Name:- Amith Deb Nath

Roll no.:- 1702009

Report Title:- Design and Simulation of Microstrip Transmission Line.

Objective:- The objective of the experiment is to design a 2.4GHz microstrip transmission line and to observe the performance of the line like reflection coefficient ,transmission coefficient and current distribution by simulating in ADS.

Structure of the Microstrip Transmission Line(place the figure and describe it):

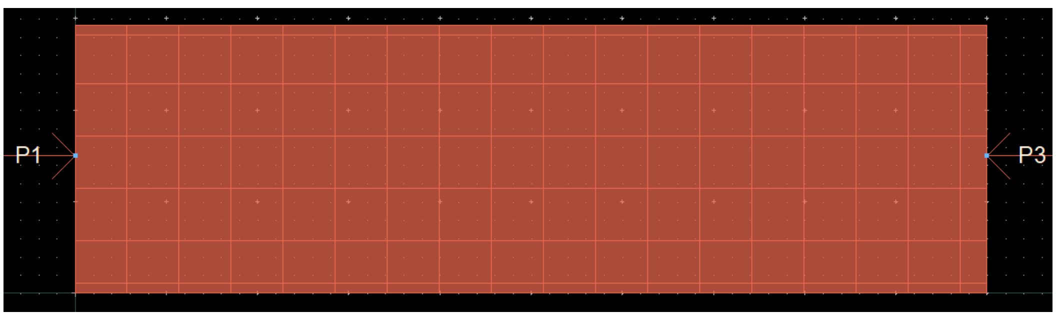
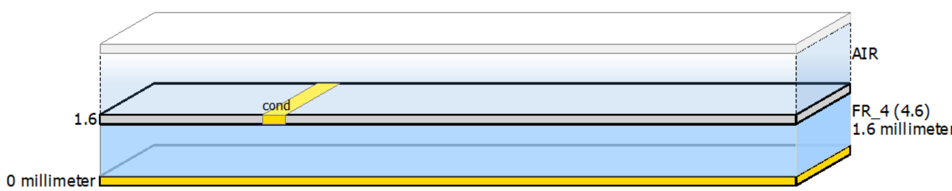


Fig.1.Layout of microstrip transmission line.



Substrate Layer Stackup

	Type	Name	Material	Thickness
	Dielectric		AIR	
1	Conductor La...	cond (1)	Copper	0.7 mil
	Dielectric		FR_4	1.6 mm
	Cover		Copper	0.7 mil

Substrate Vias

Type	Name	Top	Bottom	Material

Fig.2.Substrate under the microstrip transmission line.

Description:-here we used the width of the strip =2.93mm, this width is appeared as the height in the ADS layout. This width is calculated by Lincalc from ADS tools for Z0=50ohm and 2.4GHz frequency. And the length of the strip that we take is 10mm(randomly). In microstrip

Transmission line , this strip is mounted on the substrate. And in the bottom surface of the substrate,there is a ground plane.The substrate is designed by FR_4 material.It's thickness ,relative permittivity and TanD values are 1.6mm, 4.6, .001 respectively. 0.7 mil cu is used as a conductor. A copper sheet is used as a ground. Upon the line,there is air dielectric.

Results:

Reflection coefficient (Place S11 and S22 and describe it):-

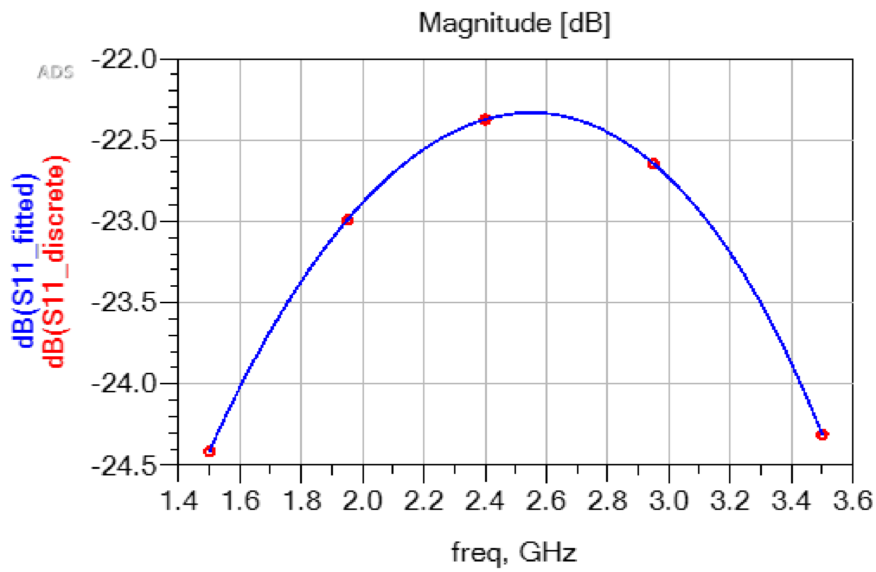


Fig.3. Reflection coefficient vs frequency (S11)(W=10mm,H=2.93mm)

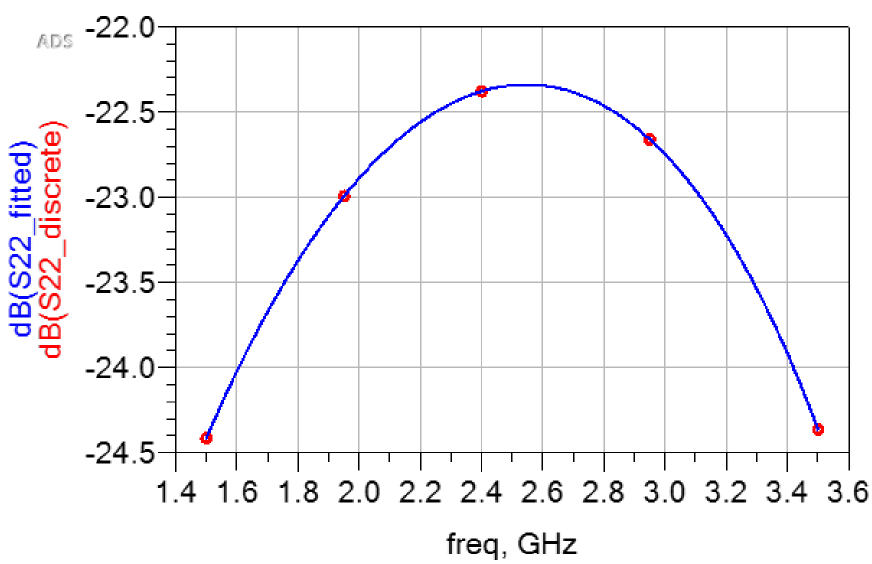


Fig.4. Reflection coefficient vs frequency (S22)(W=10mm,H=2.93mm)

Description :- From the reflection coefficient value we mainly see whether there is a impedance mismatching or not. Reflection coefficient is a parameter that describes how much of a wave is reflected by an impedance discontinuity in the transmission medium. It is equal to the ratio of the amplitude of the reflected wave to the incident wave. Here,in the figure, the reflection coefficient(magnitude) vs frequency graph(S11) is shown.the frequency range is 1.5 to 3.5 GHz. From the graph, we can see that for 2.4GHz the reflection coefficient is around -22.4 dB. For better performance the reflection coefficient should be -10dB or below of the -10dB. So, impedance is matched here.

