ANTENNAS AND WAVE PROPAGATION

LAB ASSIGNMENT 4

EXPERIMENT 4

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AIM: Design an inset feed antenna for 2.4 GHz MSA and obtain plots for return loss.

Theory: An Antenna is a transducer, which converts electrical power into electromagnetic waves and vice versa.
In this experiment we will be designing an INSET FEED 2.4 GHz MSA. An inset feed microstrip patch antenna is designed to increase the bandwidth and return loss. The inset feed and slot improves the impedance matching and return loss. Inset feeding technique of microstrip antenna is simple to implement & easy to know the behaviour of the antenna, which is controlled by the inset gap and inset length.
Impedance of the antenna can be controlled by this feeding method due to planar structure

In this experiment we will obtain the plots for return loss
The method to measure an antenna's ability to accept power is VSWR (voltage standing wave ratio). VSWR evaluates the ratio of the

peak amplitude of the voltage of the wave on the transmission line versus the minimum amplitude of the voltage of the wave. A VSWR of 1 is ideal; this indicates that there is no reflected power at the antenna port.

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|}$$

Return loss is a power loss of returned or reflected signal by a discontinuity of transmission line. Return loss gives the measure of how well a device is matched.
Return Loss is a measure in relative terms of the power of the signal reflected by a discontinuity in a transmission line or optical fiber. This discontinuity can be caused by a mismatch between the termination or load connected to the line and the characteristic impedance of the line. It is given by

$$\text{Return Loss} = -\Gamma_{dB}$$

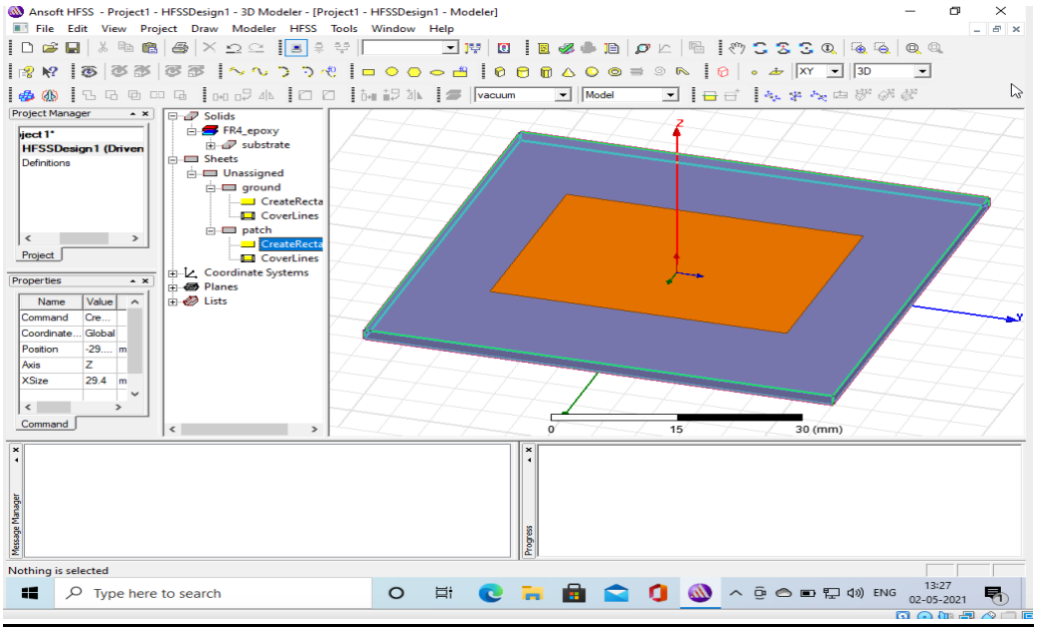
Software Specifications:

