EEO 352 Fall 2023 - Assignment 4 – Digital Gates

Please document each step with snapshots of the built circuit, plots, pictures and your observations. Please include this page.
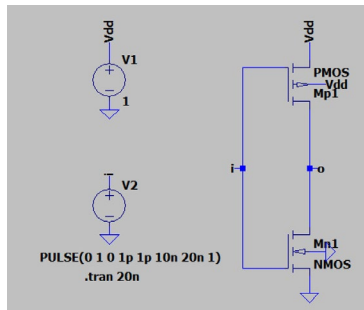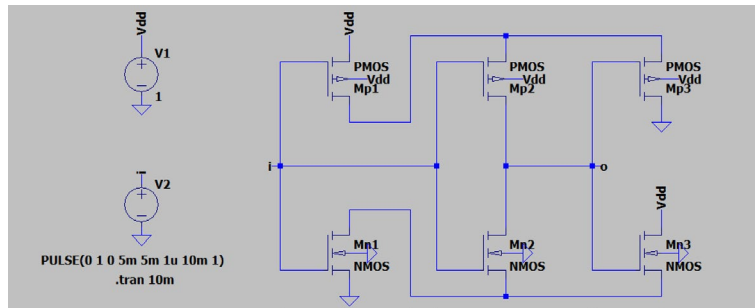

Fig.1a   Fig.1b

1) Design and simulate as follows (**50pts**):

    a) CMOS inverter, as shown in Fig.1a using the nmos4 and pmos4 ideal parts:
- using a pulse waveform simulate and plot the input and output
- using a 100Hz triangular waveform plot the input and output and extrapolate and report the threshold voltages at 50% of the output swing
- replace the ideal MOSFETs (right-click on the parts) with the Si7540DP-P/N, increase the voltages to 5V, plot the input and output, extrapolate the delays (1ns input edges) and extrapolate the thresholds (10Hz triangular waveform)

    b) CMOS Schmitt trigger, as shown in Fig.1b using the nmos4 and pmos4 ideal parts:
- using a pulse waveform simulate and plot the input and output
- using a 100Hz triangular waveform plot the input and output and extrapolate and report the threshold voltages at 50% of the output swing

    c) NAND and NOR gates using the nmos4 and pmos4 ideal parts:
- simulate and plot (use three plot panes) the inputs and output

    d) XOR gate using four ideal NAND parts (inverted output of the AND part) in the Digital library:
- simulate and plot (use three plot panes) the inputs and output

    e) XOR gate using four ideal NOR parts (inverted output of the OR part) and one inverter:
- simulate and plot (use three plot panes) the inputs and output

    Note1: when using the Si7540DP please replace the nmos4 and pmos4 with nmos and pmos first; note that the bulk gets internally connected with the source.
    Note2: the ideal parts in the Digital library nominally operate between 0V and 1V, the Si7510DP operate between 0V and 5V

2) Using the CD4007 CMOS array, build and measure (**115 pts**):

    a) The circuit at (1a), measuring the delays and the threshold voltages and plotting the corresponding inputs and outputs

    b) The circuit at (1b), measuring the delays and the threshold voltages and plotting the corresponding inputs and outputs

    c) The two circuits at (1c), using one 1kHz 5V square wave and one 500Hz square wave, plotting the 500Hz input and the output

    Note1: CD4007 requires supply and signal voltages as per datasheet, 5V recommended.

3) Using the 74LS00 NAND array, build and measure (**35 pts**):

    a) The circuit at (1d), using one 2kHz 5V square wave and one 1kHz square wave, plotting the input and the output