Transmission coefficient (Place S21 and describe it)

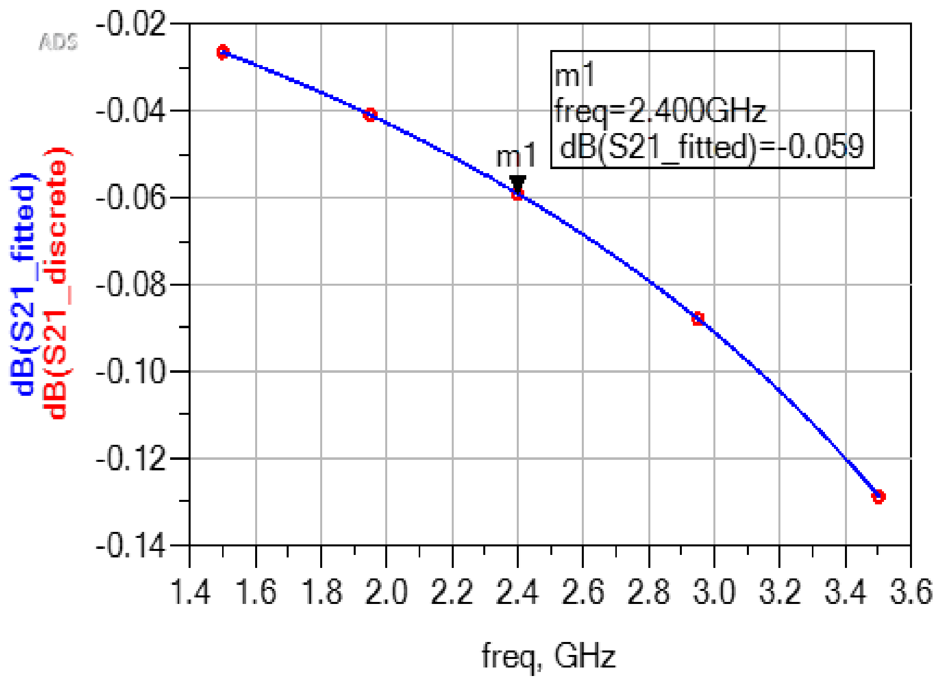


Fig.5. Transmission coefficient(Magnitude) vs frequency (W=10mm,H=2.93mm)

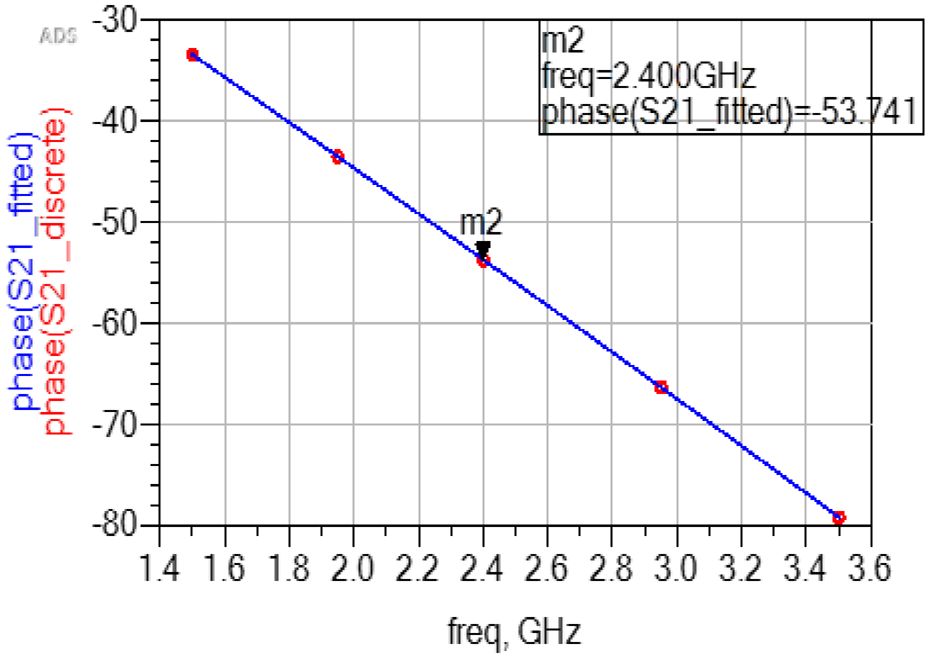


Fig.6. Transmission coefficient(Phase) vs frequency (W=10mm,H=2.93mm)

Description :- From the transmission coefficient value we mainly see whether 100% power is transmitting from pin 1 to pin 2 or not . Transmission coefficient is a parameter that describes how much of a wave is transmitted in the transmission medium. It is equal to the ratio of the amplitude of the transmitted wave to the incident wave. Here,in the figure, the transmission coefficient(magnitude and also phase) vs frequency graph(S11) is shown.the frequency range is 1.5 to 3.5 GHz. From the graph, we can see that for 2.4GHz the transmission coefficient is around -0.059 dB.It is near about 0dB and the value of transmission coefficient should be as near possible as 0 dB .So, we can tell that maximum power is transmitting from pin 1 to pin 2.

