BME 212 Electronics Laboratory

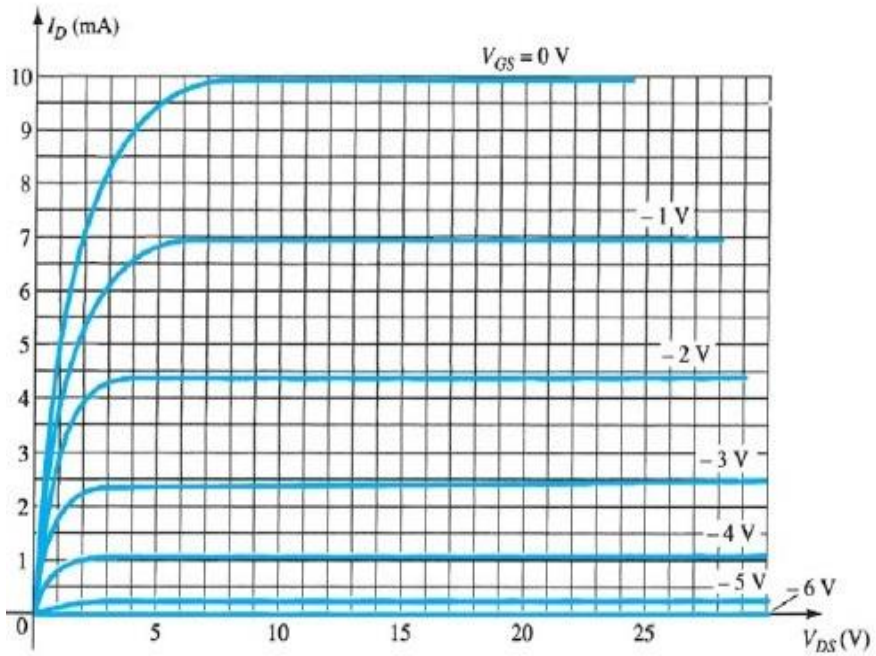
Experiment #6 Transfer Characteristics of FET and DC

Objective

The objective of this experiment is understandig the characteristics of the FET and to become familiar in the use of load-line analysis to examine FET networks.

Preliminary Work

1- Using figure given below determine the values of I_{DSS} and V_P, plot the transfer characteristics using Shockley's equation.



The level of V_{GS} that results in $I_D = 0$ mA is defined by $V_{GS} = V_P$, with V_P being a negative voltage for n-channel devices and a positive voltage for p-channel JFETs.

Shockley's Equation

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

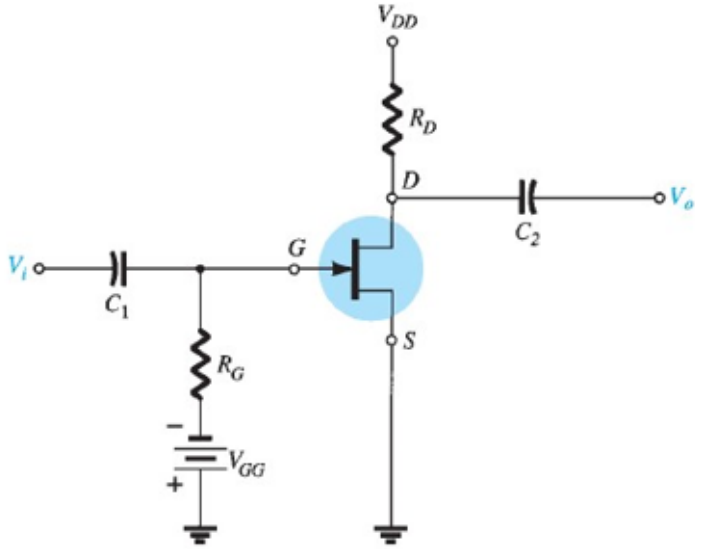
control variable

constants

Preliminary Work (Cont.)

2) For given circuit below using given biasing conditions calculate the V_{GSQ}, I_{DQ}, V_{DS}, V_D,V_G, and V_S.

Plot the transfer characteristic (Shockley curve) of the circuit and repeat the step a.