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

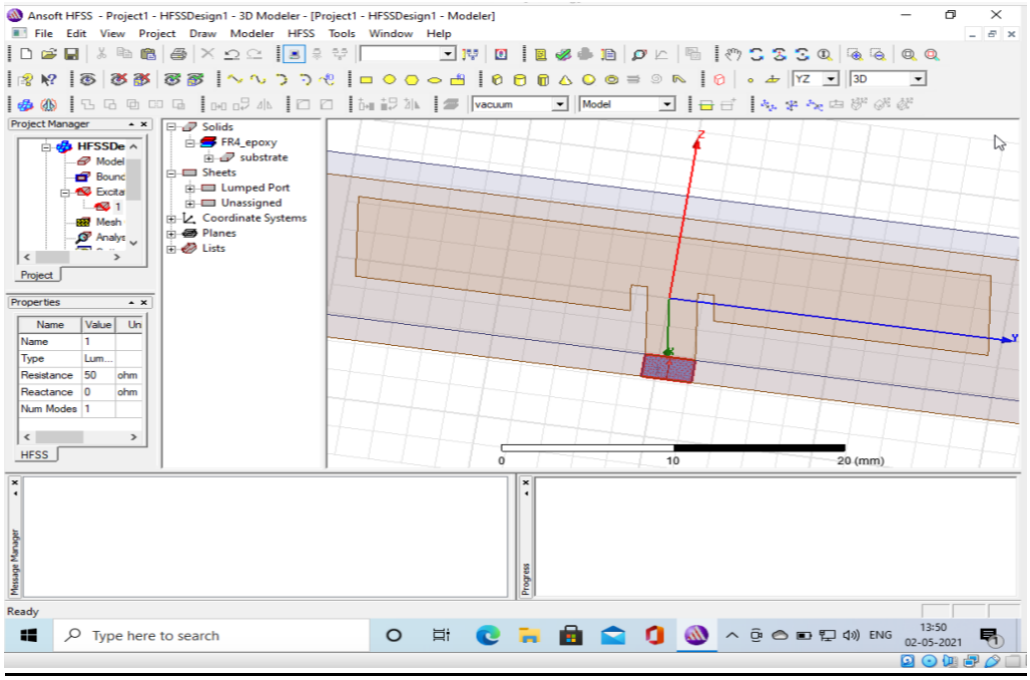
PROCEDURE:

DESIGN OF INSET FEED 2.4 GHz MSA

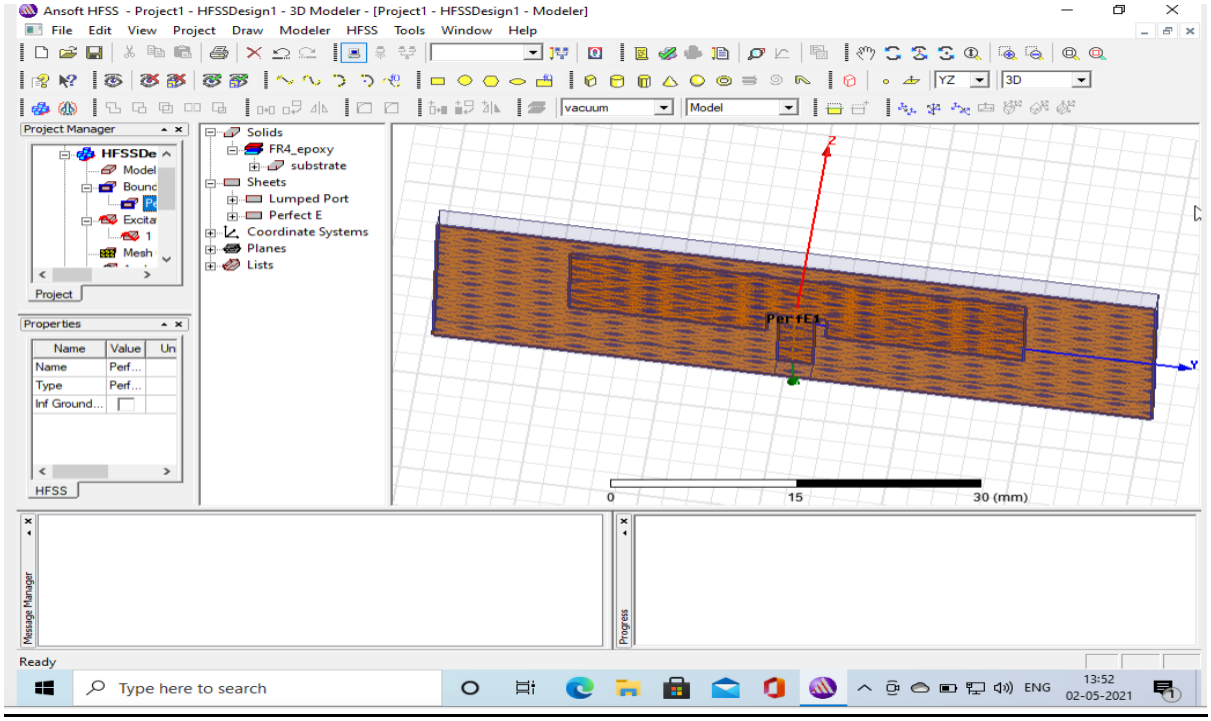
1. Open the HFSS 13 and create a new file with the name of AWP_LAB_4.
2. Then in the new project file you will have. A white XY sheet having the XYZ Axis on it.
3. Then design a Rectangular Box around the XYZ axis. Name it ground.
4. Change the specifications and dimensions of the ground with your convenience.
5. Inside the Ground, design another rectangle and name it substrate. Change the specifications and dimensions of the substrate with your convenience. Use the material FR4_eproxy.
6. Inside the Ground and substrate, design another rectangle and name it patch. Change the specifications and dimensions of the substrate with your convenience. Use the material FR4_eproxy. The size should be set according to 2.4 GHz Antennas.