Current distribution:- [Place the figure and describe it] :-

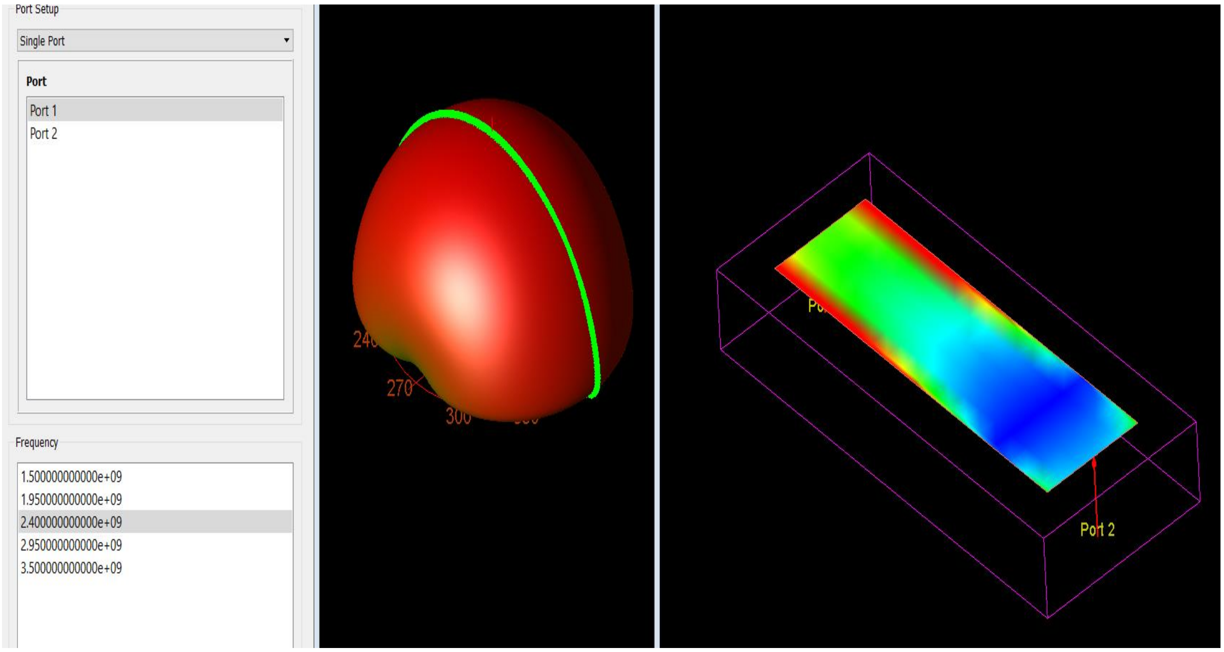


fig.7. Current distribution of the microstrip transmission line

Description:- From the current distribution, for 2.4GHz frequency, we can see that the wave is travelling from pin 1 to pin 2 and it is maximum at one point and another point it is minimum. So, it behaves like a sin wave and it can modeled by sin wave also. Another information we get from the current distribution is that if the wave is linearly polarized,whether it is vertical or horizontal. We simply enable the arrow keys and see the direction of current. We will understand whether it is vertical or horizontal.

Task:

1. Change the Width of the strip line for some lower and higher values from the Properties window:-[keep the Height fixed]. What change do you observe in the magnitude and phase of S21?

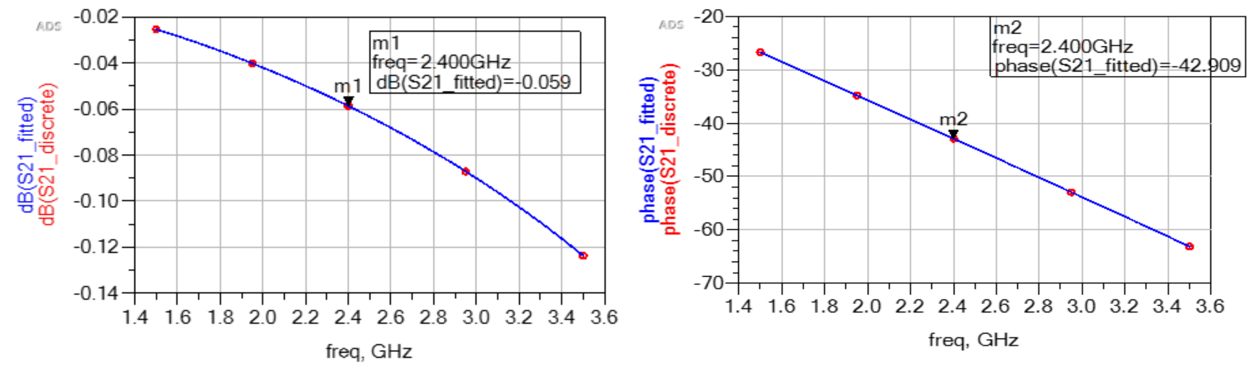


Fig.8. Transmission coefficient vs frequency (Magnitude and phase)(W=8mm,H=2.93mm)

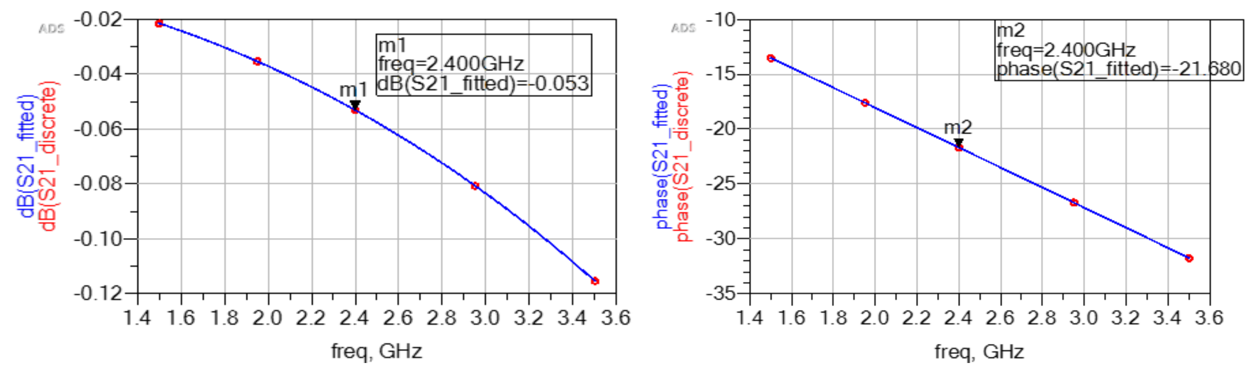


Fig.9. Transmission coefficient vs frequency (Magnitude and phase)(W=4mm,H=2.93mm)

