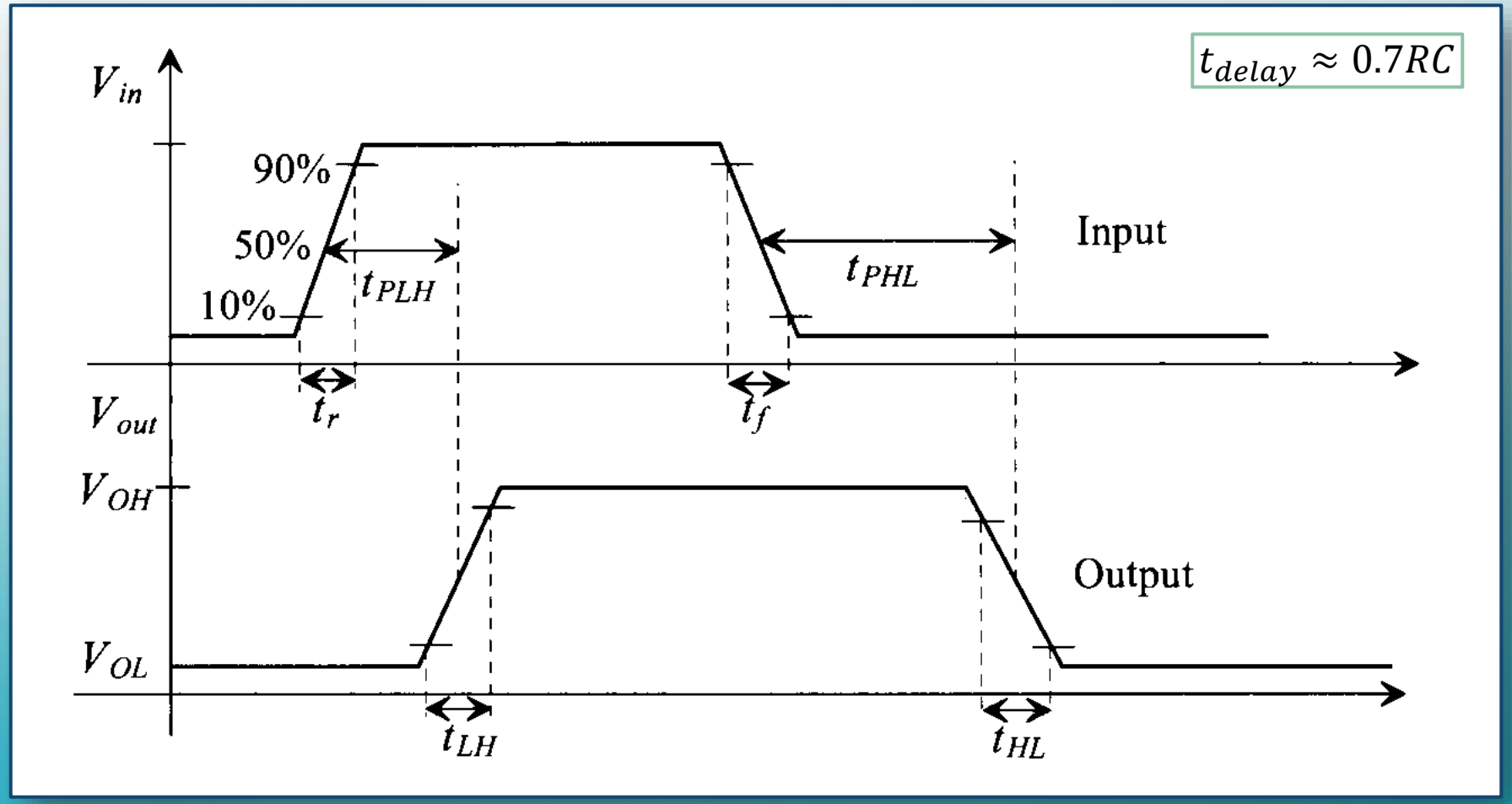
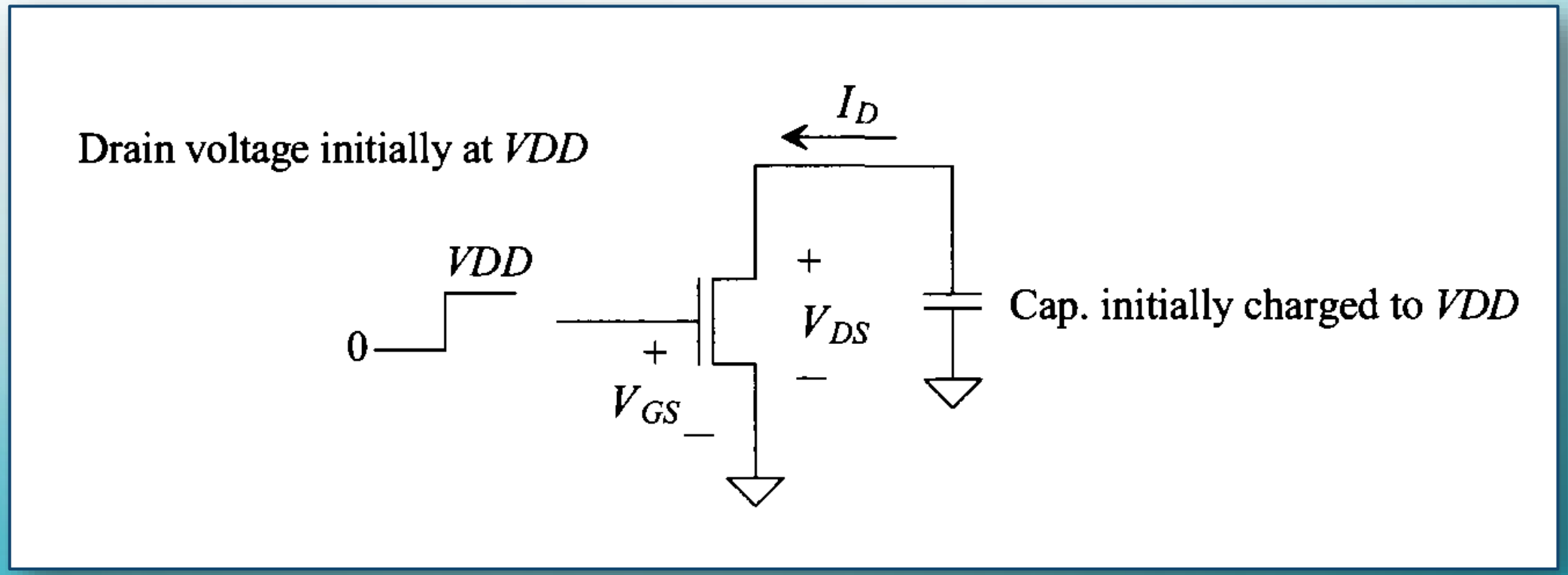
POBUĐIVANJE VELIKIH KAPACITIVNOSTI

