To study of High & Low frequency response of FET

HIGH-FREQUENCY RESPONSE OF FET AMPLIFIER

Theory:

The analysis of the high-frequency response of the FET amplifier will proceed in a very similar manner to that encountered for the BJT amplifier. As shown in Figure 1, there are interelectrode and wiring capacitances that will determine the high-frequency characteristics of the amplifier. The capacitors C_{gs} and C_{gd} typically vary from 1 pF to 10 pF, whereas the capacitance C_{ds}, is usually quite a bit smaller, ranging from 0.1 pF to 1 pF.

Because the network of Fig.1 is an inverting amplifier, a Miller effect capacitance will appear in the high-frequency ac equivalent network appearing. At high frequencies, C_i will approach a short-circuit equivalent and V_{gs} will drop in value and reduce the overall gain. At frequencies where C_o, approaches it short-circuit equivalent, the parallel output voltage V_o will drop in magnitude.

Schematic Diagram:

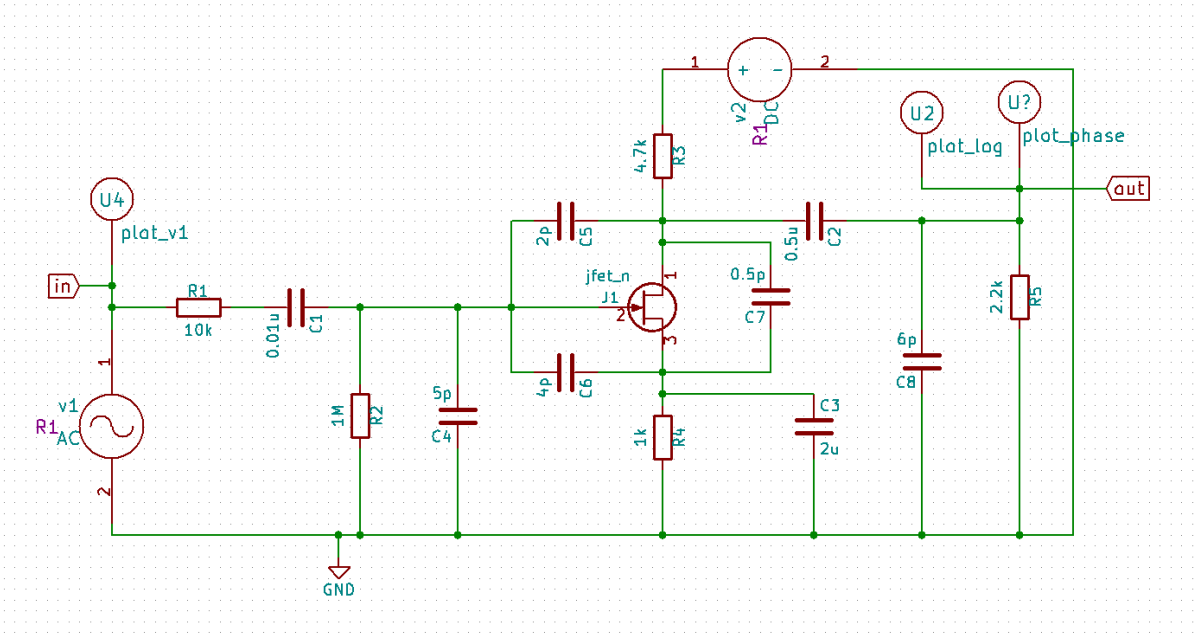

Figure 1: High-Frequency Response of FET amplifier

Simulation graph result:

