Ref. No.: Ex/PG/ETCE/T/111G/2024

M.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FIRST YEAR
FIRST SEMESTER EXAM 2024

MICROWAVE AND MILLIMETER WAVE CIRCUITS (MW)

Time: 3 hours Full Marks:100

Answer any Five questions.

1. Design a two way power divider using lumped components at 1.5 GHz for a 50 Ohm system. How will you implement those lumped components using microstrip line sections considering FR4 substrate (substrate dielectric constant = 4.4 and substrate height = 1.6 mm)? Draw the layout of the power divider. [20]

2. a) Write design equations for multi-section impedance matching network for maximally flat response. [5]

   b) Design a five-section binomial transformer to match a 50 Ohm load to a 100 Ohm line at 1.5 GHz. How will you implement your design using microstrip line sections with substrate dielectric constant of 4.4 and height of 1.6 mm. [8+7]

3. Design a 4^{th}-order maximally flat low-pass filter for fabrication using microstrip lines. The design parameters are: cut-off frequency = 1.5 GHz, system impedance = 50 Ohm. Consider microstrip lines with substrate dielectric constant of 4.4 and height of 1.6 mm. [20]

4. a) How will you design a two way unequal power combiner with 1:2 output power ratio for 2 GHz using microstrip configuration. How will you implement your design using microstrip line sections with substrate dielectric constant of 4.4 and height of 1.6 mm. [20]

5. a) Show that it is impossible to design a three port network that is lossless, reciprocal and matched at all ports. [10]

   b) Design a 2-branch -6 dB quadrature hybrid coupler and find its s-parameters. [10]

6. a) Write design steps for a low pass filter with equal ripple. Explain frequency scaling and impedance scaling. [6+4]

   b) Explain Richard's transformation. [10]

7. a) Derive relation between S-parameters and Z-parameters. [10]

   b) If -3dB branch-line couplers are cascaded using quarter wavelength transmission lines having characteristic impedance Z_0 as shown in

Figure 1, then estimate S-parameters for the newly formed four port network. [10]

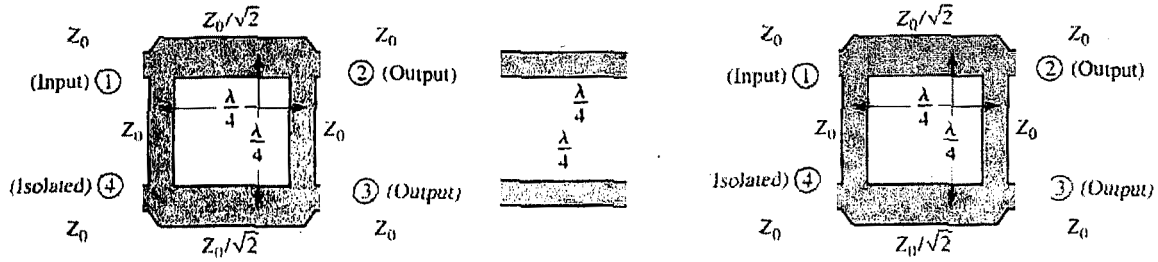

Figure 1

8. Write short notes on [10x2]

a) Impedance matching with tapered line
b) Circulator, isolator and their applications in microwave