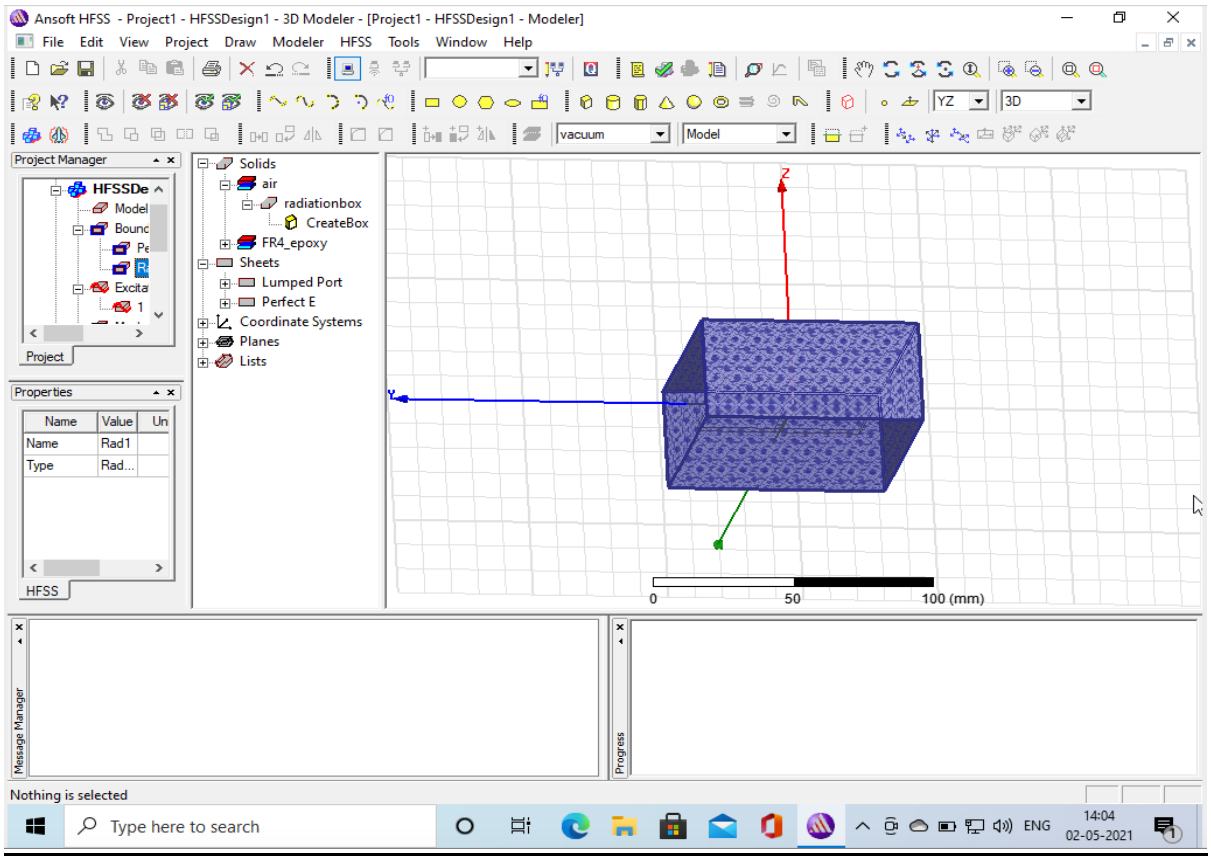
7. Now as the patch is ready we will apply Feed to the Antenna. We will do this in form of a feedline. Then we will design another patch for the feedline and then we will subtract it from the feedline. We will cut the rectangle from the patch using subtract function.
8. In the screenshot below we will give excitation to the Antenna. Create a rectangle on the YZ Plane and name it port. Then adjust its dimensions. We will assign excitation in the form of Lumped Port. The excitation is as shown below.



