ANTENNAS AND WAVE PROPAGATION

LAB ASSIGNMENT 1

EXPERIMENT 1

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AIM: Design a rectangular micro strip antenna to resonate at 2.4 GHz frequency.

Theory: An Antenna is a transducer, which converts electrical power into electromagnetic waves and vice versa.

An Antenna can be used either as a transmitting antenna or a receiving antenna. A transmitting antenna is one, which converts electrical signals into electromagnetic waves and radiates them. A receiving antenna is one, which converts electromagnetic waves from the received beam into electrical signals. In two-way communication, the same antenna can be used for both transmission and reception. Antennas are much more than simple devices connected to every radio. They're the transducers that convert the voltage from a transmitter into a radio signal. And they pick radio signals out of the air and convert them into a voltage for recovery in a receiver.

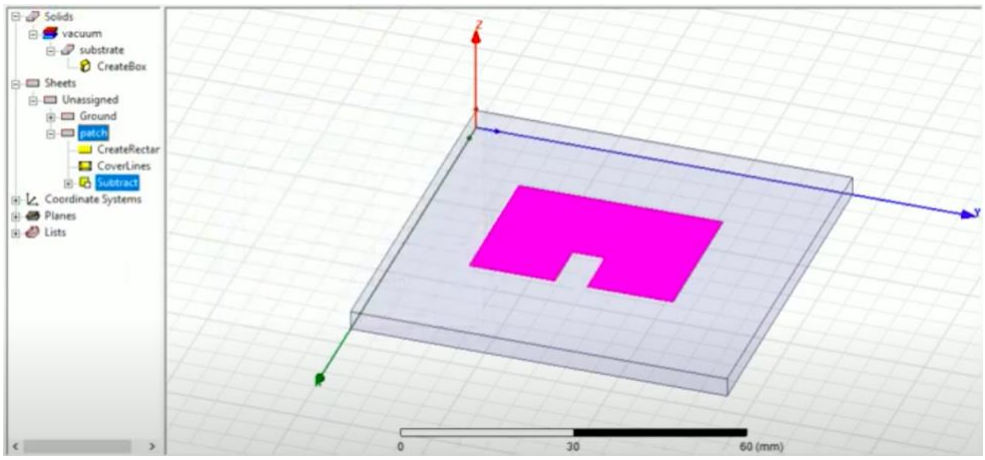
In this experiment we will be designing a patch microstrip Antenna which resonates at 2.4 GHz. A patch antenna is a type of antenna with a low profile, which can be mounted on a surface. It consists of a planar rectangular, circular, triangular, or any geometrical sheet or "patch" of metal, mounted over a larger sheet of metal called a ground plane. Micro strip antennas are low-profile antennas. A metal patch mounted at a ground level with a di-electric material in-between constitutes a Micro strip or Patch Antenna. These are very low size antennas having low radiation. Usually, the patch or micro-strip is chosen to be square, circular or rectangular in shape for the ease of analysis and fabrication.

Software Specifications:

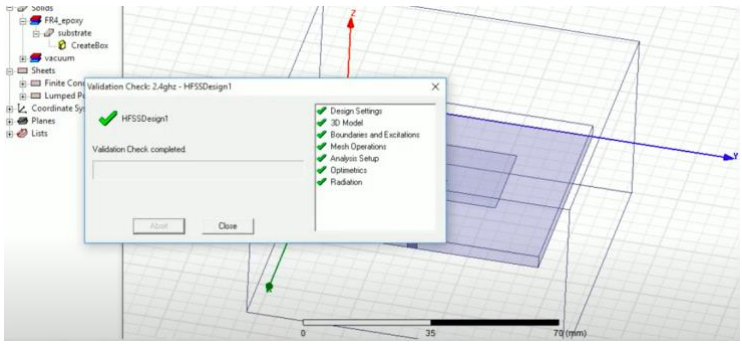
Operating System: Windows 10 Virtual Machine OS
Software: HFSS Version 13
KIT: Antenna Design Kit

Procedure:

1. Open the HFSS 13 and create a new file with the name of AWP_LAB_1.
2. Then in the new project file you will have. A white XY sheet having the XYZ Axis on it.
3. Then design a Rectangular Box around the XYZ axis. Name it ground.
4. Change the specifications and dimensions of the ground with your convenience.
5. Extend the Ground Rectangle box along the Z axis vertically.
6. Change the specifications and dimensions of the ground with your convenience.
7. Inside the Ground, design another rectangle and name it patch. Change the specifications and dimensions of the ground with your convenience.
8. Inside the patch strip design another rectangle and name it subtract. Change the specifications and dimensions of the ground with your convenience.
9. Then select the patch layer and subtract layer and subtract both of them. As shown below:

