

ECE 5020 HW1

$$1. \quad Z_{RL} = R_L \quad Z_{CL} = \frac{1}{sC_L} \quad Z_{acL} = \frac{R_L \cdot \frac{1}{sC_L}}{R_L + \frac{1}{sC_L}} = \frac{R_L}{1 + sR_L C_L}$$

$$Z_{RS} = R_S$$

$$Z_{network} = R_S + \frac{R_L}{1 + sR_L C_L} \quad T(s) = \frac{V_o(s)}{V_s(s)} = \frac{Z_{acL}}{Z_{network}} = \frac{\frac{R_L}{1 + sR_L C_L}}{R_S + \frac{R_L}{1 + sR_L C_L}} = \frac{R_L}{R_L(sR_L C_L + 1) + R_S}$$

$$T(s) = \frac{R_L}{sR_S R_L C_L + R_L + R_S}$$

$$\tau = RC = R_S || R_L \cdot C_L = \frac{R_S \cdot R_L}{R_S + R_L} \cdot C_L = \tau$$

$$V_c(0) = 0V \quad V_o(s) = T(s) \cdot \frac{1}{s} = \frac{R_L}{sR_S R_L C_L + R_L + R_S} \cdot \frac{1}{s} \quad V_o(s) = \frac{A}{s(s+a)}$$

$$V_o(0) = 1V$$

$$V_o(s) = \frac{\frac{R_L}{R_L + R_S}}{s} - \frac{\frac{R_L}{R_L + R_S}}{s+a}$$

$$A = \frac{R_L}{R_L + R_S} \quad a = \frac{1}{R_L R_S C_L / (R_L + R_S)} = \frac{1}{\tau}$$

$$\hookrightarrow V_o(t) = \frac{R_L}{R_L + R_S} - \frac{R_L}{R_L + R_S} e^{-\frac{t}{\tau}} = \frac{R_L}{R_L + R_S} (1 - e^{-\frac{t}{\tau}}) = V_o(t)$$

$$2. \quad V_t = 0.35V \quad V_{DD} = 1.0V \quad \leftarrow \text{Pmos?}$$

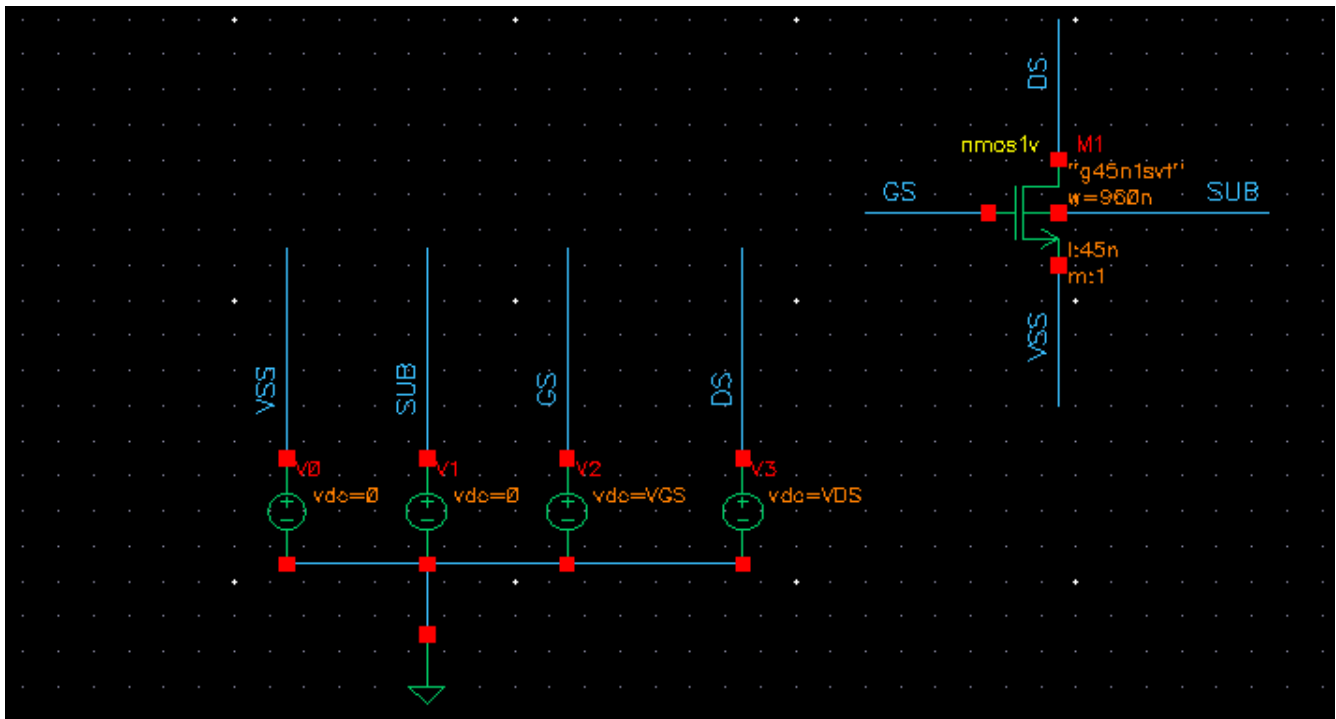
$$a) \quad V_{in} = 0V \quad \boxed{V_{out} = 0V} \quad b) \quad V_{in} = 0.6 \quad V_{gs} = 1 - 0.6 = 0.4V \quad \boxed{V_{out} = 0.6V}$$

