Indian Institute of Technology Tirupati

Department of Electrical Engineering

Digital VLSI Design (EE535L)

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Assignment1

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Chapter 1

Assignments

1.1 Assignment 1

Plot the following characteristics of n-channel and p-channel MOSFETs using LTspice (use 50nm models from cmosedu.com for MOSFETs).

1.1.1 Transfer characteristics (fix Vds vary Vgs)

For obtaining the transfer characteristics, We used NMOS with 4 terminal based on 50 nm technology with channel length 50 nm and width 100 nm. In it we took Vgs as a 1st DC source which was varying from 0 to 2 volt with increment of 0.1 volt.and we used Vds as 2nd voltage source for getting how they change on different values of Vds. Because of short channel effect we were not getting constant current in saturation region in the output characteristics.

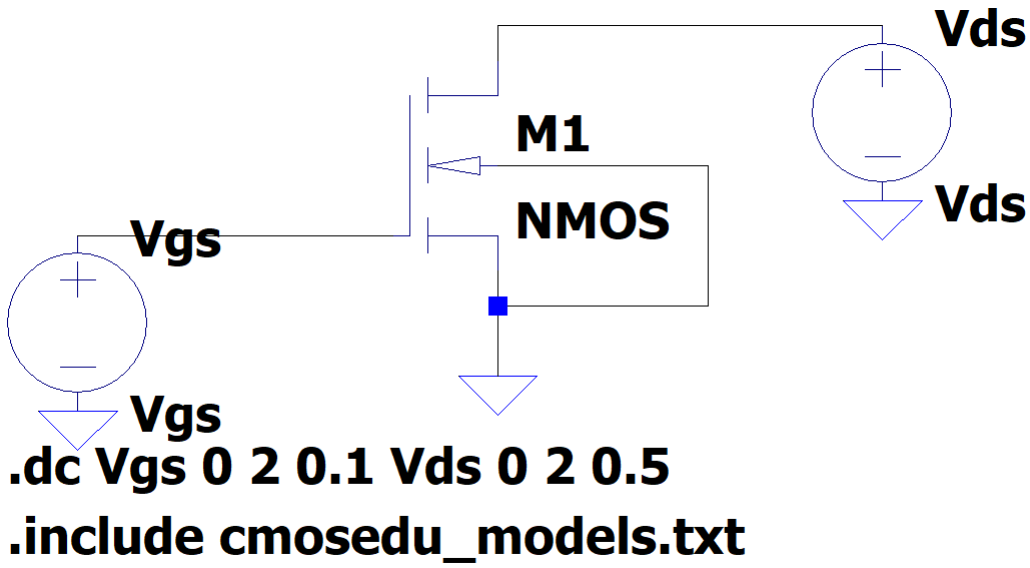

Figure 1.1: Schematic diagram for plotting transfer and output characteristics for NMOS