PROJEKTOVANJE VLSI KOLA, ETR, ELEKTRONIKA

VRIJEME KAŠNJENJA I VRIJEME TRANZICIJE



MOSFET KAO PREKIDAČ



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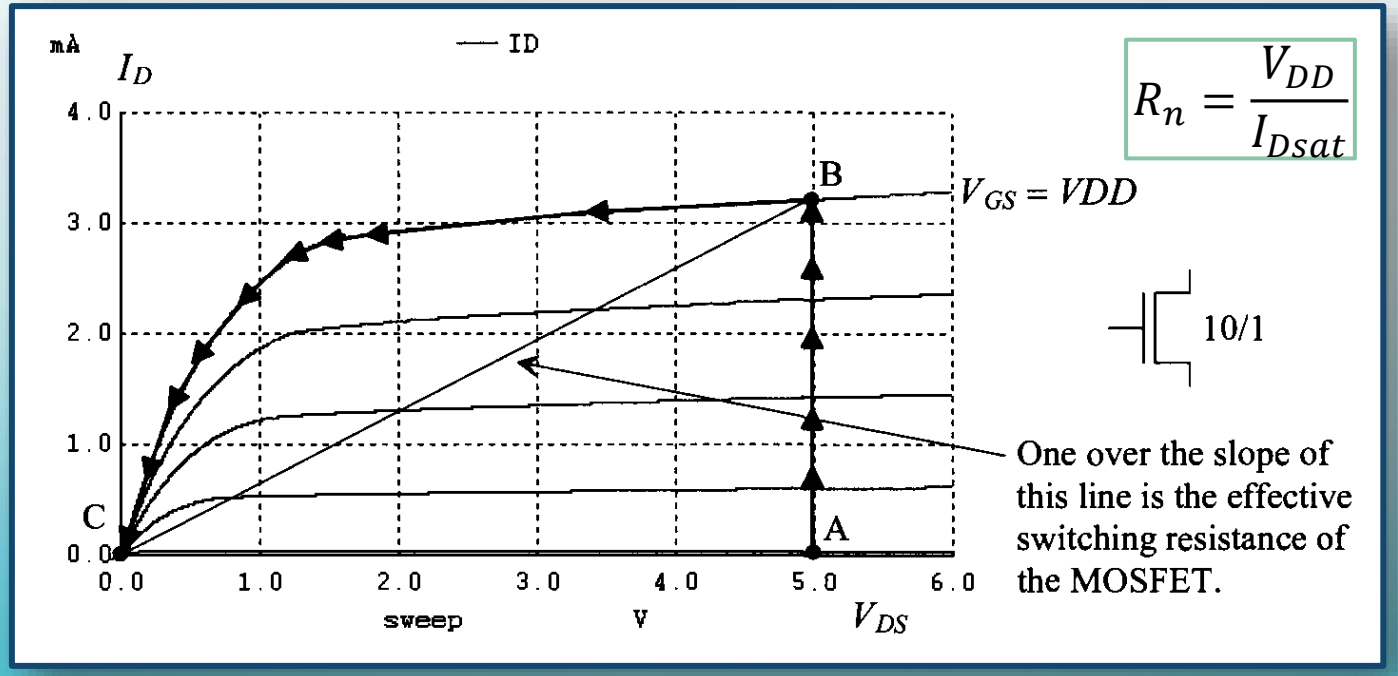