$$c) \quad V_{in} = 0.8 \quad V_{DD} - V_t = 0.65V$$

$$\boxed{V_{out} = 0.65V}$$

$$d) \quad V_{in} = 1.0V \quad \boxed{V_{out} = 0.65V}$$

3. NMOS Schematic



NMOS DC Sweep

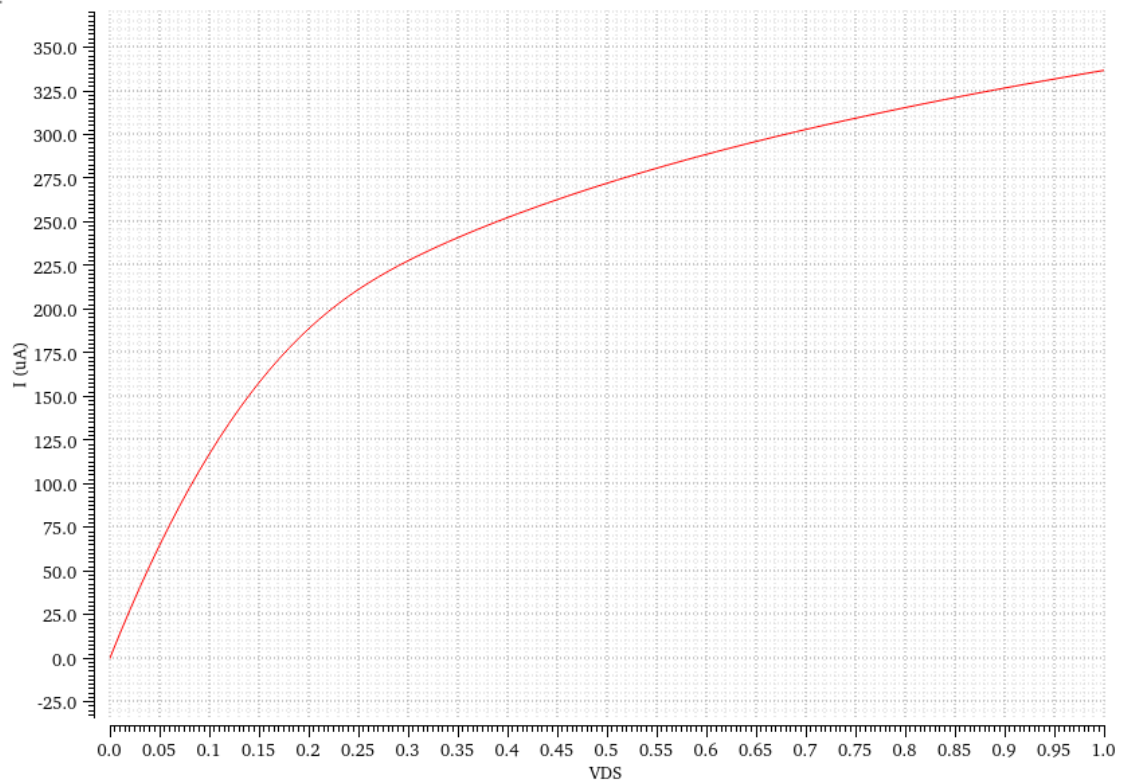
DC Response

Thu Sep 5 23:40:11
2024

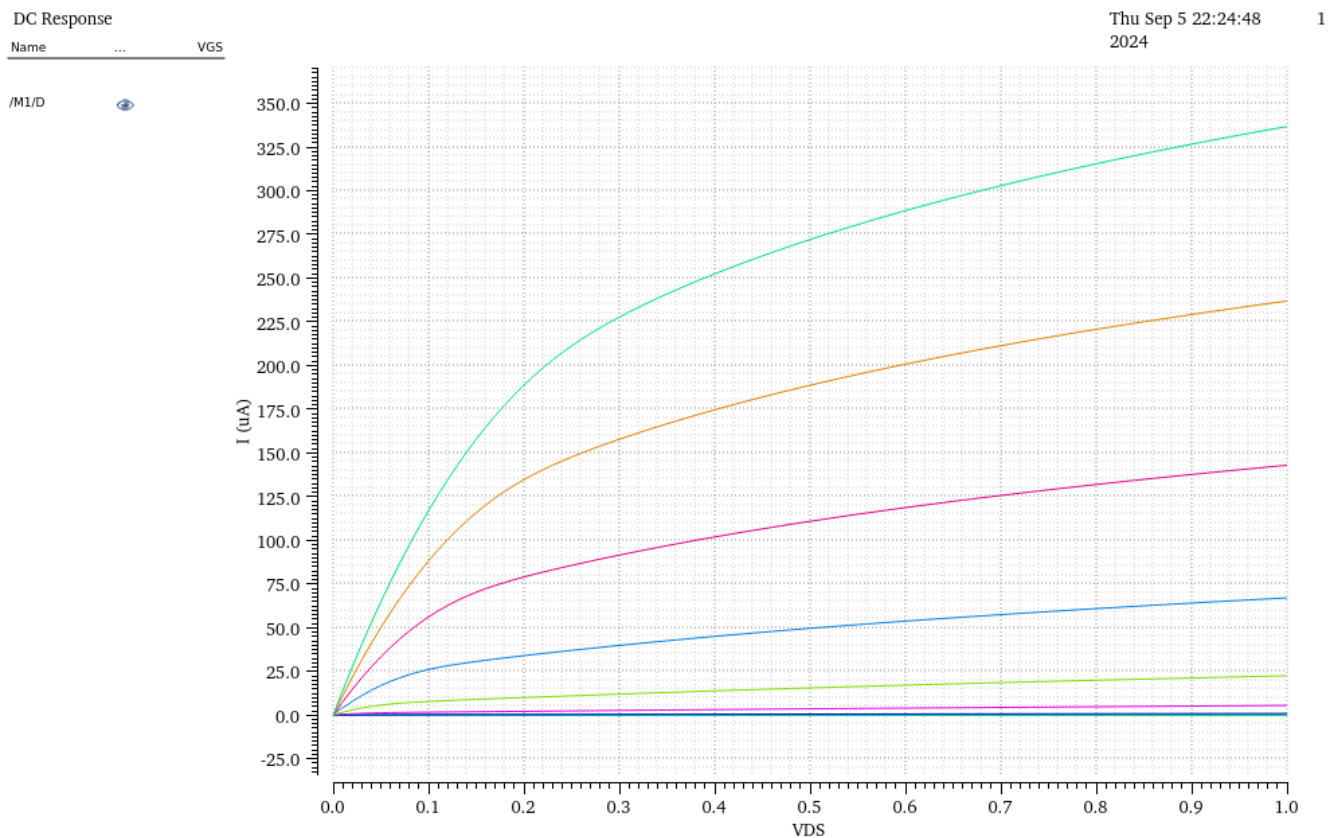
1

Name Vis

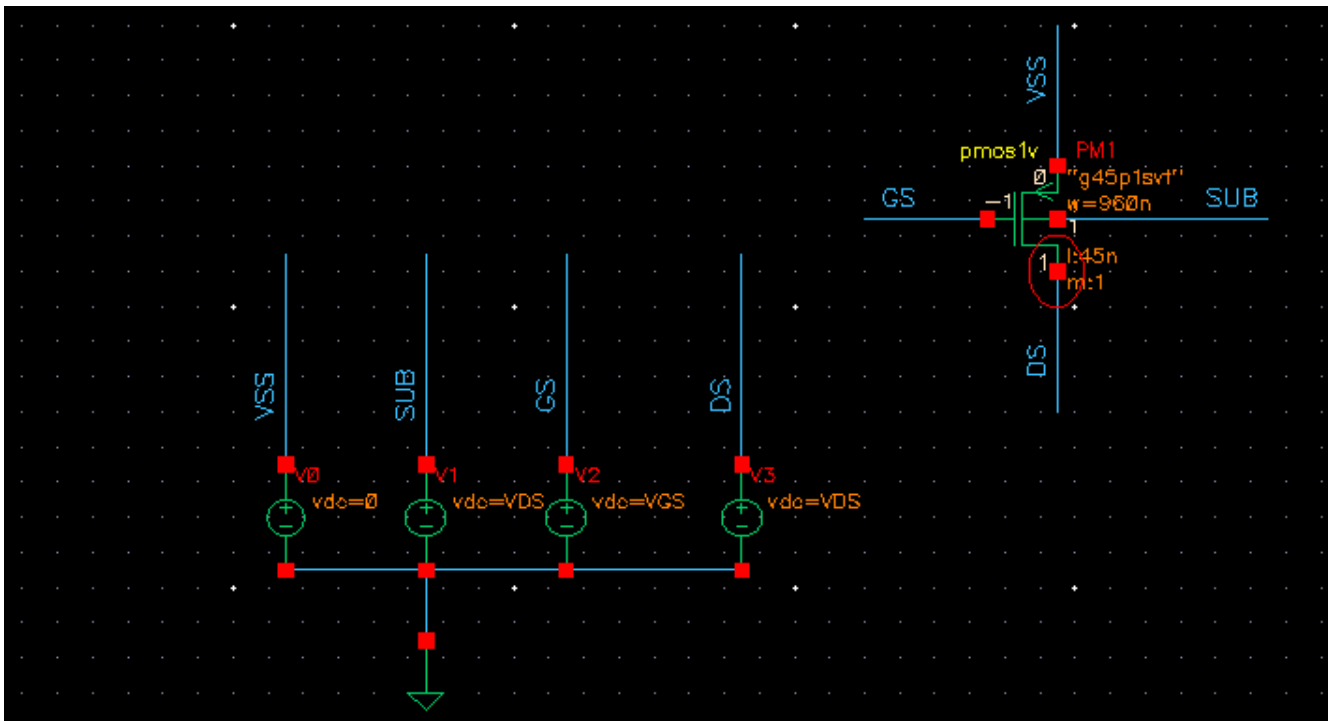