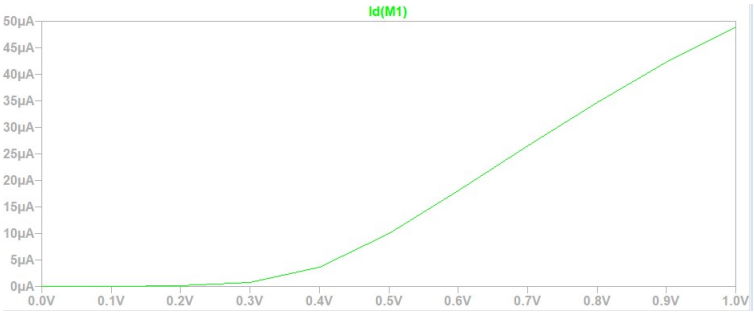

Figure 1.2: ID vs Vgs for particular Vds of 0.5 V for NMOS

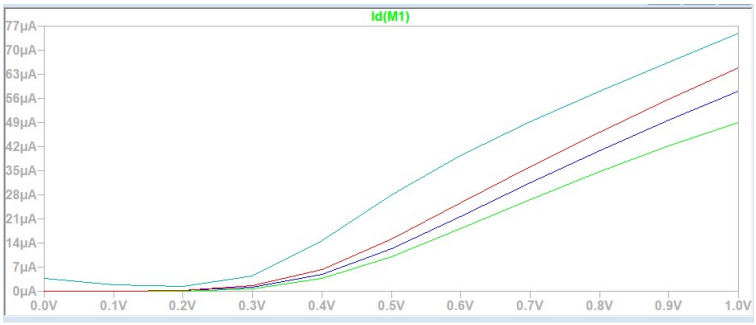

Figure 1.3: ID vs Vgs for various Vds from 0 to 2 V for NMOS

For PMOS:For obtaining the transfer characteristics, We used PMOS with 4 terminal based on 50 nm technology with channel length 50 nm and width 100 nm. In it we took Vgs as a 1st DC source which was varying from 0 to -2 volt with increment of 0.1 volt.and we used Vds as 2nd voltage source for getting how they change on different values of Vds. Because of short channel effect we were not getting constant current in saturation region in the output characteristics.

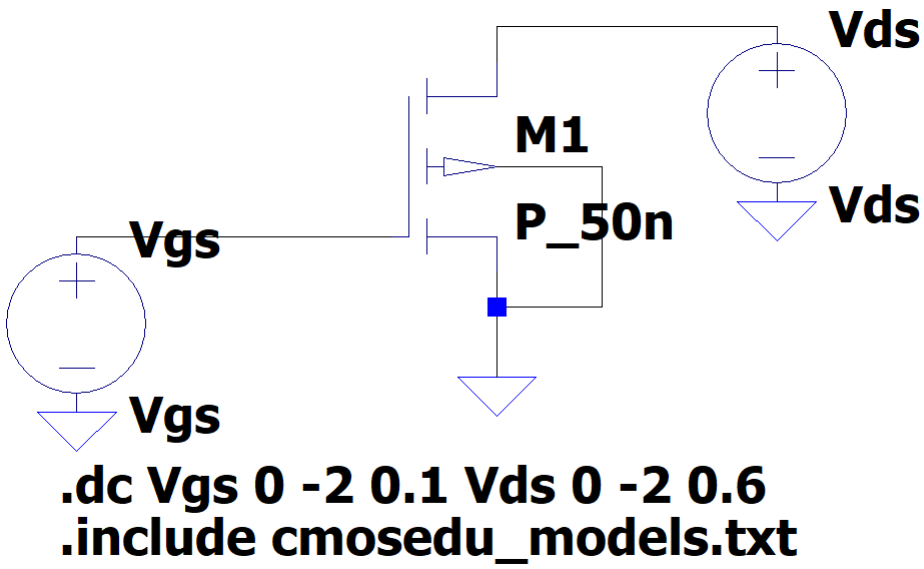

Figure 1.4: Schematic diagram for plotting transfer and output characteristics for PMOS

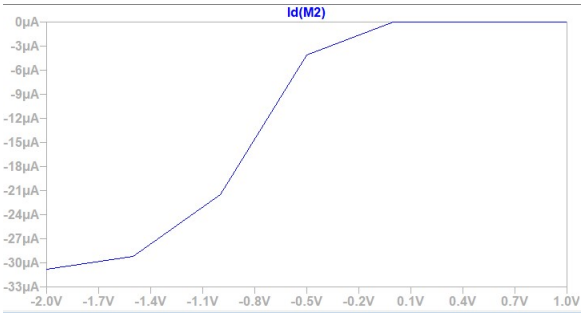

Figure 1.5: ID vs Vgs for particular Vds of 0.5 V for PMOS

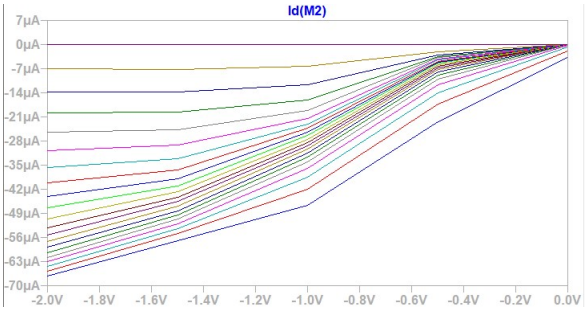

Figure 1.6: ID vs Vgs for various Vds from 0 ro 2 V for PMOS

1.1.2 Output/drain characteristics (fix Vgs vary Vds)

The output characteristics is plotted, Id Vs Vds for various Vgs values from 0.5 V to 2 V. The output