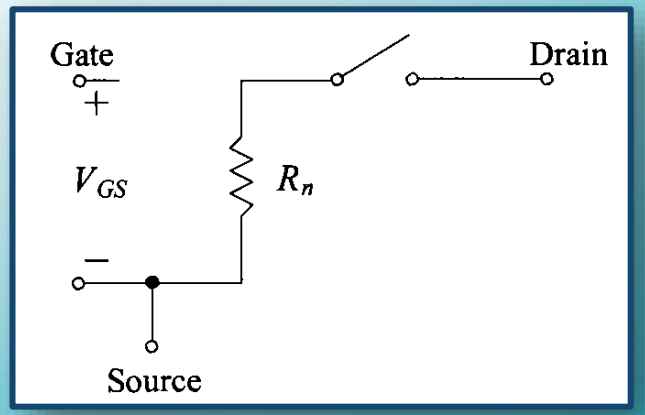

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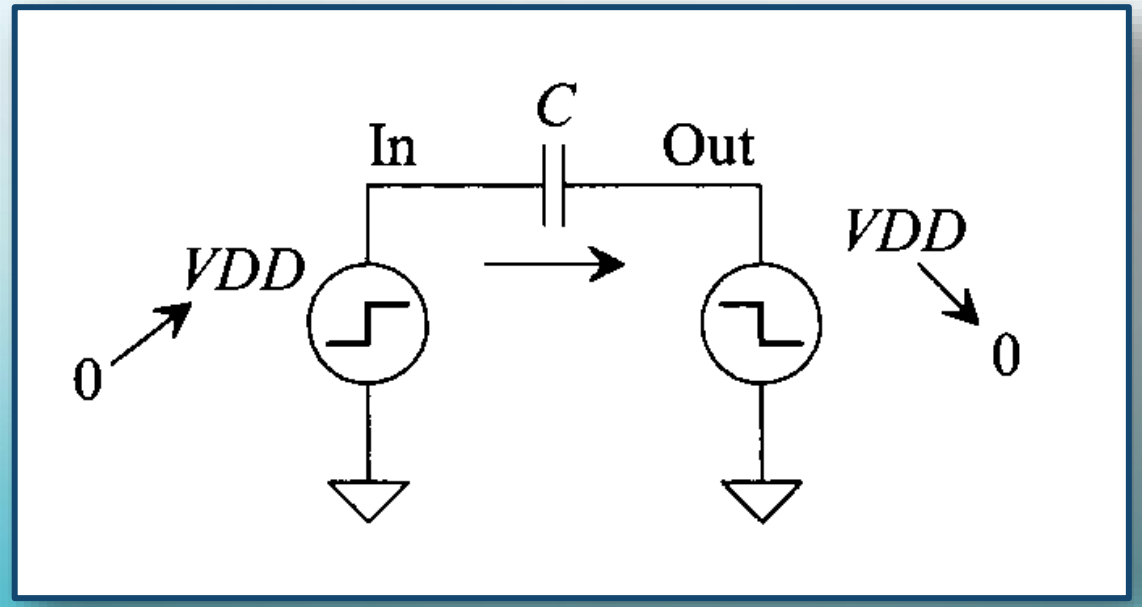