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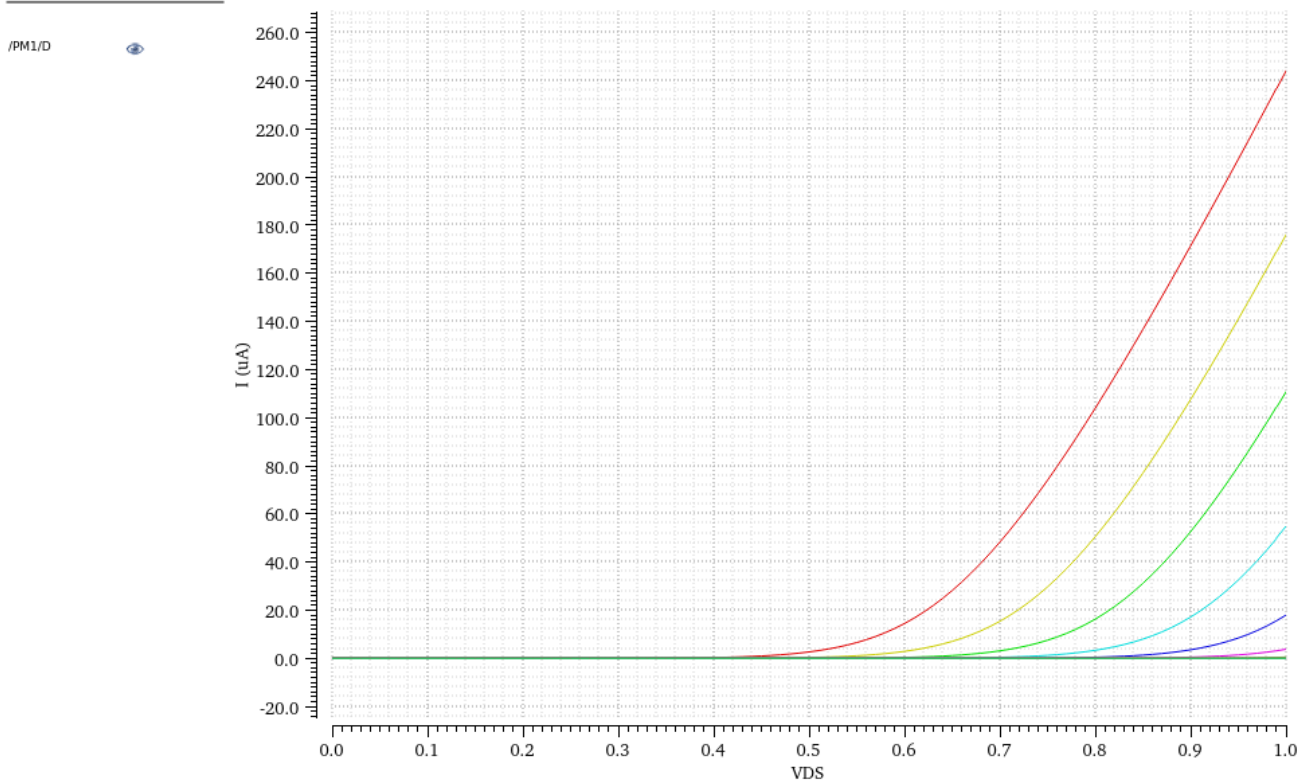
NMOS Parametric DC Sweep



PMOS Schematic



1



PMOS Parametric DC Sweep (-1 to +1, I was curious)

