

CRL712 Major

May 2, 2008
Time 2 hrs.

Marks : 4+4+4+5+6+6+6+5 = 40.

1. What is the **available** power gain of a lossless quarter-wave transmission line with $Z_c = 100\Omega$, in a reference (source and load) of 50Ω ? (G_a = power available to load / power available from source).
2. What are the centres and radii of the load and source stability circles for a 2-port which consists of a shunt -100Ω resistor ? Reference is 50Ω .
3. What are the advantages and disadvantages of HEMTs as compared to HBTs for microwave applications ?
4. The S-parameters of a device (including bias network) at 1 GHz are : $S_{11} = S_{22} = 0.5\angle 45^\circ$, and $S_{21} = 4$, $S_{12} = 0$. Design the input and output matching networks in microstrip (give electrical lengths). What are the S-parameter magnitudes of the complete amplifier including matching networks ? *Design for maximum gain.*
5. What should be the resistor values for a resistive-T 10dB attenuator designed for a 50 ohm system ?
6. A 1 GHz switch (operating with 50 ohm source and load) is designed with 2 series diodes, separated by a 50 ohm quarter-wave line. What will be the insertion loss for the diodes in OFF state, when they can be represented by 0.2pF capacitors ? Ignore bias lines.
7. A loaded line phase shifter (designed for 50-ohm input and output) uses a 100-ohm, quarter-wave line, loaded by shunt admittances at both ends. Suggest any value of this shunt admittance (jB , equal for both), which will result in $S_{11} = 0$.
8. Explain the operation of a 90° - coupler based phase shifter.

Formulas:

$$S_{11} = \frac{A + B/Z_0 - CZ_0 - D}{A + B/Z_0 + CZ_0 + D}$$
$$S_{12} = \frac{2(AD - BC)}{A + B/Z_0 + CZ_0 + D}$$
$$S_{21} = \frac{A + B/Z_0 + CZ_0 + D}{A + B/Z_0 + CZ_0 + D}$$
$$S_{22} = \frac{-A + B/Z_0 - CZ_0 + D}{A + B/Z_0 + CZ_0 + D}$$

The Complete Smith Chart

Black Magic Design

