

Lecture 11

MOSFET

4.3 MOSFET Circuits at DC

- We study a number of design and analysis examples of circuits with **DC** voltages and currents only
- In the following examples, we will neglect the Channel Length Modulation effect, i.e.

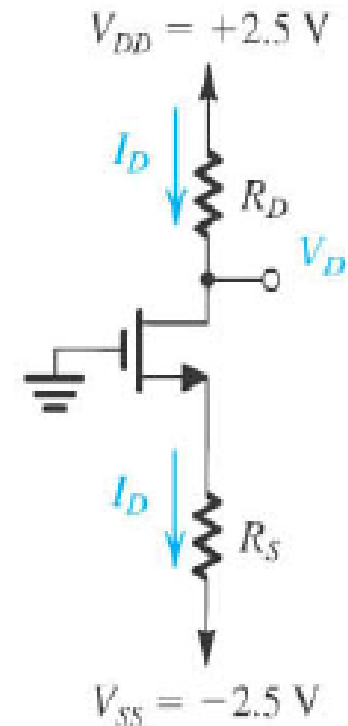
$$\lambda = 0$$

- **Recall that:** $V_{OV} = V_{GS} - V_t$
 - For NMOS transistors: V_t and V_{OV} are +ve
 - For PMOS transistors: V_t and V_{OV} are -ve

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Example 4.2: Design the circuit shown so that the transistor operates at $I_D = 0.4 \text{ mA}$ and $V_D = +0.5 \text{ V}$. The NMOS transistor has $V_t = 0.7 \text{ V}$, $\mu_n C_{ox} = 100 \text{ } \mu\text{A/V}^2$, $L = 1 \text{ } \mu\text{m}$, and $W = 32 \text{ } \mu\text{m}$.

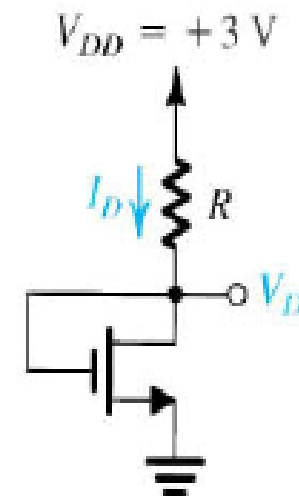
In Which Region Does the NMOS Operate?



MOSFET Circuits at DC *cont.*

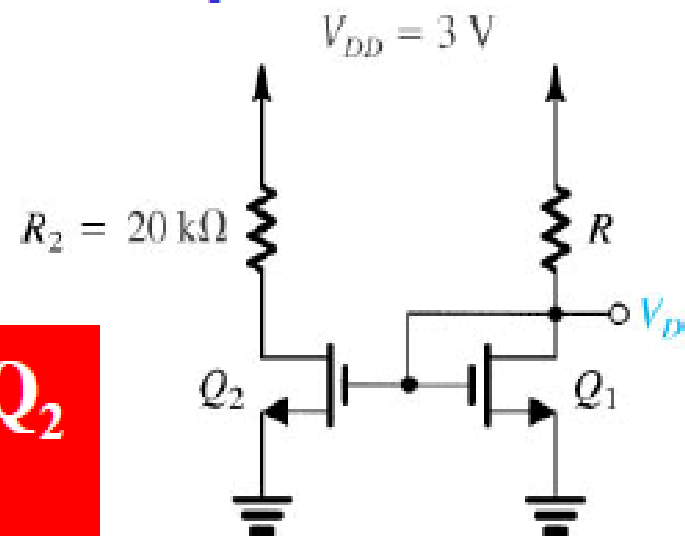
Example 4.3: Design the circuit shown to obtain a Current I_D of $80\ \mu\text{A}$. Find the value required for R and find the DC voltage V_D . Let the NMOS transistor have $V_t = 0.6\ \text{V}$, $\mu_n C_{ox} = 200\ \mu\text{A}/\text{V}^2$, $L = 0.8\ \mu\text{m}$, and $W = 4\ \mu\text{m}$.

In Which Region Does the NMOS Operate?



MOSFET Circuits at DC *cont.*

Exercise: From the previous example, let the voltage V_D be applied to the gate of another transistor Q_2 as shown in the Figure below. Assume that Q_2 is identical to Q_1 . Find the drain current and voltage of Q_2 .



In Which Region Does Q_2 Operate?