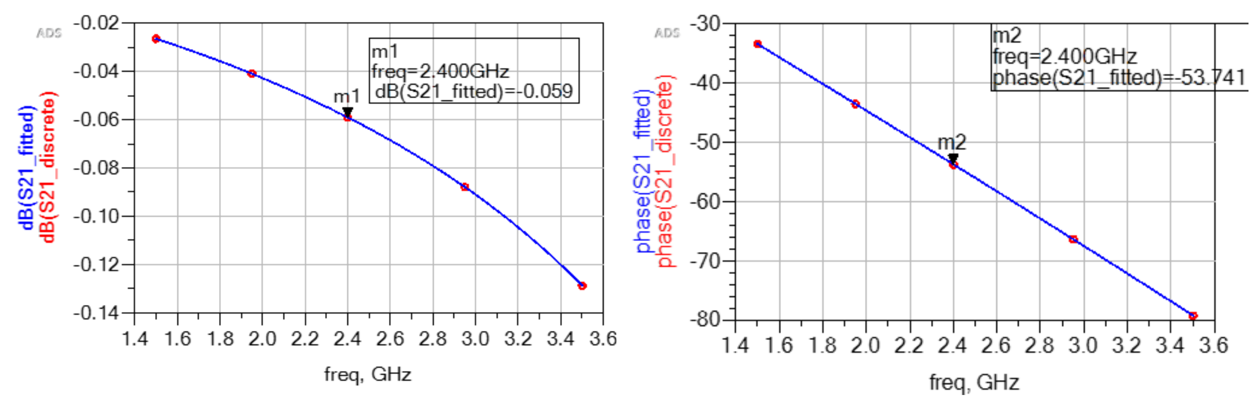


Fig.10.Transmission coefficient vs frequency (Magnitude and phase)(W=10mm,H=2.93mm)

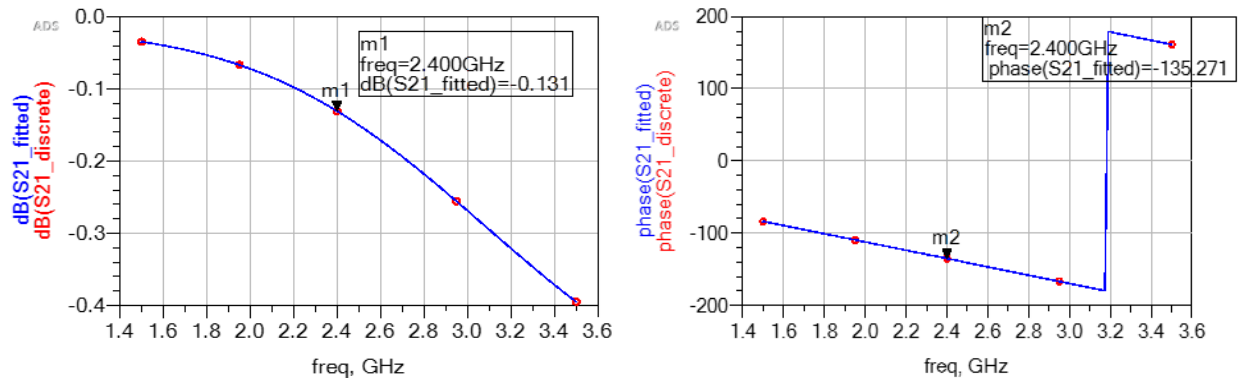


Fig.11.Transmissioncoefficient vs frequency(Magnitude and phase)(W=25mm,H=2.93mm)

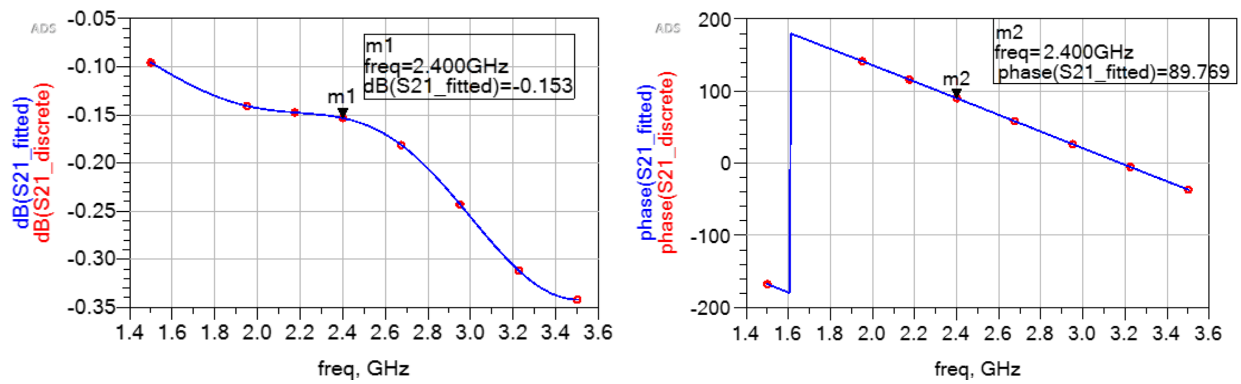


Fig.12.Transmission coefficient vs frequency(Magnitude and phase)(W=50mm,H=2.93mm)

Here, we fixed the height to 2.93mm, we varied the width. We take the width of 8mm,4mm,10mm,25mm,50mm. we get the values of S21 magnitude are -0.059dB,-0.053dB,- 0.059dB,-.131dB, -.153dB respectively we get the values of S21 phases are -42.909,-21.680,-53.741,-135.271, 89.769m respectively. So,there is no significant change of S21 magnitude when we vary the width but there is a significance change in phase.If we reduced the width, the phase approaches to 0 that is to resonant point.

2. Change the Height of the strip line for some lower and higher values from the Properties window
[keep the Width fixed]. What do you understand from this study?

