Ref. No.: Ex/PG/ETCE/T/111G/2018

M.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FIRST YEAR
FIRST SEMESTER EXAM 2018

MICROWAVE AND MILLIMETER WAVE CIRCUITS (MW)

Time: 3 hours | Full Marks:100

Answer any FOUR questions.

1. a) Considering R = 1 Ohm, calculate ABCD and S-parameters at 2 GHz for the network shown in Figure 1. Plot S-parameters vs. frequency for 1GHz -3GHz frequency band in dB scale. [10+2]

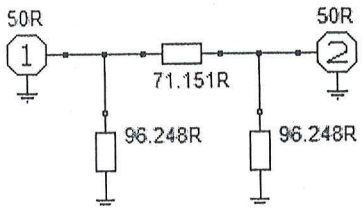

Figure 1

b) Considering R = 1 Ohm, calculate S-parameters at 100 MHz for the network shown in Figure 2. Design a two way equal power splitter using this network where all ports are of 50 Ohm for 100 MHz. [8+5]

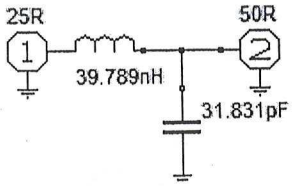

Figure 2

2. a) How will you design a two way unequal power divider with 1:3 output power ratio using microstrip configuration. Derive design equations. Is it possible to design a realizable microstrip power divider with arbitrary power division ratios? [5+10+2]

b) Design a 3dB two-way power divider with 50 Ohm input port and 75 Ohm output ports using transmission line sections. [8]

3. a) Show that it is impossible to design a three port network that is lossless, reciprocal and matched at all ports. Is it possible to design a non-reciprocal three port network that is lossless and matched at all ports? Answer with arguments. [6+2]

b) If -3dB branch-line couplers are cascaded using quarter wavelength transmission lines having characteristic impedance Z_0 as shown in Figure 3, then estimate S-parameters for the newly formed four port network. [12]

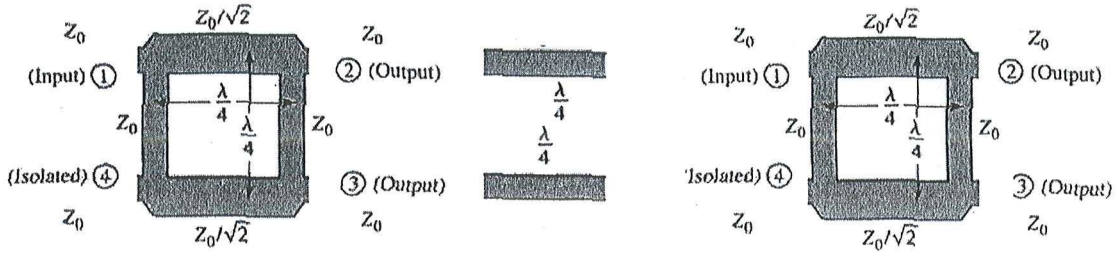

Figure 3

c) Is it possible to design a 0 dB branch line coupler using three branches. Write your answer with proper arguments. [5]

4. a) Design a 2-branch -6 dB quadrature hybrid coupler and find its s-parameters. Is it possible to design a realizable -20 dB branch line coupler? What types of couplers are suitable for -20 dB coupling? [Answer with proper arguments] [13+2+2]

b) How will you increase the bandwidth of a three way Wilkinson power combiner? Discuss considering all ports and isolations. [8]

5. a) Write design steps for a low pass filter with maximally flat response. Explain frequency scaling and impedance scaling. [6+4]

b) Design a 5^{th} order maximally flat low-pass filter with a cut-off frequency of $f_0 = 1.5$ GHz, impedance of 50 Ohm. Implement your design using a microstrip line with substrate relative dielectric constant of 4.4 and 1.6 mm substrate height. [8+2+5]

6. a) Write down the design steps of a quarter wavelength impedance matching transformer and calculate it's fractional bandwidth. [10]

b) Find the scattering parameters for the four-port Bagley polygon power divider shown in Figure 4. [15]

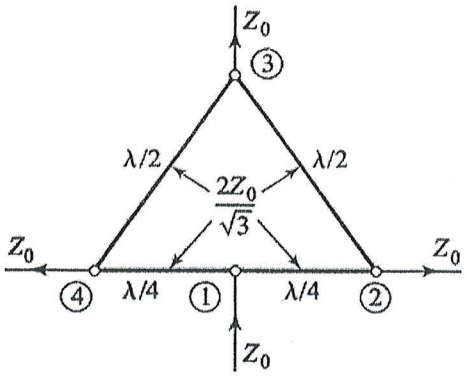

Figure 4

7. Write short notes on (Any five) [5x5]

a) Impedance matching with tapered line
b) Circulator, isolator and their applications in microwave
c) Lowpass to highpass, filter transformation and their implementation using microstrip
d) Richards' transformation for distributed elements
e) Kuroda identities
f) Even-odd mode analysis