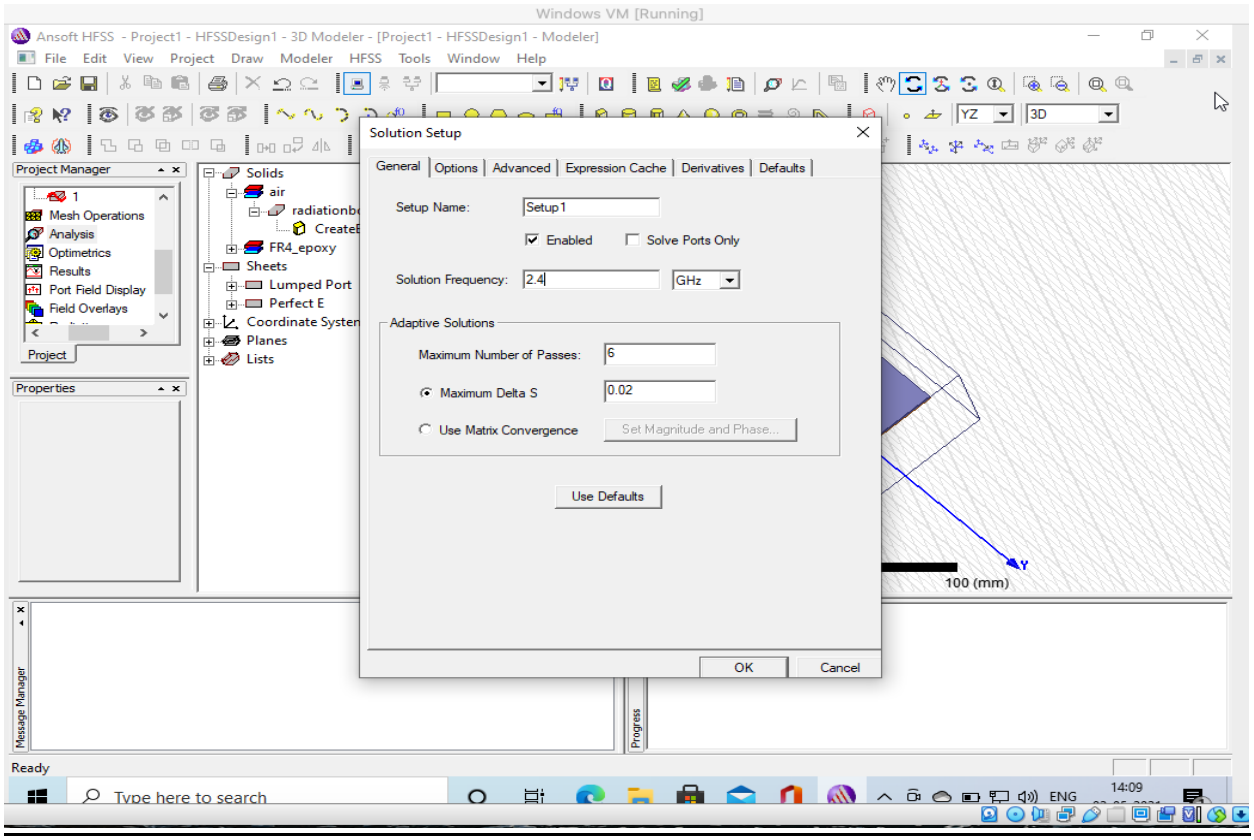
9. We will then select ground and patch part and assign boundary to both of them in the form of Perfect E which is Electric Field. It is as shown below.