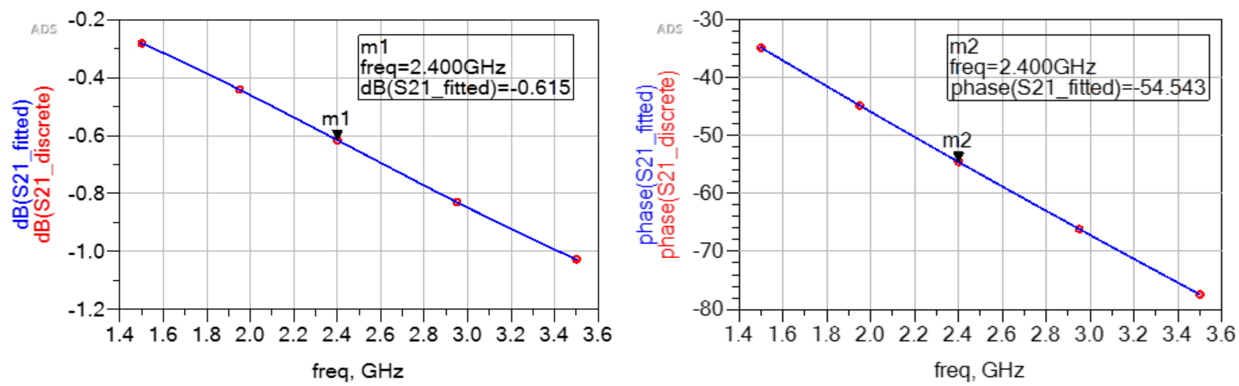


Fig.13. Transmission coefficient vs frequency (Magnitude and phase)(W=10mm,H=1mm)

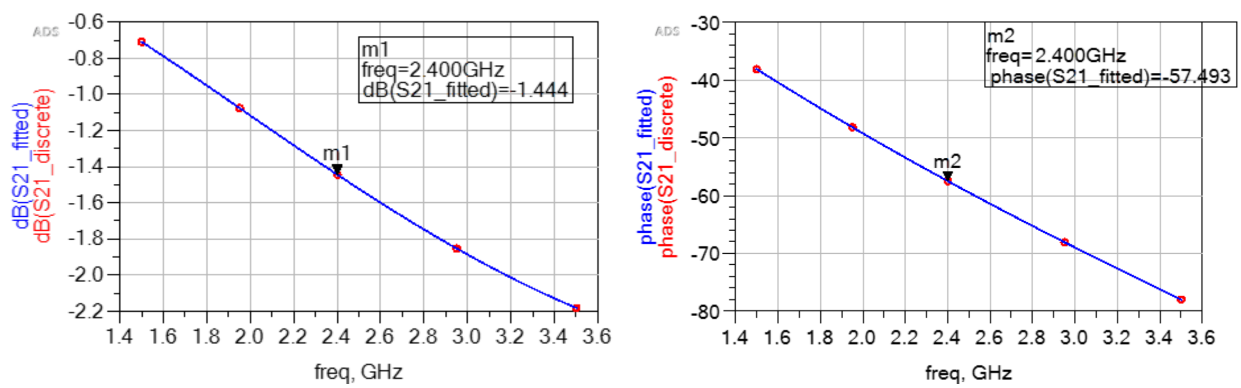


Fig.14. Transmission coefficient vs frequency (Magnitude and phase)(W=10mm,H=.5mm)

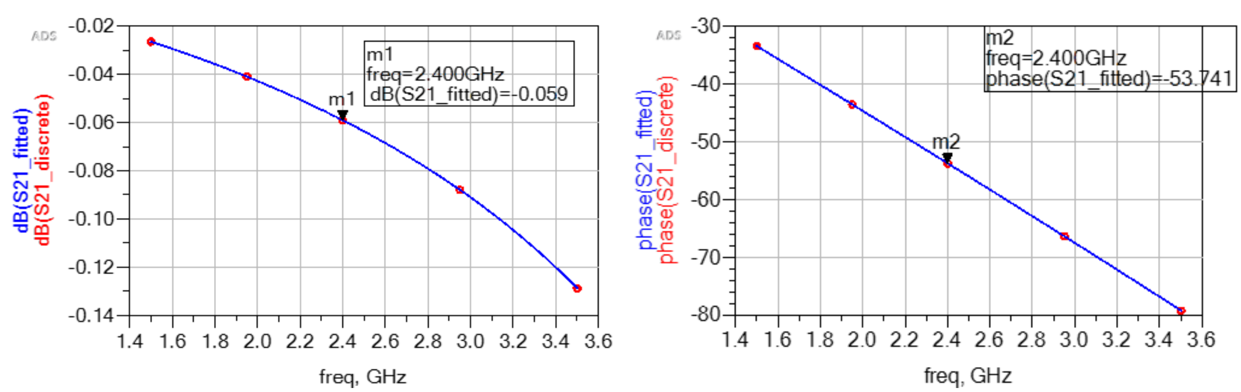


Fig.15.Transmission coefficient vs frequency(Magnitude and phase)(W=10mm,H=2.93mm)

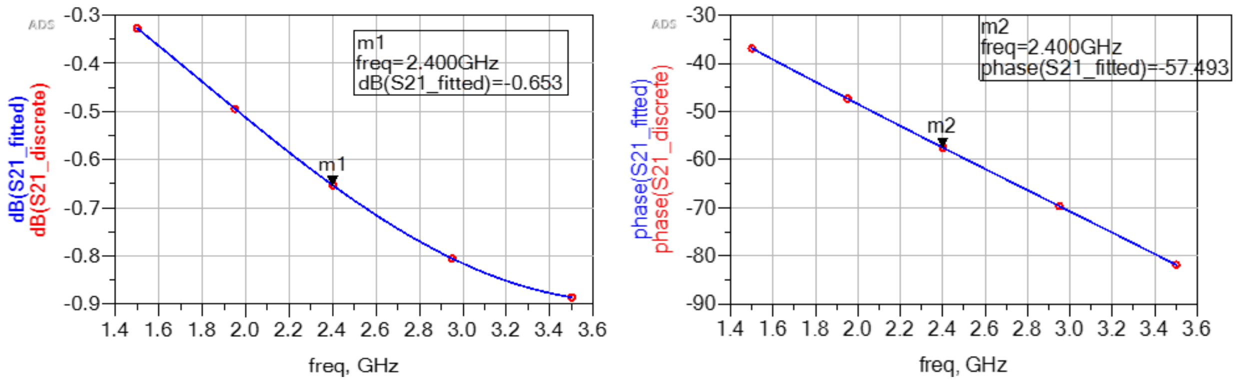


Fig.16. Transmission coefficient vs frequency (Magnitude and phase)(W=10mm,H=5mm)