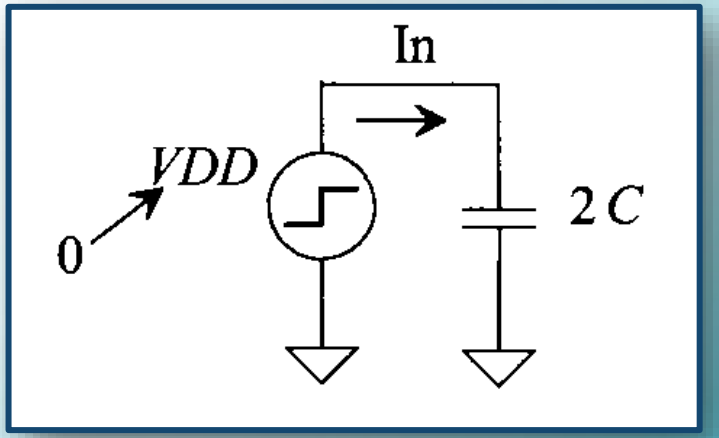
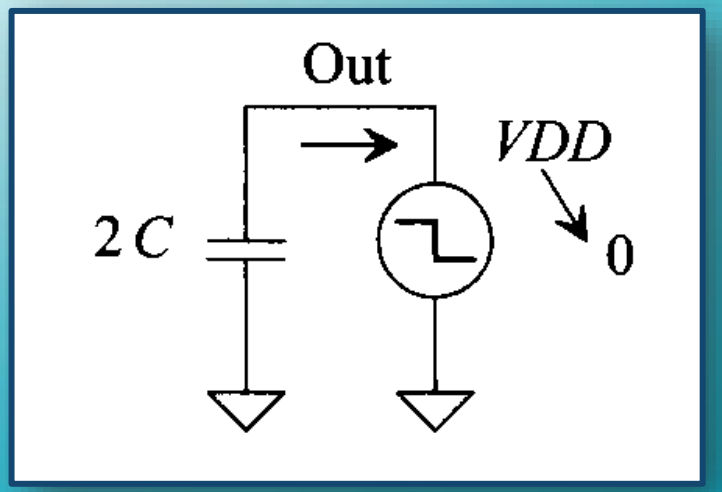
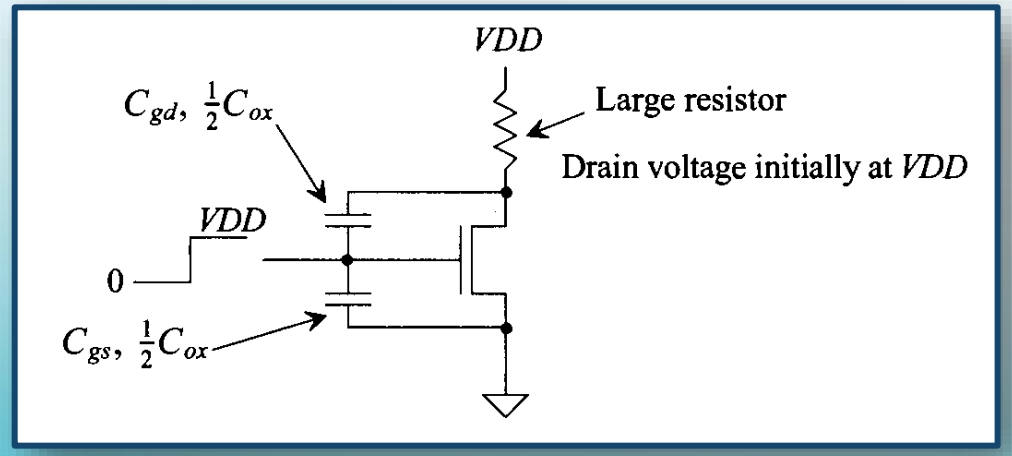
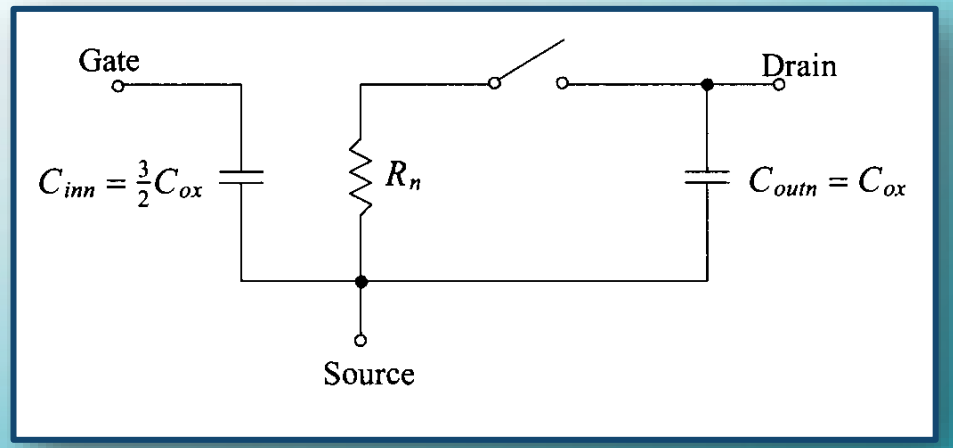