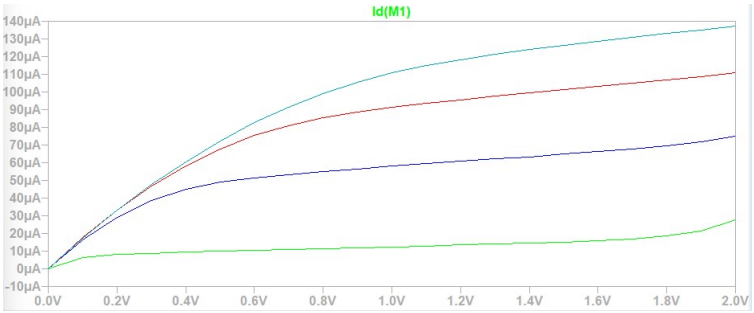

Figure 1.7: Output characteristics for NMOS

characteristics is plotted, Id Vs Vds for various Vgs values from -2 V to -0.5 V.

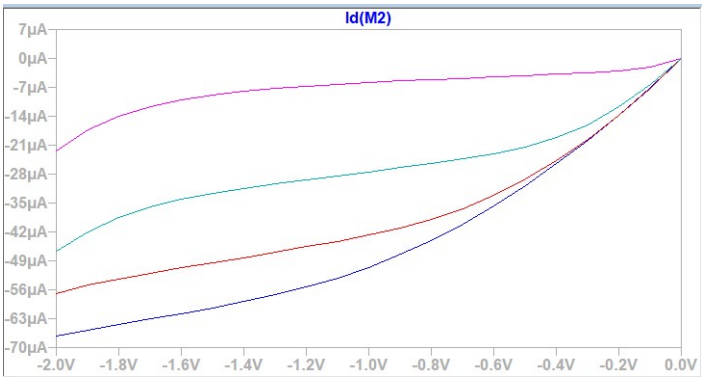

Figure 1.8: Output characteristics for PMOS

1.2 C-V characteristics of NMOS

The C-V characteristics of NMOS is drawn between Vgs gate to source voltage and capacitance of MOSFET.

Basically there are three different type of regions

1- Accumalation region(Vgs less then 0)

2- Depelation region(Vgs in between 0 and Vtn)

3- Inversion region(Vgs is greater then Vtn)

