دارات الكترونية
المحاضرة /5/ - عملي

الدكتور السموءل صالح
المهندس جبران خليل
المهندسة ايه خيربك

Depletion-type MOSFET

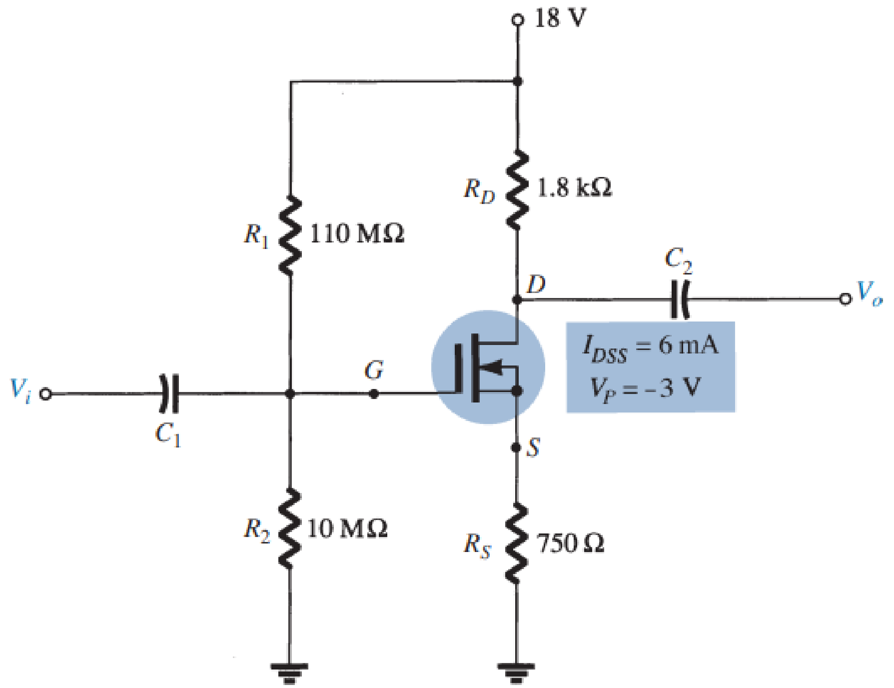
- The similarities in appearance between the transfer curves of **JFETs** and **depletion-type MOSFETs** permit a similar analysis of each in the dc domain.
- The primary difference between the two is the fact that depletion-type MOSFETs permit operating points with positive values of VGS and levels of ID that exceed IDSS. In fact, for all the configurations discussed thus far, the analysis is the same if the JFET is replaced by a depletion-type MOSFET.

Depletion-type MOSFET

- For the n-channel depletion-type MOSFET of the following Fig, determine:

a. I_{DQ} and V_{GSQ}.

b. V_{DS}.



Depletion-type MOSFET

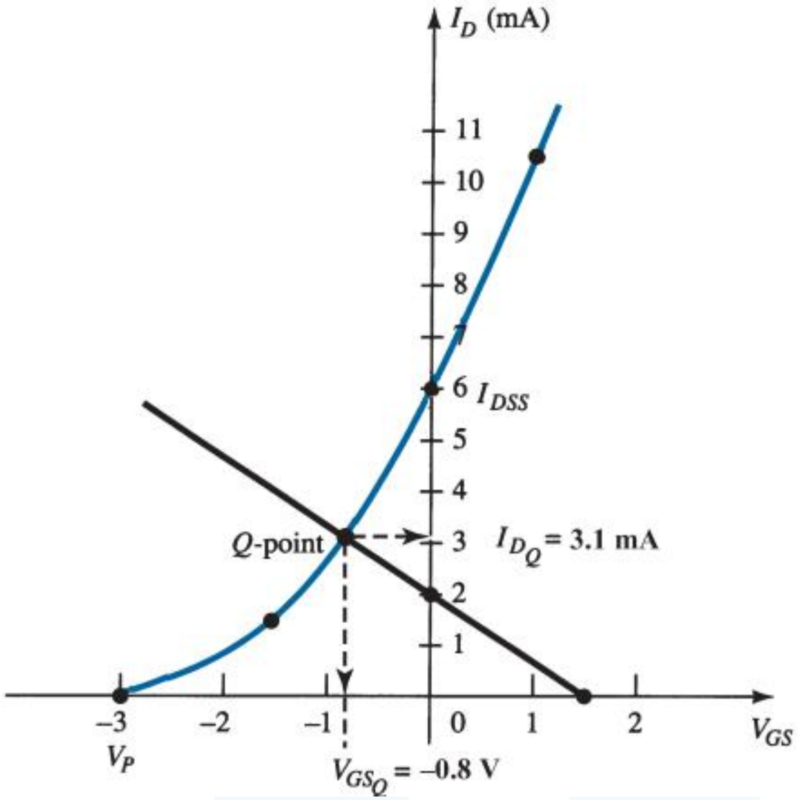
- For the transfer characteristics, a plot point is defined by
  ID = IDSS/4 = 6 mA/4 = 1.5 mA and VGS = VP/2 = -3 V/2 = -1.5 V.
- Considering the level of VP and the fact that Shockley's equation defines a curve that rises more rapidly as VGS becomes more positive, a plot point will be defined at VGS = +1 V.
- Substituting into Shockley's equation yield

$$I_D = I_{Dss}\,(1 - \frac{V_{GS}}{V_p})^2$$

Depletion-type MOSFET

$$I_D = I_{Dss}\,(1 - \frac{V_{GS}}{V_p})^2$$

- $I_D = 6mA(1 - \frac{1}{-3})^2$
- $I_D = 10.67mA$
- The resulting transfer curve appears in the Fig. behind Proceeding as described for JFETs, we have:



Depletion-type MOSFET

- From $V_G = \frac{R_2 V_{DD}}{R_1+R_2}$ => $V_G = \frac{10M\Omega(18V)}{10M\Omega+110M\Omega}$ = 1.5v
- $V_{GS} = V_G - I_D R_S = 1.5 - I_D(750\Omega)$
- Setting I_D = 0 mA results in FET Biasing

VGS = VG = 1.5 V

- Setting $V_{GS} = 0$ V yields

$$I_D = \frac{V_G}{R_S} = \frac{1.5\ v}{750\Omega} = 2mA$$

Depletion-type MOSFET

- The plot points and resulting bias line appear in the previous Fig. The resulting operating point is given by

$$I_{DQ} = 3.1\text{ mA}$$

$$V_{GSQ} = -0.8v$$

b. From $V_{DS} = V_{DD} - I_D (R_S + R_D) = 18v - (3.1mA)(1.8k\Omega + 750\Omega)$=10.1v

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الطريقة الحسابية لايجاد I_D

- $V_{GS} = V_G - I_D R_S = 1.5\ v - I_D (0.75\ (K\Omega))$
- $I_D = I_{Dss} (1 - \frac{V_{GS}}{V_p})^2$
- $I_D = 6 (1 - \frac{1.5 - 0.75\ I_D}{-3})^2$
- $I_D = 6 (1.5 - 0.25\ I_D)^2$
- $I_D = 6(2.25 - 0.75 I_D + 0.0625 {I_D}^2)$
- $I_D = (13.5 - 4.5 I_D + 0.375 {I_D}^2)$
- $0 = 13.5 - 5.5 I_D + 0.375 {I_D}^2$

- $=> I_{D1} = 3.1mA => V_{GS} = -0.8\ v$
- $=> I_{D2} = 11.5\ mA => V_{GS} = -7v$

الحل الثاني يعد مرفوض لان

$V_{GS} > V_p$

و بالتالي

$I_D = 3.1\ mA$