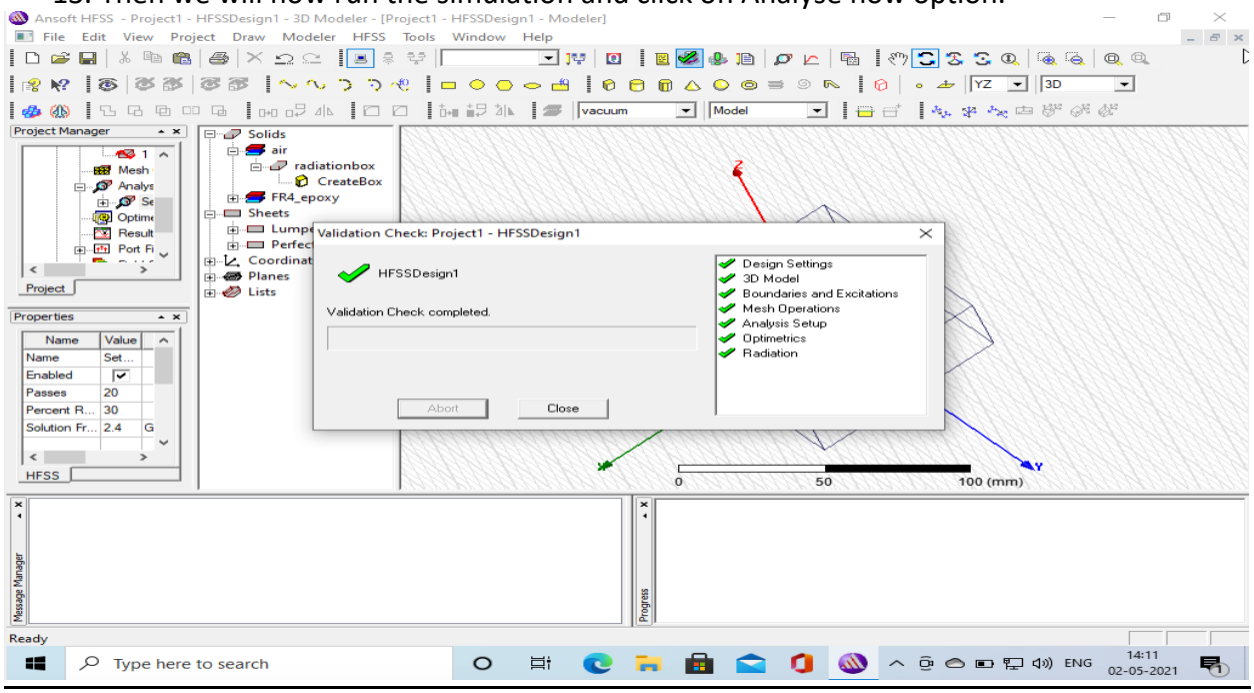
10. Now we will design a box around our entire Antenna. Select the 3D Rectangle and design it around our antenna. Set it's dimensions and material to air. Then we will give radiation boundary to the box. As shown below.