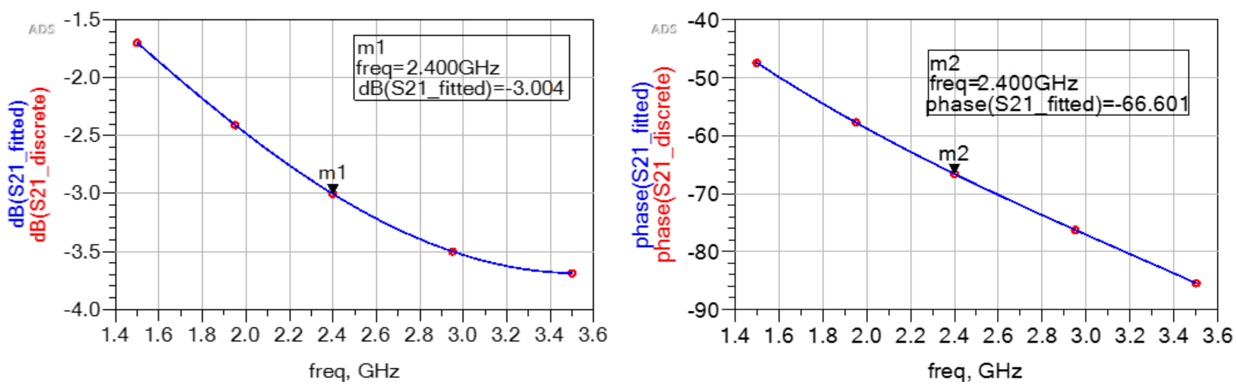


Fig.17.Transmission coefficient vs frequency (Magnitude and phase)(W=10mm,H=10mm)

Here, we fixed the width to 10mm, we varied the height. We take the height of 1mm,.5mm,2.93mm,5mm,10mm. we get the values of S21 magnitude are -0.615dB,-1.444dB,- 0.059dB,-.653dB, -3.004dB respectively we get the values of S21 phases are -54.543,-57.493,-53.741,-57.493,-66.601 respectively. So,there is no significant change of S21 phase when we vary the height(unless we vary more like 10mm case here) but there is a significance change in magnitude.If we reduced the height, the S21 magnitude approaches to 0dB that is to 100% power transmitting point.

3. Investigate the effect of pin impedances on the performances.

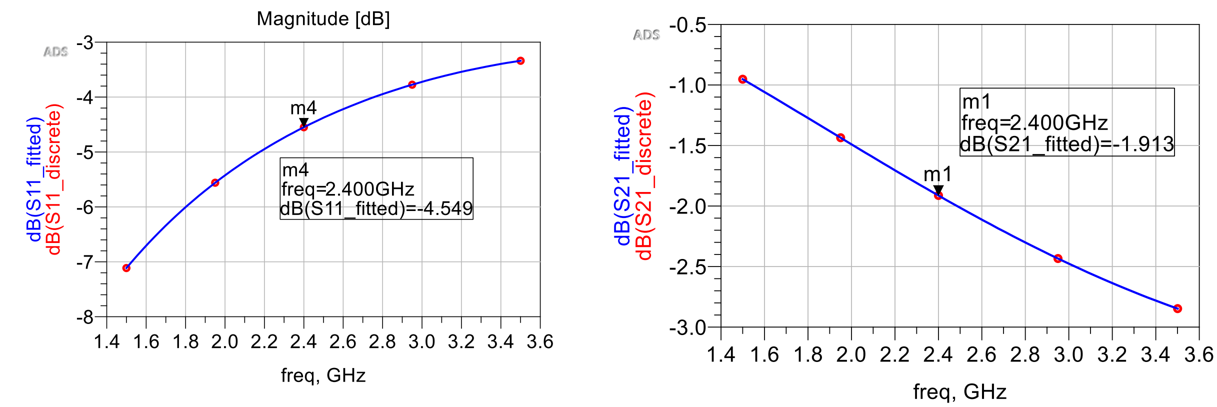


Fig.18. S11 and S21 (magnitude) when pin impedance is 20ohm.

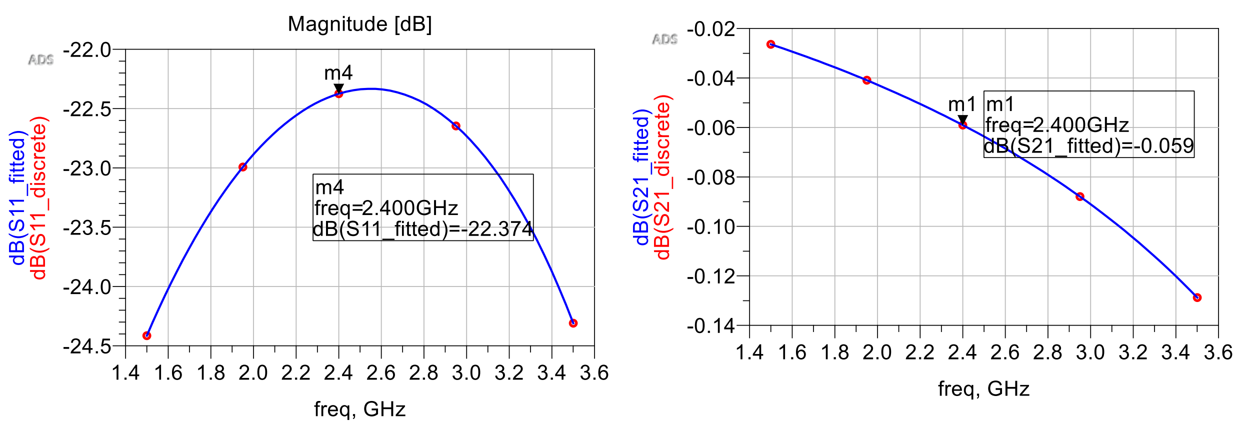


Fig.19. S11 and S21 (magnitude) when pin impedance is 50ohm.

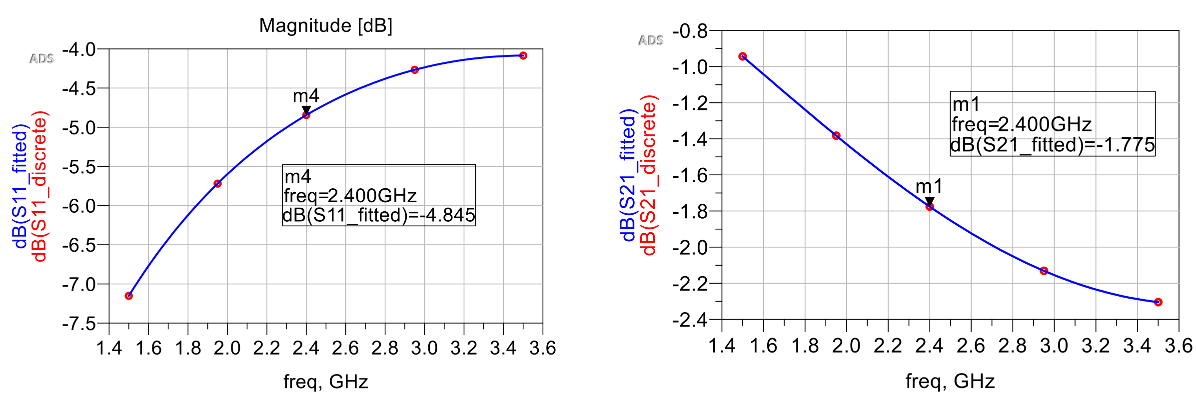


Fig.20. S11 and S21 (magnitude) when pin impedance is 100ohm.

