc for a rectangular waveguide having dimensions a and b (a ¿ b) along x- and y-axis, respectively, where f/fc varies from 0 to 2. The waveguide is filled with air medium.

Best wishes