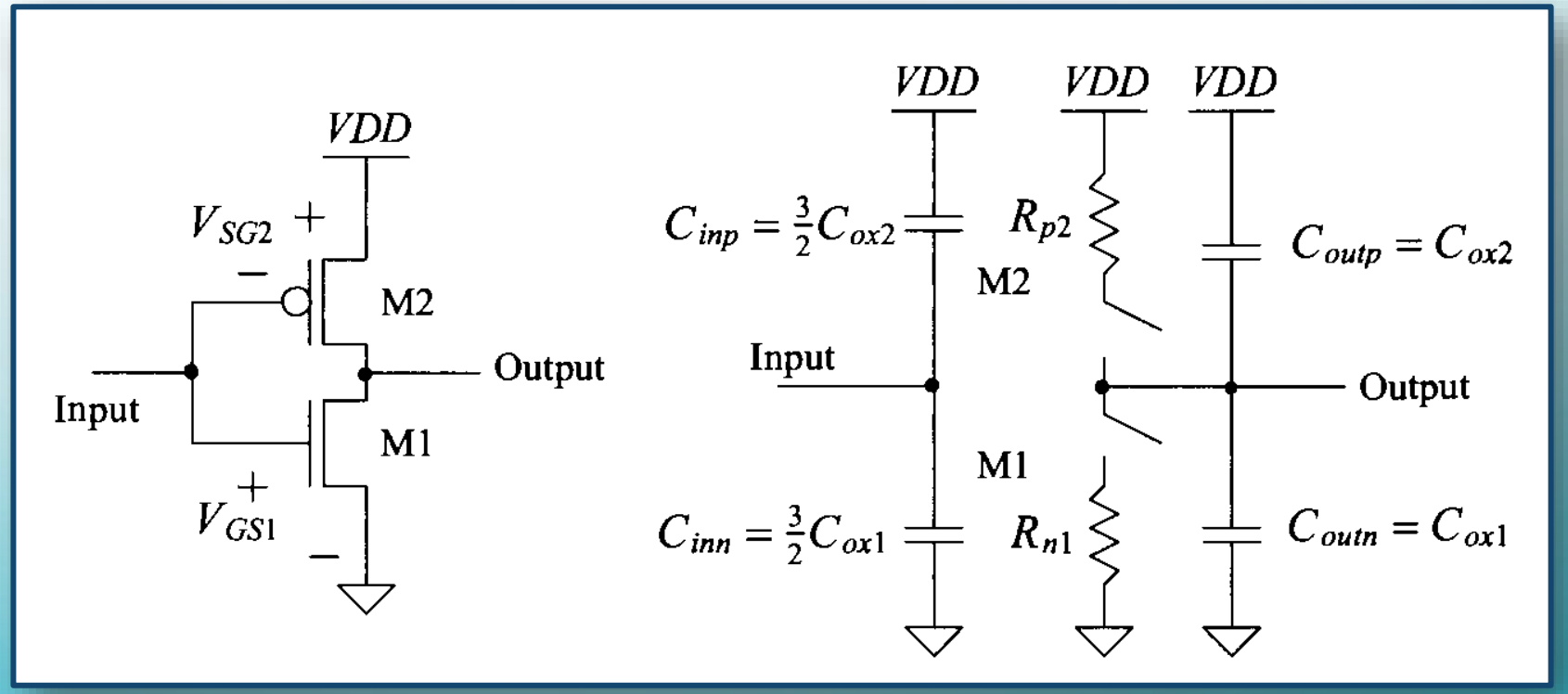


MOSFET KAO PREKIDAČ





CMOS INVERTOR



$$t_{PHL} \approx 0.7R_{n1}C_{out} \approx 0.7R_{n1}(C_{outn} + C_{outp} + C_L) \approx 0.7R_{n1}(C_{oxn} + C_{oxp} + C_L)$$

$$t_{PLH} \approx 0.7R_{p2}C_{out} \approx 0.7R_{p2}(C_{outn} + C_{outp} + C_L) \approx 0.7R_{p2}(C_{oxn} + C_{oxp} + C_L)$$

CMOS INVERTOR

Izvršiti parametarsku vremensku analizu CMOS invertora. Parametar je kapacitivno opterećenje na izlazu koje ima vrijednosti C_L={10 pF, 20 pF, 40 pF}. Na ulaz kola se dovodi povorka pravougaonih impulsa amplitude 1.5 V i frekvencije 5 MHz, pri čemu je t_r=t_f=1 ns. Izračunati koliko iznosi vrijeme kašnjenja t_{d1} za pojedina kapacitivna opterećenja. Napon napajanja kola je V_{DD}=1.5 V. Dimenzije MOSFET-ova su: $(W/L)_{n1}$ = (35 μm/0.35 μm) i $(W/L)_{p2}$ = (100 μm/0.35 μm) .

CMOS INVERTOR

$$t_{d1} = t_{PHL} + t_{PLH} = 0.7\left(R_{n1} + R_{p2}\right)\left(C_{oxn} + C_{oxp} + C_L\right)$$

$$R_{n1} \approx \frac{V_{DD}}{I_{Dsat}} \approx 354\ \Omega,\ R_{p2} \approx \frac{V_{DD}}{I_{Dsat}} \approx 354\ \Omega$$

