CRL 712 RF and Microwave Active Circuits

Minor Exam-I (Time 2.00 hrs) 15th March 2021

Note: Solve all questions Max Marks: 30

Q1. With the help of a neat diagram, explain the working principle of a non-reciprocal ferrite phase shifter.

[Marks 5]

Q2. A p-i-n diode chip is mounted across a 50-ohm microstrip line in shunt configuration. The frequency is 10 GHz, and the diode parameters are: C_j=0.1pF, R_f=0.9 ohms, R_r=2.2 ohms, L_p=C_p=0. Find the value of inductance placed across the diode to minimize the insertion loss for the ON-state of the switch. Calculate the resulting isolation and the insertion loss of the switch.

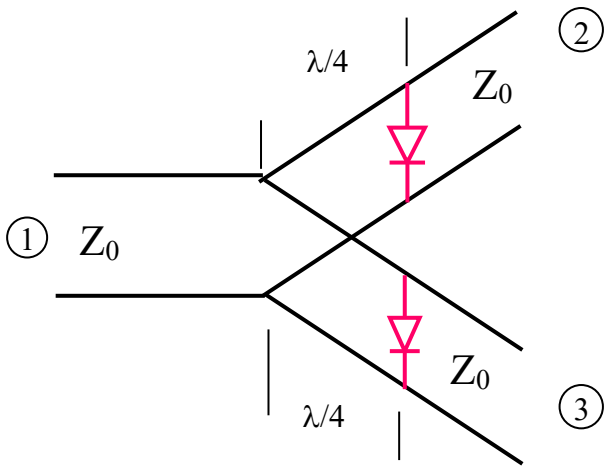
[Marks 4,2,2]

Q3. Consider a SPDT switch with identical p-i-n diodes shown below. The forward and reverse bias impedances of the diode are, $Z_f = 0.6\Omega$ and $Z_r = -j500\Omega$, respectively. The characteristic impedance of all transmission lines is $Z_0 = 50\Omega$. Ports 2 and 3 are connected to matched power meters.

(a) Determine the input VSWR and return loss in dB (at port 1).

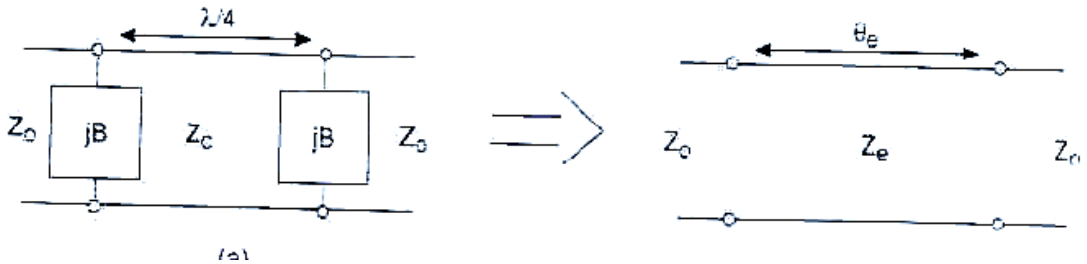
(b) Determine the insertion loss and isolation of the switch.

[Marks 5,2,2]



Q4. Consider a loaded line phase shifter shown below. Derive expressions for Z_e and θ_e of an equivalent transmission line in terms of normalized susceptance b.

[Marks 8]



ABCD to S-Parameter Conversion Formulas

$$S_{11} = \frac{1}{\Delta}\left(A + BY_0 - CZ_0 - D\right),\ S_{12} = \frac{2}{\Delta}\left(AD - BC\right)$$

$$S_{21} = \frac{2}{\Delta},\ S_{22} = \frac{1}{\Delta}\left(-A + BY_0 - CZ_0 + D\right)$$

$$\Delta = \left(A + BY_0 + CZ_0 + D\right); Y_0 = 1/Z_0$$