EE 611 – 2019 Microwave Integrated Circuits

Course Project

Butler Matrix Design

1. **Problem Statement:**

   Design a Broadband 4X4 Butler Matrix Circuit Using Microstrip Transmission line at the frequency of operation 5.4 GHz. The design is to be fabricated on FR – 4 substrate with $\varepsilon_r = 4.4$, h = 1.6 mm, tan $\delta = 0.02$.

2. **Procedure:**

   a. Design the Butler Matrix using Ideal T-Lines
      i. Butler Matrix is a combination of 90˚ Hybrids and phase delay lines.
      ii. Design a 90˚ hybrid and verify its function.
      iii. Then take the proper combination of 90˚ hybrids and delay lines, design 4X4 Butler Matrix.

   b. Verify the same with the microstrip Transmission line
   c. Generate the corresponding layout
      i. After verifying the design, Using Generate layout function, generate the layout of the design.
      ii. Add some M-lines and curved paths, such that no line is overlapped in the layout.
      iii. Now assign ports to the layout and verify the results
      iv. If the results are good, then go for fabrication.

   d. Print the layout on Butter paper and give it in the PCB lab for fabrication.