Ref. No.: EX/PG/ETCE/T/111G/16/2017

Master of Electronics & Telecommunication Engineering
1st Semester Examination, 2017

Microwave and Millimeter Wave Circuits

Time: 3 hours Full Marks:100

Answer any FIVE questions.

1. a) Using ABCD parameters find the simplified value of (AD – BC) for a reciprocal 2-port network [6]

   b) Considering R = 1 Ohm, calculate ABCD and S-parameters at 1 GHz for the network shown in Figure 1. [14]

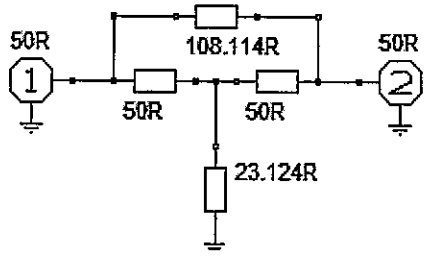

Figure 1.

2. a) Show that it is impossible to design a three-port network that is lossless, reciprocal and matched at all ports. With proper explanations write your opinion on possibility for designing "A three-port lossless and reciprocal network with two matched ports" [8+3]

   b) Comment on realizability of the following networks and explain their utility if realizable:
   i) three-port lossless and reciprocal network with a single matched port
   ii) three-port lossy network with all port matched
   iii) three-port lossless and non-reciprocal network with all matched ports [9]

3. a) Using a single 25 Ohm resistors construct a two way equal power divider circuit considering a 50 Ohm system. Calculate S-matrix for this power divider. Write your opinion regarding the effectiveness of this power divider. [10]

   b) Design a 4-way planar power divider/combiner using multiple quarter wavelength transformers and without using any crossover junctions. Find S-matrix for your design. [4+6]

4. a) Draw the geometry of a planar 3 dB branch line directional coupler and mark its different ports. Find out its S-parameters using even and odd mode analysis. Explain your result. [2+6+2]

b) Can you use branch line coupler as power divider/combiner? Explain with arguments. [4]

c) Why no power can be delivered to a 50 Ohm resistor connected at the isolated port of this branch line coupler, when input port is connected to a signal generator operating at the designed frequency? Can this coupler be used keeping its isolated port open circuited? [3+3]

5. a) Write design steps for a low pass filter with maximally flat response. Explain frequency scaling and impedance scaling. [8]

b) How can open or short circuited transmission line sections be used replace lumped inductor or capacitors of your low pass filter? Explain the principle of operation of a stepped impedance low pass filter. [4+4]

c) How can a thick transmission line section used in a stepped impedance low pass filter be modelled using open circuit stubs? [4]

6. Design a stepped impedance Chebyshev low pass microstrip filter using the following specifications:

i) Cut off frequency = 2 GHz
ii) 5^{th} order
iii) Pass band ripple = 0.1 dB
iv) Substrate relative dielectric constant = 4.4
v) Substrate height =1.6 mm
vi) Port impedances of 50 Ohm
vii) Lowest Line impedance = 10 Ohm
viii) Characteristic impedance = 50 Ohm
ix) Highest Line impedance = 120 Ohm

Sketch the layout of your design. [20]

7. a) Is it possible to design an impedance matching transformer using $3\lambda/4$ length transmission lines? Explain re-entrance. [3+3]

b) Sketch the layout of a four quarter-wave section microstrip impedance transformer with maximally flat response to match a 200 Ohm load to a 50 Ohm input line. Considering:
i) Frequency = 1 GHz
ii) Substrate relative constant = 4.4
iii) Substrate height = 1.6 mm [14]

8. Write short notes on (Any two) : [2x10]

a) Impedance matching with tapered line
b) Circulator, isolator and their applications in microwave
c) Ratrace
d) Kuroda identities

[END]