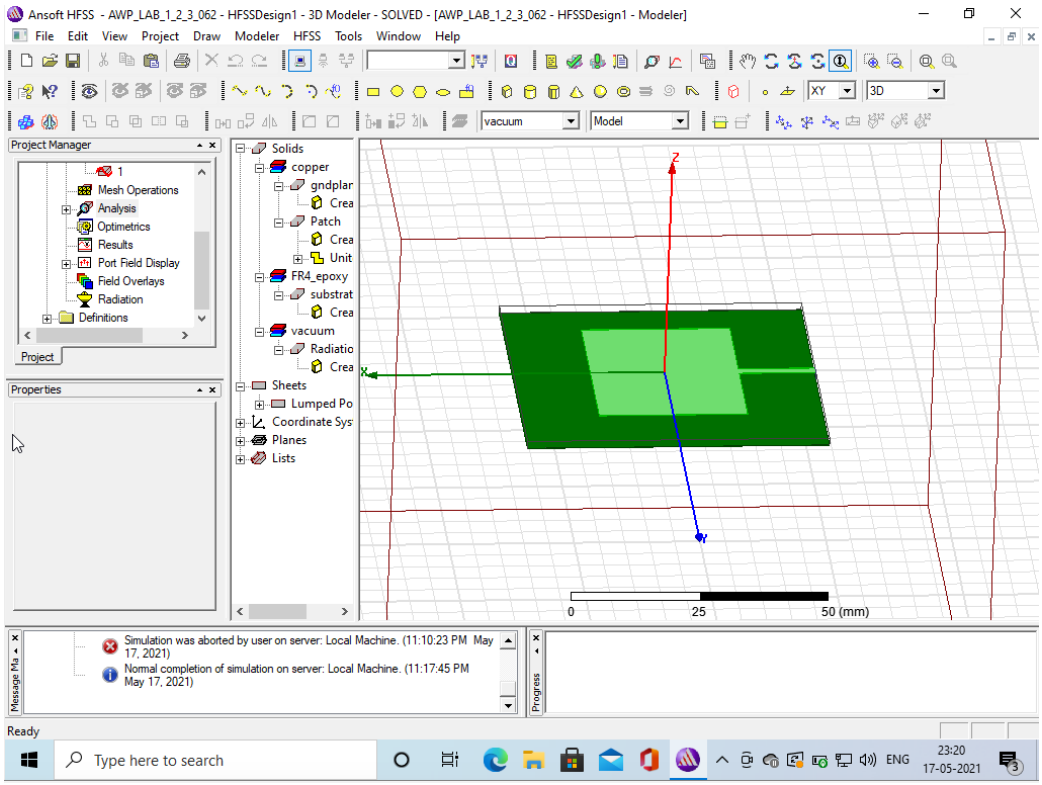


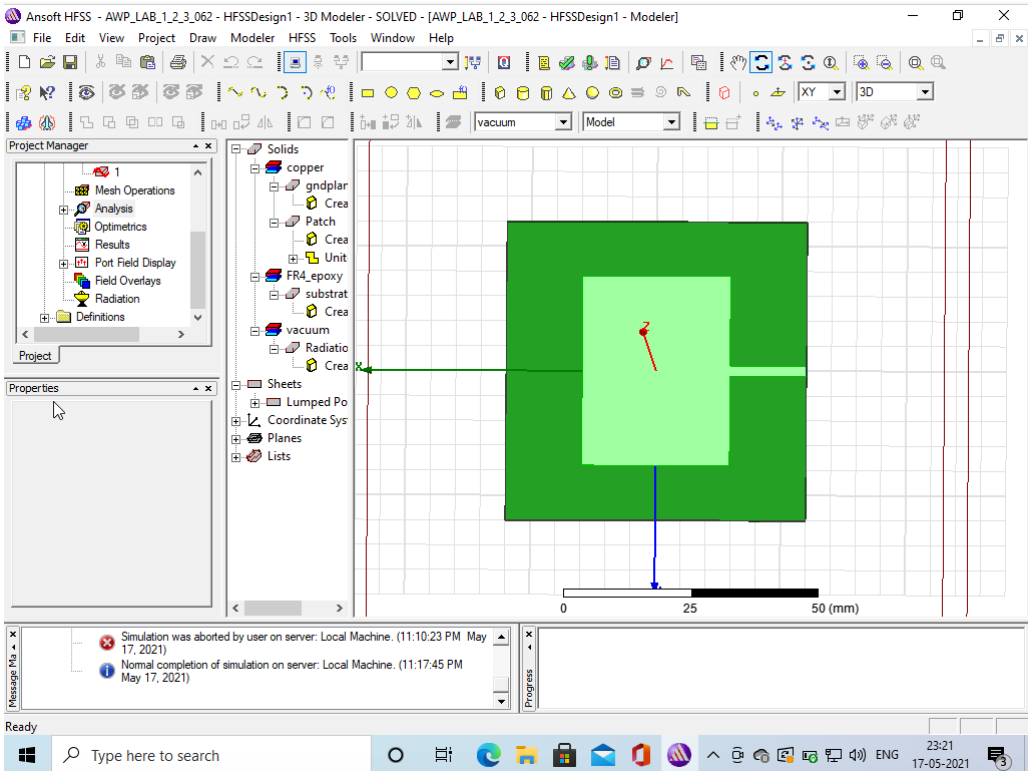
10. Design another rectangular strip and extend it along the X axis and Change the specifications and dimensions of the ground with your convenience. Name it feedline.
11. Then select the Patch and Feedline Strip and Unite them. As shown in the screenshot below.
12. Vertically add another strip and name it Fed. Change the specifications and dimensions of the ground with your convenience.
13. Now cover the entire strip up till now with another rectangular Box and name it Radiation Box. Change the specifications and dimensions of the ground with your convenience. Set it's transparency to minimum.
14. Now for the Ground and Patch sheet right click to assign boundary and add the Finite Conductivity Boundary. Add the material as Copper.
15. To the Radiation Boz right click and add Radiation in the options.
16. Change the Material of Substrate to FR$_epoxy.
17. Now under HFSS in the file menu click on Solutions Type. Select terminal.
18. Now right click on Fed strip and under assign excitement option select Lumped Port and select ground as user reference.
19. From the File Menu go back to HFSS menu and select under Analysis setup you can add Solution Step.
20. In Solution frequency write 2.4 GHz and the maximum number of passes as 20.
21. Then to this setup add a frequency sweep as Sweep type = Fast and Step size = 0.01.
22. Do a Validation Check for the Antenna to see if everything is working.

