Lecture 12

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.
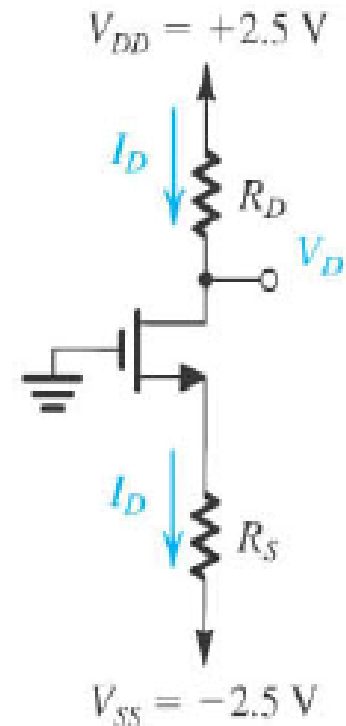
$$\lambda = 0$$

• **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

4.3 MOSFET Circuits at DC

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

In Which Region Does the NMOS Operate?

$V_{DD} = +2.5$ V

I_D R_D

V_D

I_D R_S

$V_{SS} = -2.5$ V
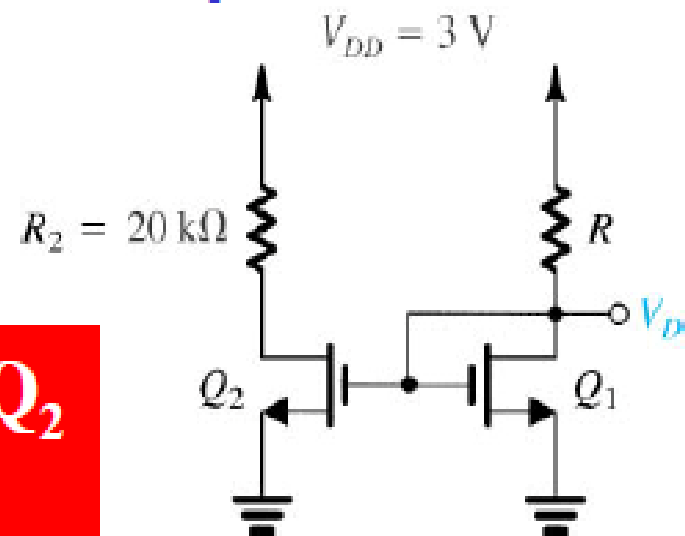
MOSFET Circuits at DC *cont.*

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

In Which Region Does the NMOS Operate?

$V_{DD} = +3$ V

I_D ⬇ R

V_D
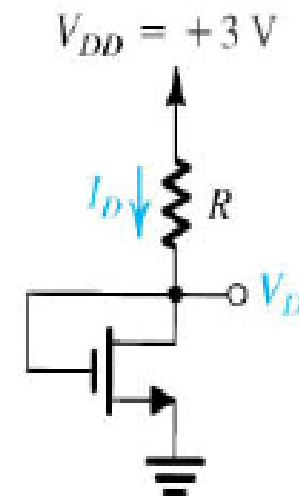
MOSFET Circuits at DC *cont.*

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.

$V_{DD} = 3\text{ V}$

$R_2 = 20\text{ k}\Omega$

R

V_D

Q_2

Q_1

In Which Region Does Q_2 Operate?