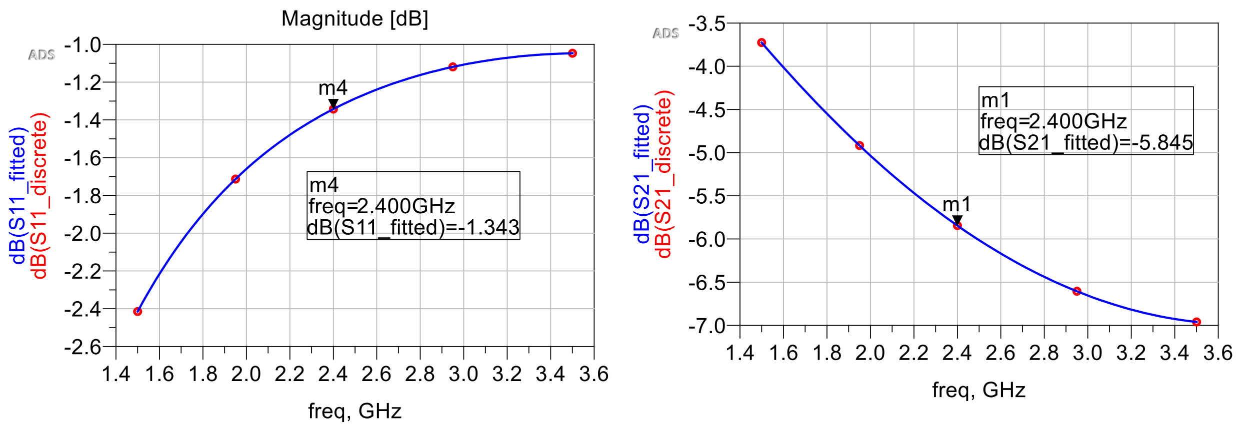


Fig.21. S11 and S21 (magnitude) when pin impedance is 200ohm.

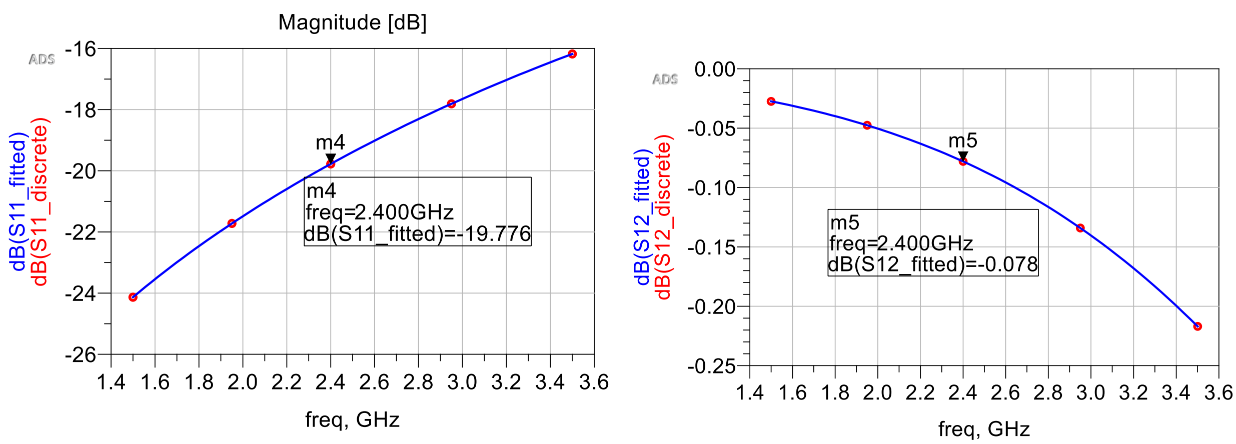


Fig.22. S11 and S21 (magnitude) when pin impedance is 40ohm.

Here, we varied the impedance of the 2 pin . we take the value of impedance of the 2 pin 20ohm,50ohm,100ohm,200ohm,40ohm. We get the magnitude of S11 values are -4.549dB, -22.374dB,-4.845dB,-1.343dB, -19.776dB respectively. So,we observed here that when we are more away from 50ohm ,S21 magnitude is above -10dB(approaces to 0dB) that is more impedance mismatching is happening.Because the characteristics impedance of the line is 50ohm.

4. Use your designed microstrip transmission line to feed the designed antenna for Lab-1.

i) What result do you get?