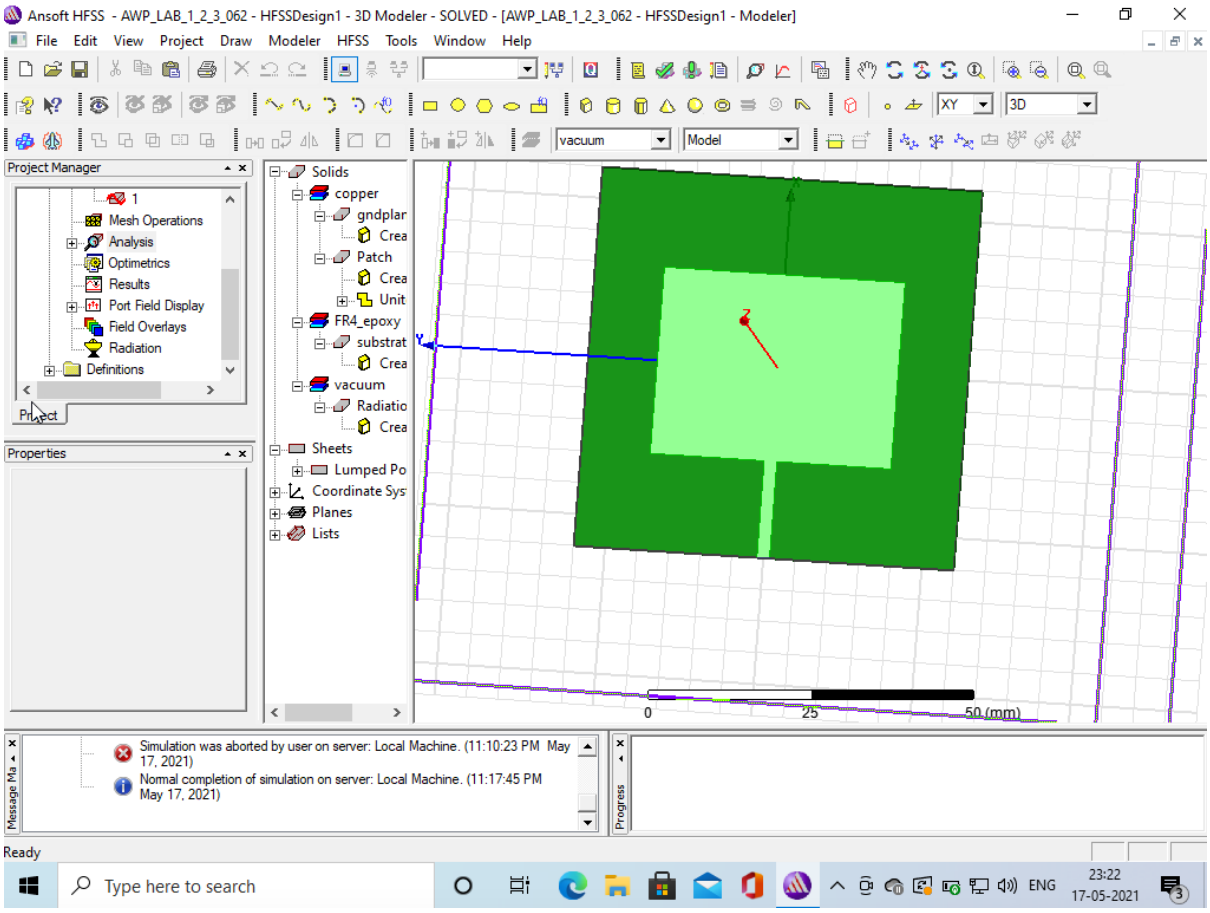


23. Then Click on Analyse All option and Run the Antenna.
24. Then The 2.4 GHz resonating Microstrip Patch Antenna is Ready.

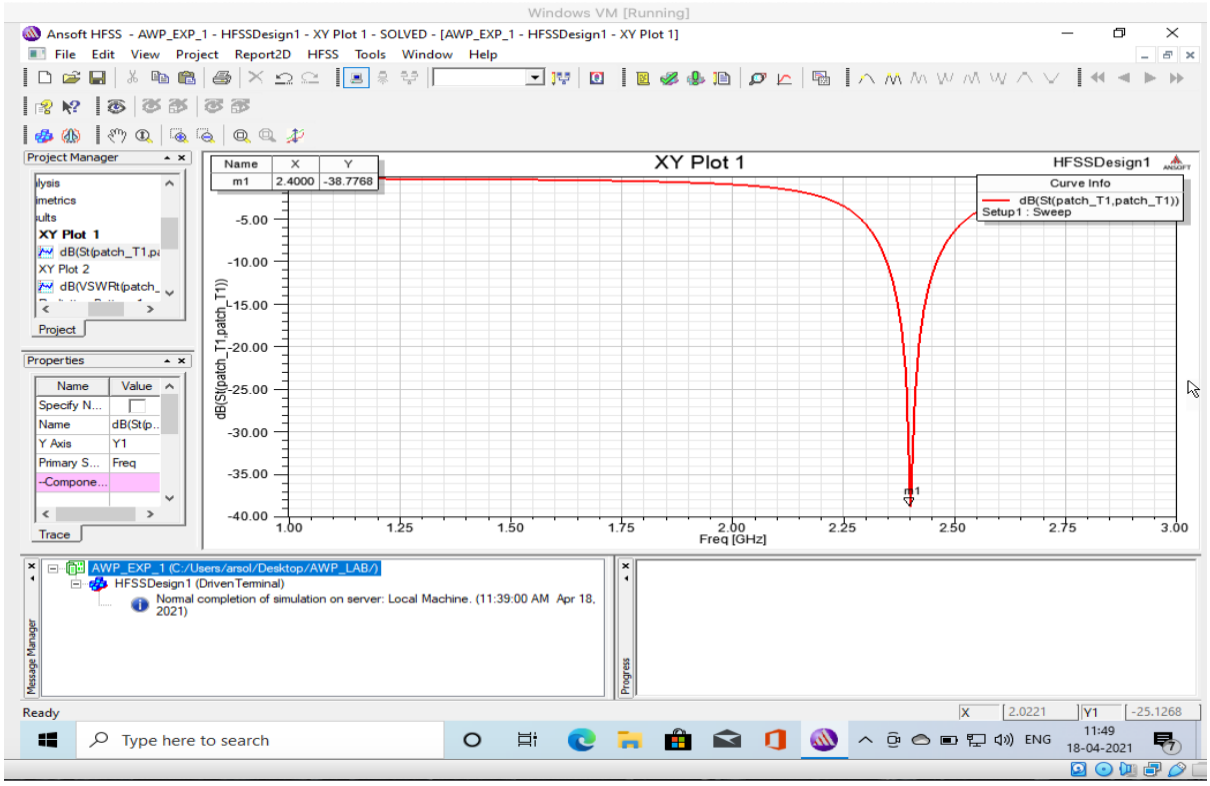
FINAL OUTPUT OF THE EXPERIMENT:







The first XY plot of the Antenna resonating at 2.4 GHz Frequency:



Conclusion: From this experiment we have learnt how to design a rectangular micro strip patch antenna (MSA) to resonate at 2.4 GHz. We have also learnt how to use the HFSS 13 software to design microstrip antennas.