$$C_{oxn} = \frac{\varepsilon_{ox}}{t_{ox}} W_{n1} L_{n1} = \frac{3.453 \cdot 10^{-11}\ \mathrm{F/m}}{7.6\ \mathrm{nm}} \cdot 35\ \mu\mathrm{m} \cdot 0.35\ \mu\mathrm{m} = 55.66\ \mathrm{fF}$$

$$C_{oxp} = \frac{\varepsilon_{ox}}{t_{ox}} W_{p2} L_{p2} = \frac{3.453 \cdot 10^{-11}\ \mathrm{F/m}}{7.6\ \mathrm{nm}} \cdot 100\ \mu\mathrm{m} \cdot 0.35\ \mu\mathrm{m} = 159.02\ \mathrm{fF}$$

$$t_{d1} \approx 0.7\left(R_{n1} + R_{p2}\right) C_L$$

CMOS INVERTOR

$$t_{d1} \approx 0.7(R_{n1} + R_{p2})C_L$$

$$t_{d1}(C_L = 10\ \text{pF}) \approx 4.956\ \text{ns}$$

$$t_{d1}(C_L = 20\ \text{pF}) \approx 9.912\ \text{ns}$$

$$t_{d1}(C_L = 40\ \text{pF}) \approx 19.824\ \text{ns}$$

POBUĐIVANJE VELIKIH KAPACITIVNOSTI

$$N = ln\frac{C_L}{C_{in1}}$$

$$C_{in1} = \frac{3}{2}\left(C_{oxn} + C_{oxp}\right) = 322.02\ \text{fF}$$

$$N(C_L = 10\ \text{pF}) = ln\frac{C_L}{C_{in1}} = 3.44$$

$$N(C_L = 20\ \text{pF}) = ln\frac{C_L}{C_{in1}} = 4.13$$

$$N(C_L = 40\ \text{pF}) = ln\frac{C_L}{C_{in1}} = 4.82$$