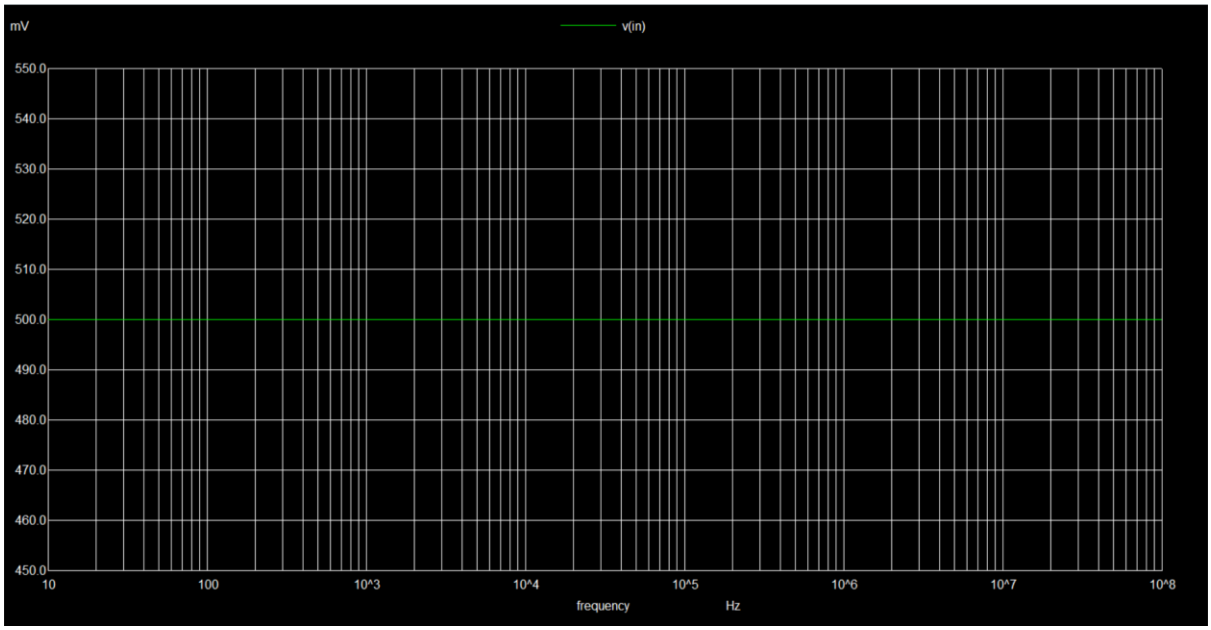

Figure 2: ngspice input plot

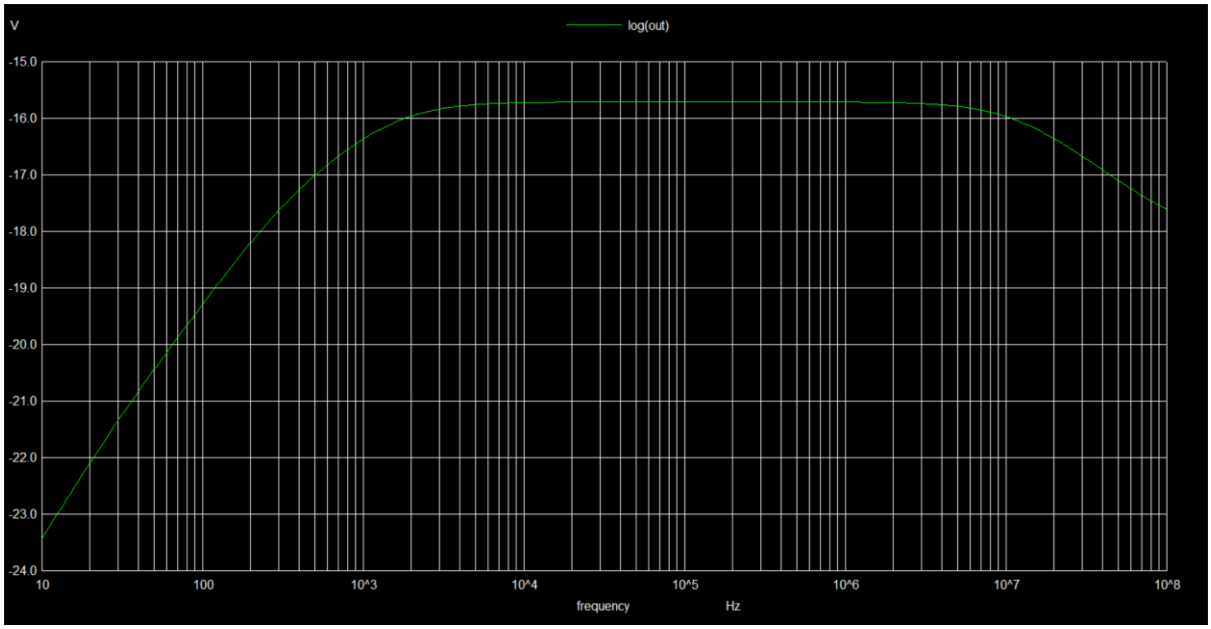

Figure 3: ngspice output frequency plot

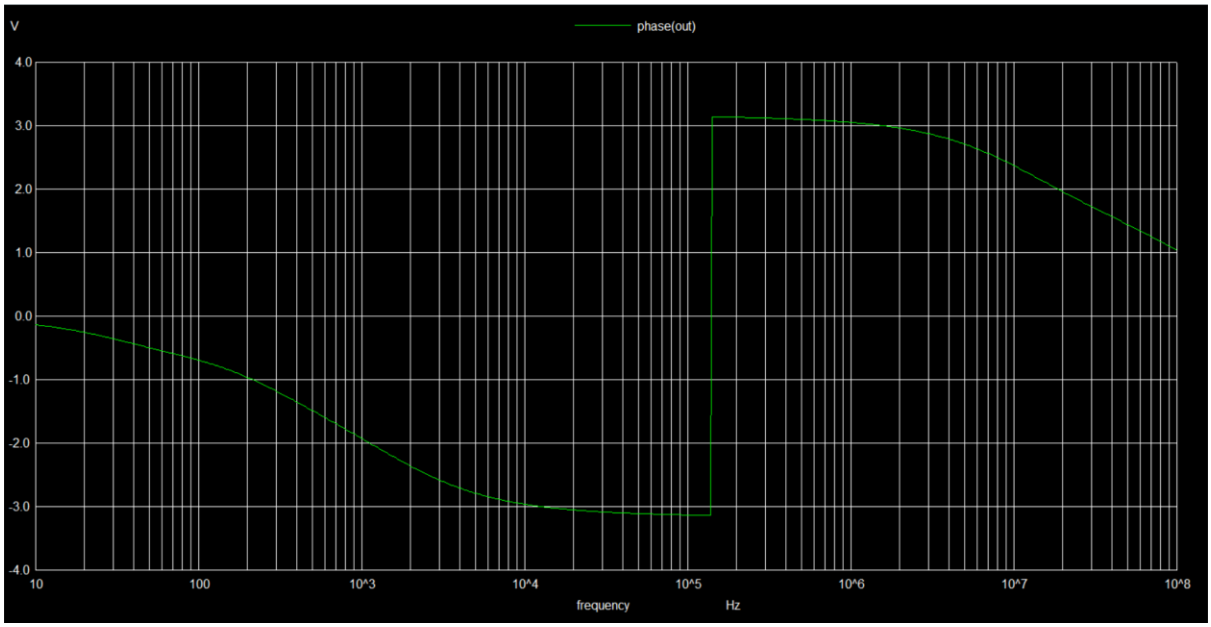

Figure 4: ngspice output phase plot

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ngspice 35

No compatibility mode selected!


Circuit: * e:\esim_workspace\high_frequency_fet\high_frequency_fet.cir

Doing analysis at TEMP = 27.000000 and TNOM = 27.000000

Warning: v1: has no value, DC 0 assumed

No. of Data Rows : 701
ngspice 1 ->
x0 = 10227.2, y0 = -15.4583    x1 = 10577.7, y1 = -15.9583
dx = 350.491, dy = -0.5
dy/dx = -0.00142657    dx/dy = -700.982