11. Now set the Analysis Setup from the left hand column and set the solution frequency to 2.4 GHz and maximum no. of passes as 20.

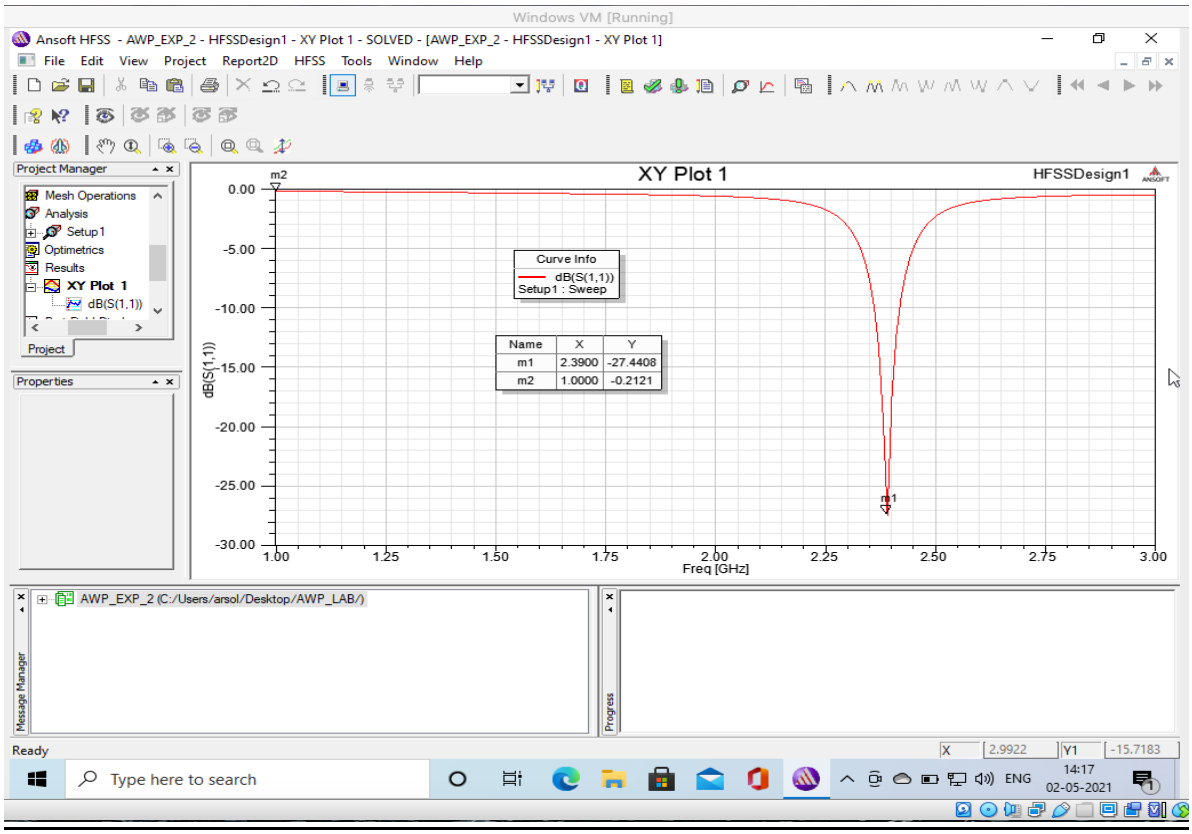


12. Right click on setup and add frequency sweep. Change sweep type to Fast. Set the step size as 0.01.
13. Then we will now run the simulation and click on Analyse now option.



The Antenna is designed. We will then get a rectangular plot from the results option in Dbs.

FINAL OUTPUT OF THE DESIGN:



Resonant Frequency = 2.4 GHz (approx.)

CONCLUSION: In this experiment, we have learnt how to design an Inset feed Patch Micro Strip Antenna at 2.4 GHz. We can also conclude that looking at the output of the return loss of our Antenna that the inset design of our antenna results in improved impedance matching and return loss of the antenna. We can also conclude the previous by comparing our output with the one we got in Experiment 2.