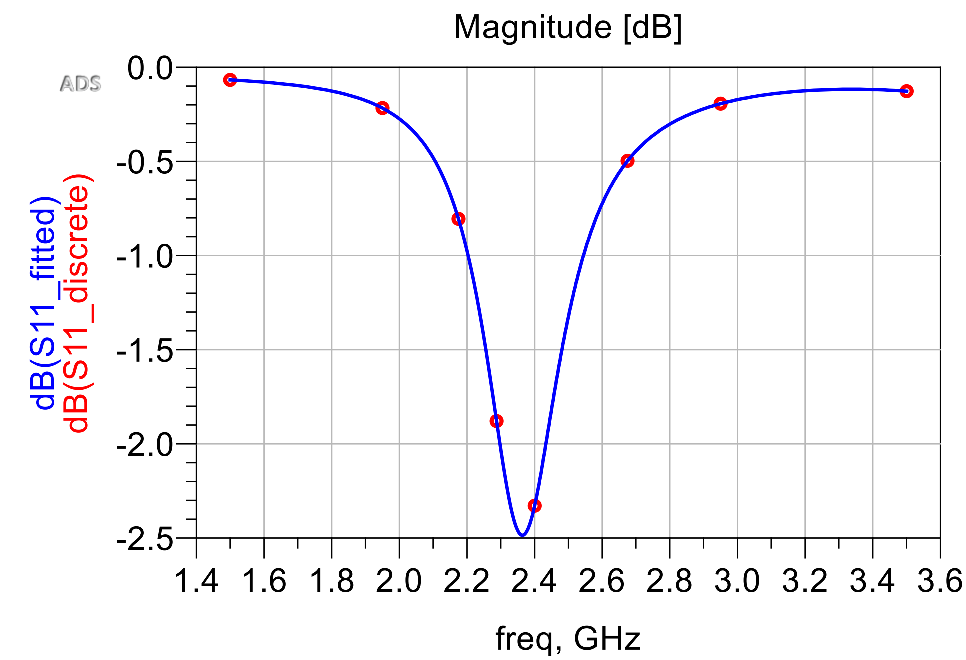


Fig.23.Reflection coefficient(magnitude) vs frequency

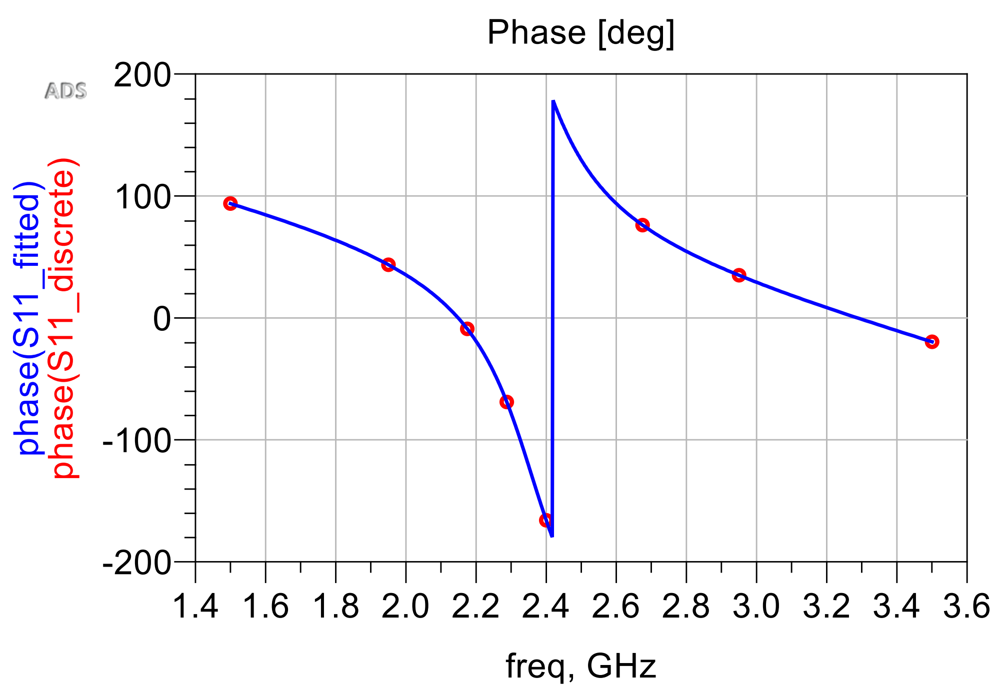


Fig.24.Reflection coefficient(phase) vs frequency

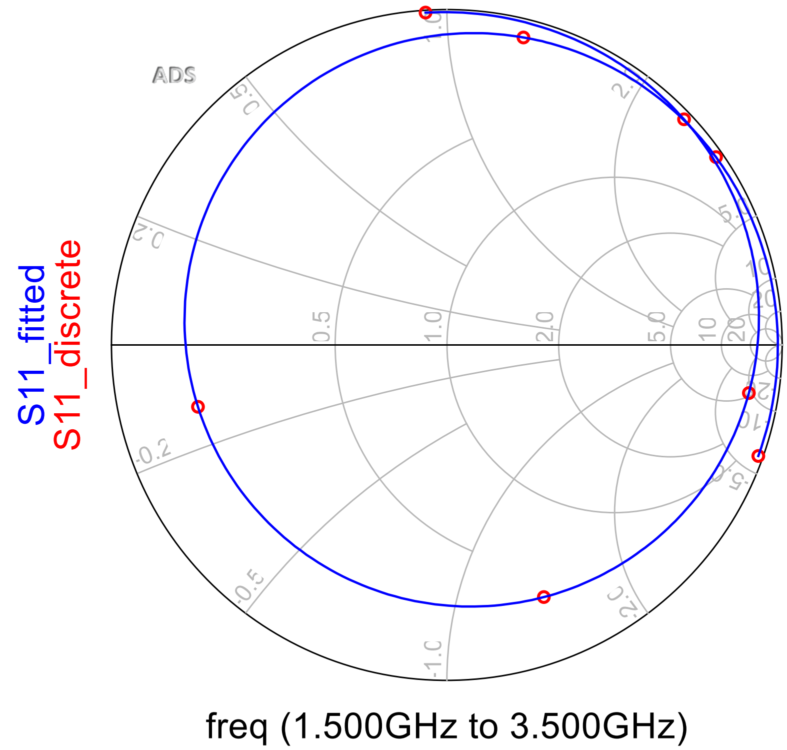


Fig.25.Smith Chart

From fig 23 , we see that at 2.4 GHz frequency, the magnitude of reflection coefficient is near about -2.4dB that is there is a greater impedance mismatching . Around 50% power is reflecting. So,in fig 25, the arc doesnot pass through s=1 /center in the smith chart. From fig 24,we can see that at 2.4 GHz , phase is 0 that is resonance is happening at this frequency.

ii) Explain the reason for finding such kind of results?

At the edge of the patch antenna ,the impedance is maximum.when we move upward to center of the patch ,impedance decreases and the impedance is minimum at the center of the patch antenna, and the impedance gradually increases after crossing the center and becomes maximum again at the opposite edge. The microstrip transmission line that we used for feeding purpose has an impedance value of 50 ohms.We connected the line at the edge of patch antenna. So, the microstrip line and patch antenna has a greater mismatch at the edge.therefore,we get such results of fig 23 and 25.

iii) If the result is not satisfactory in 3(i), how can you solve it?

The impedance of the microstrip transmission line is 50ohm. In the patch antenna ,at the edge , impedance is like 300ohm .when we moves toward the center at y direction, at one point between edge and center ,we will get the impedance of patch is 50ohm.At that point ,we have to connect the microstrip transmission line. So,it will be the feeding location. Therefore ,we have to use inset fed technique to do that.