x0 = 1.94001e+06, y0 = -15.4167    x1 = 1.56719e+06, y1 = -15.9861
dx = -372823, dy = -0.569444
dy/dx = 1.52739e-06    dx/dy = 654714
```

Figure 5: ngspice result

LOW-FREQUENCY RESPONSE OF FET AMPLIFIER

Theory:

The analysis of the FET amplifier in the low-frequency region will be quite similar to that of the BJT amplifier. There are again three capacitors of primary concern as appearing in the network of Figure 6 C_G, C_C, and Cs. Although Figure 6 will be used to establish the

fundamental equations, the procedure and conclusions can be applied to any FET configuration.

Schematic Diagram:

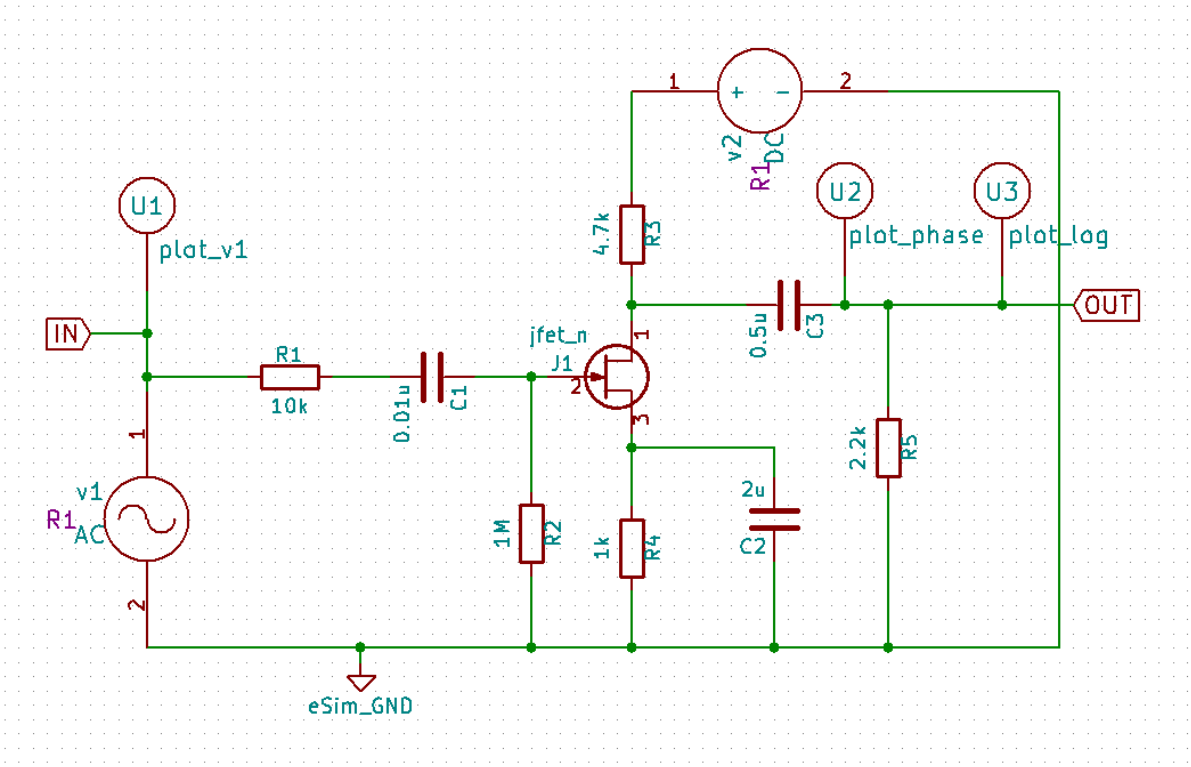

Figure 6: Low-Frequency Response of FET amplifier

Simulation result:

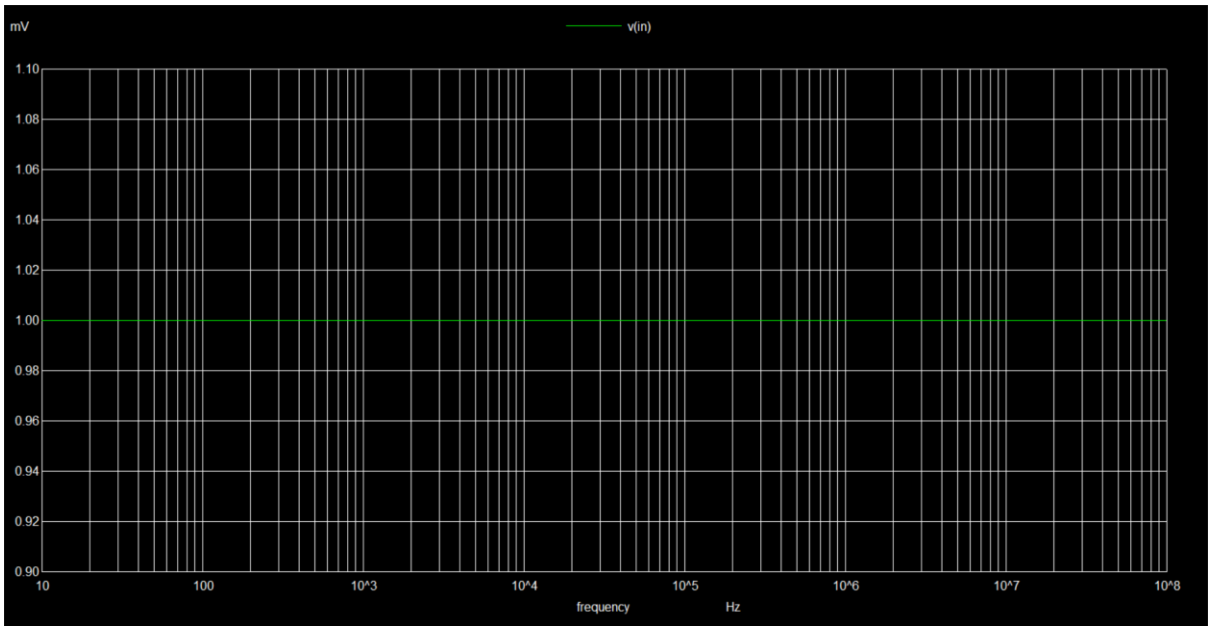

Figure 7: ngspice input plot

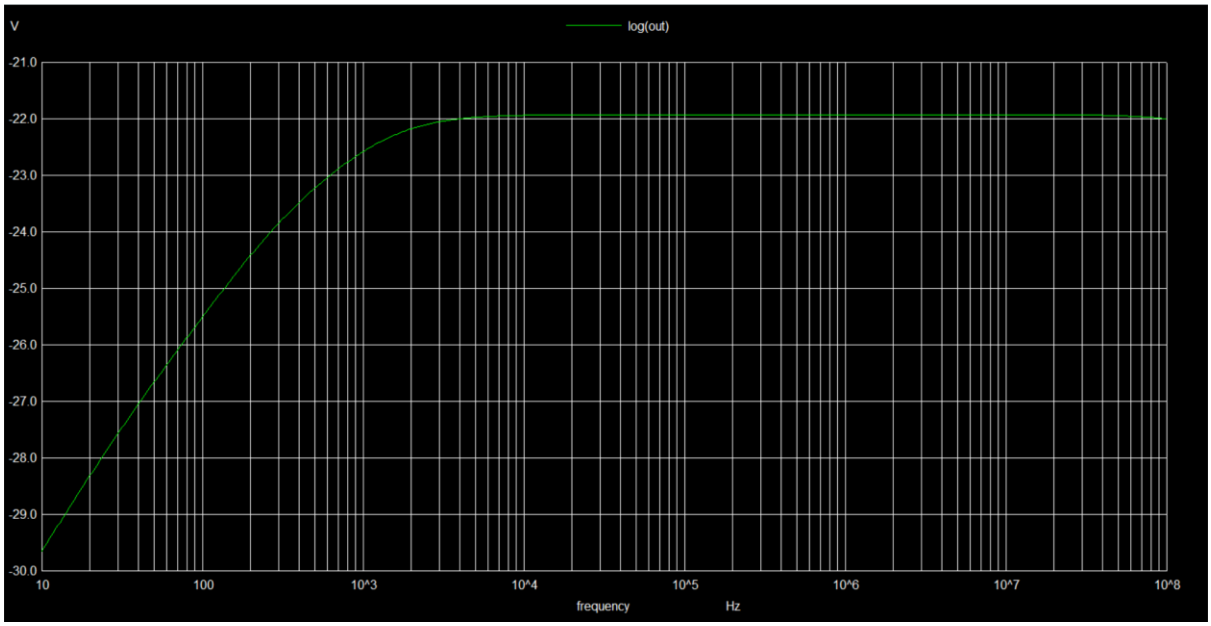

Figure 8: ngspice output frequency plot

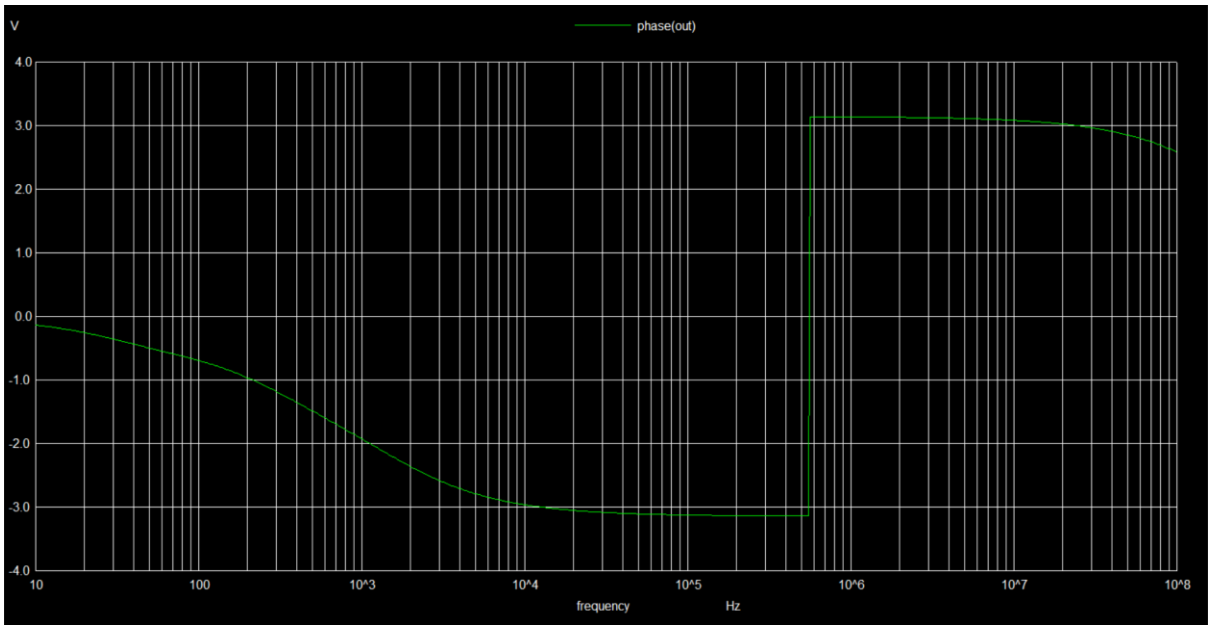

Figure 9: ngspice output phase plot

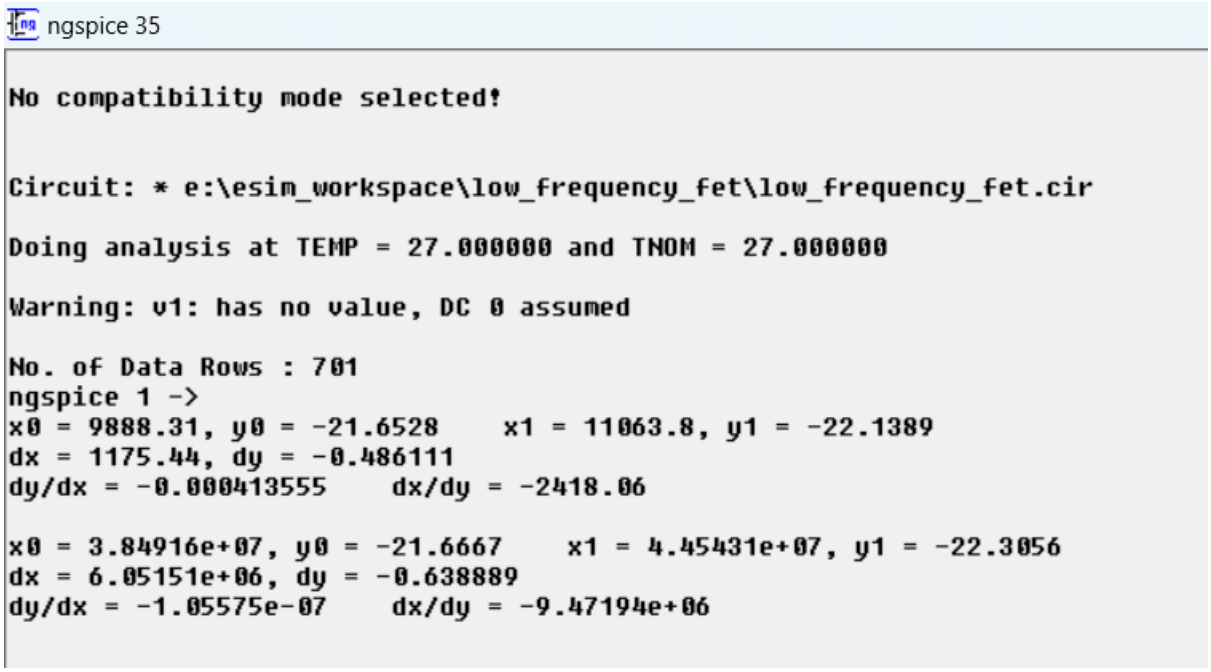

Figure 10: ngspice result

Conclusion:

Thus, the High and Low frequency response of FET amplifier have studied and analysed by using eSim and I get the appropriate waveforms.

References:

1. https://www.electronics-tutorials.ws/amplifier/amp_3.html
2. https://www.multisim.com/content/2r9b3BmtwahfQbUbgkYLaT/fet-amplifier-high-frequency-response/open/
3. https://www.multisim.com/content/nMY9KCaG864ywnncrwRV7R/fet-amplifier-low-frequency-response/
4. Eleventh edition “Electronic Devices And Circuit Theory” by “Robert L.Boylestad & Louis nashelsky”.