CRL711- CAD OF RF AND MICROWAVE CIRCUITS

Major Test **Marks 40** **Time: 2 Hr**

Q1. A $100\,\Omega$ characteristic impedance line with a $100\,\Omega$ load is to be matched to a $50\,\Omega$ line using sections of $20\,\Omega$ and $110\,\Omega$ lines as shown in Figure 1. Using Smith chart, determine the lengths ℓ_1 and ℓ_2 as fractions of a wavelength.

(8 Marks)

Q2. From the first principle, derive scattering matrix of the circuit shown in Figure 2 in a $50\,\Omega$ system.

(6 marks)

Q3. Two identical 90^0 branch line couplers with coupling =8.34 dB are connected as shown in Figure 3. Port 2 is terminated in a load Z_2=30+j30 Ω and Port 3 is terminated in a load Z_3=70-j30 Ω. Find the resulting phase and amplitude of signal emerging out at port 4. The system impedance is 50 ohms.

(8marks)

Q4. For a single parallel-coupled line section, the voltages at coupled port 3 and the through port 2 are given by the following expressions:

$$\frac{V_3}{V_1} = \frac{jC\tan\theta}{\sqrt{1-C^2}+j\tan\theta};\frac{V_2}{V_1} = \frac{\sqrt{1-C^2}}{\sqrt{1-C^2}\cos\theta + j\sin\theta}$$

Design a three-section 30-dB coupler with a binomial (maximally flat) response, a system impedance of 60 ohms at a centre frequency of 2 GHz. Realize the coupler in stripline having ground plane spacing of 2 mm and dielectric constant of the substrate=2.22. Use attached nomogram to draw the layout.

(12 marks)

Q5. Two identical 10 dB backward wave (Parallel-coupled) directional couplers are connected back-to-back to sample incident and reflected power in a system. The sampled reflected power level is found to be 10 dB below the sampled incident power. Draw a schematic showing arrangement of the two couplers. If the power incident from the source into the first coupler is 1 milliwatt, what is the power reflected from the load getting into the second coupler.

(6 marks)

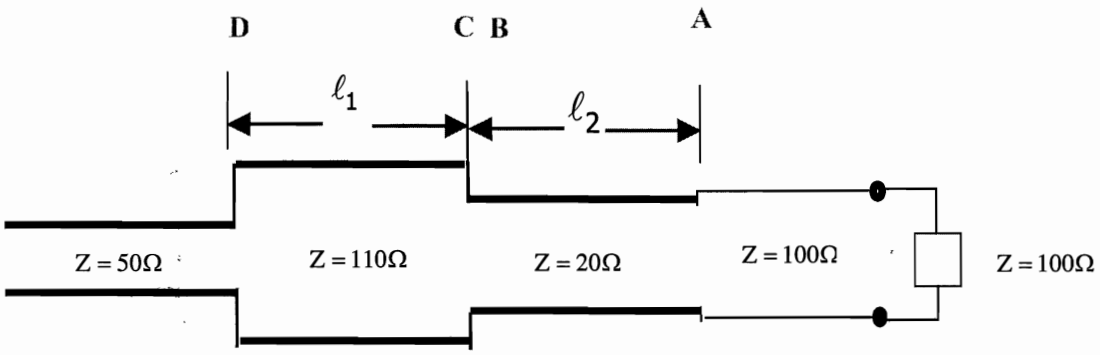

Figure 1

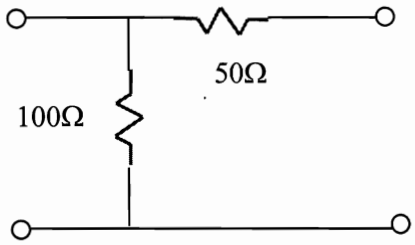

Figure 2

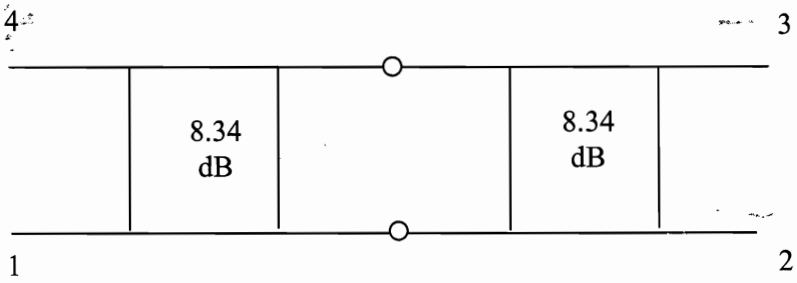

Figure 3