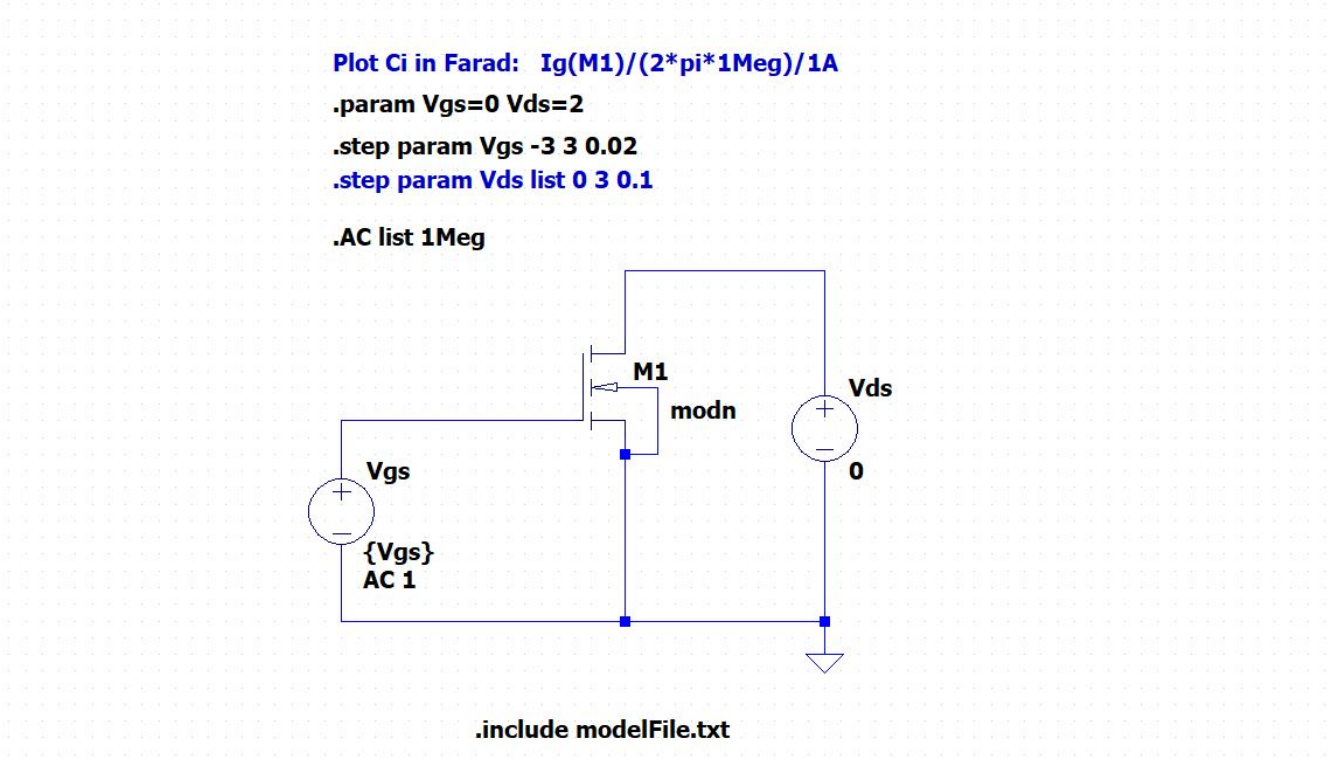

Figure 1.9: Digital circuit of NMOS

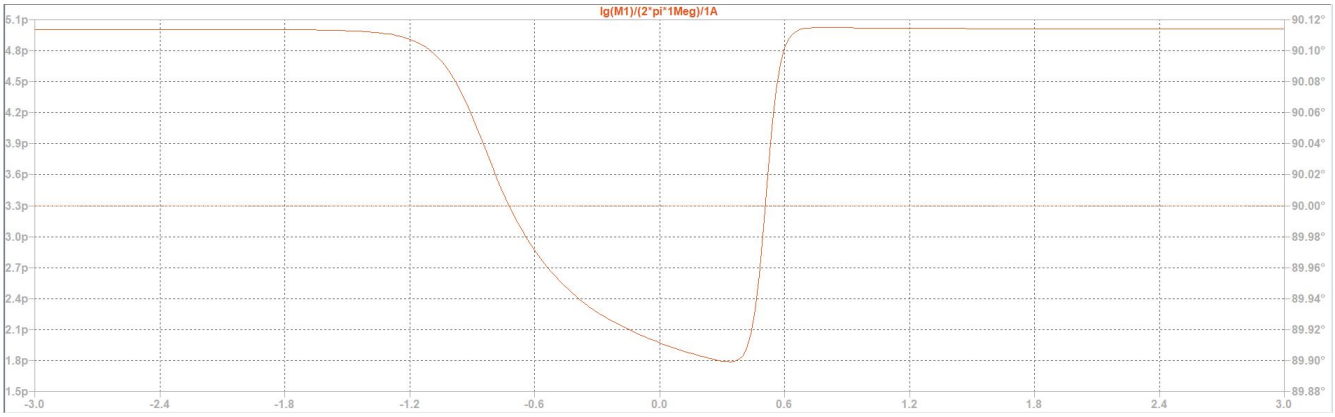

Figure 1.10: C-V characteristics of NMOS