**Lab 8: Nodal Analysis of Common-Source Small-Signal Model**

EE 3310L

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1. **Introduction**

The purpose of this lab is to plot the frequency response of a common-source MOSFET voltage amplifier using s- domain nodal analysis of the small-signal model [1]. MATLAB can be used to solve systems of equations. With MATLAB all nodal equations generated from any circuit in s-domain can be solved.

1. **Experimental Methodology [1]**

The first step of the experiment is to draw the small signal model of a common-source n-channel MOSFET voltage amplifier with all capacitances included, mainly cgs, cgd, and cds where the letters g, d, and s correspond to gate, drain, and source respectively as seen in figure 1 below.

**Diagram

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Figure 1: Small signal model of a common-source n-channel MOSFET voltage amplifier with all capacitors.

From the circuit in figure 1 above, nodal analysis is performed in s-domain with the equations displayed in figure A1 in the appendix. The node equations from figure A1 are then put into MATLAB to be solved and have the gain and phase graph displayed as seen in figure A2 in the appendix.

1. **Results and Description**

The gain and phase graphs generated from the MATLAB code as seen in figure A2 in the appendix can be seen below in figure 2.

Chart

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Figure 2: MATLAB generated gain and phase graphs of a common-source n-channel MOSFET voltage amplifier with all capacitors.

Due to MATLAB calculating phase from -π to π instead of 0 to 2π, we are unable to obtain a connected phase response graph and­ instead have a disconnect where the value abruptly increases.

1. **Discussion**

The gain from Multisim and calculation as seen in EE Lab 7 are similar to the MATLAB value while the experimental gain was slightly lower [2]. The MATLAB and Multisim upper cutoff frequencies were similar, while the experimental and calculated upper cutoff frequencies were similar [2]. The MATLAB, Multisim, and calculated lower cutoff frequencies were similar while the experimental lower cutoff frequency was slightly higher [2].

1. **Summary and Conclusions**

The most of lab itself is simple and straightforward to complete due to the given instructions and MATLAB code.

**Reference**

[1] Tritschler, Joe. "Nodal Analysis of Common-Source Small-Signal Model." N.p., n.d. Web. 10 Mar 2023.

[2] Yeoh, Alex. "Lab 7: Common-Source N-Channel MOSFET Voltage Amplifier." N.p., n.d. Web. 11 Mar 2023.

**Appendix A**

Analytical Calculations for Lab 7

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Figure A1: Nodal analysis for a common-source n-channel MOSFET voltage amplifier.

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Figure A2: MATLAB code of the nodal analysis.