V_{DD} = 12 V, V_{GG} = -1.5 V

R_D = 1 kΩ, R_G = 470 kΩ

I_{DSS} = 10 mA, V_P = - 4 V

Hints:

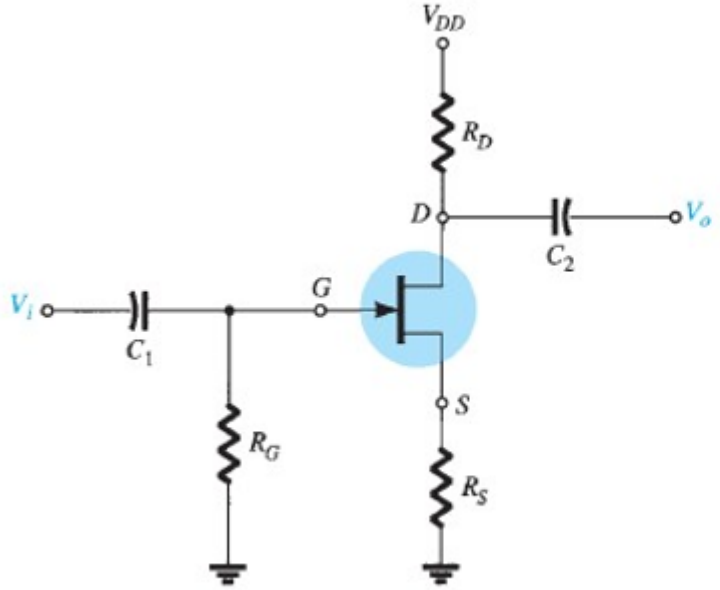
$$V_{GSQ} = -V_{GG}$$

$$I_{DQ} = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$V_{DS} = V_{DD} - I_D R_D$$

Preliminary Work (Cont.)

3) For given circuit below using given biasing conditions, determine the Q point and calculate the V_{GSQ},I_{DQ}, V_{DS}, V_D,V_G, and V_S



$V_{DD} = 15$ V

$R_D = 3.3$ kΩ, $R_G = 1$ MΩ, $R_S = 2$ kΩ

$I_{DDS} = 8$ mA, $V_P = -6$ V

Hints:

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$I_D = \frac{I_{DSS}}{2}$$

$$V_{GS} = -I_D R_S = -\frac{I_{DSS} R_S}{2}$$

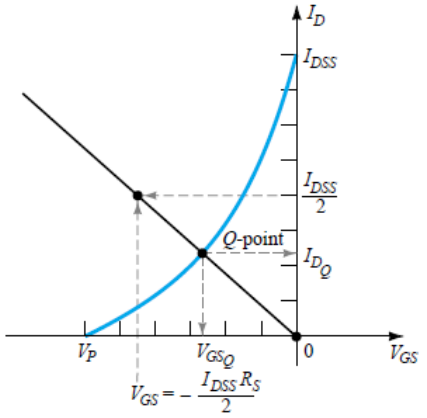
$$V_{GS} = -I_D R_S$$

$$V_{DS} = V_{DD} - I_D(R_S + R_D)$$

$$V_S = I_D R_S$$

$$V_G = 0 \text{ V}$$

$$V_D = V_{DS} + V_S = V_{DD} - V_{R_D}$$

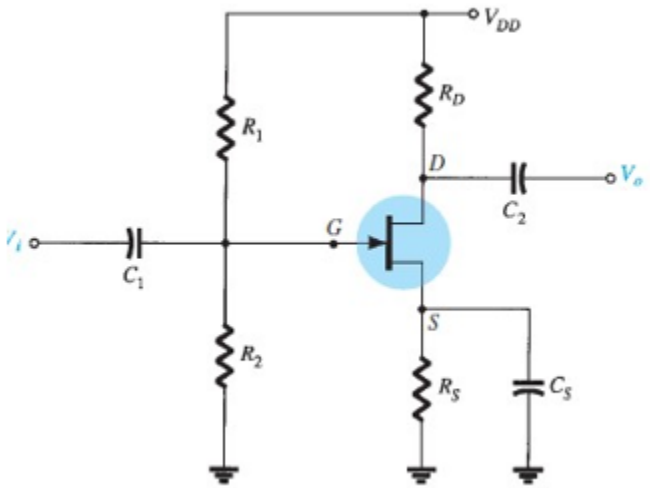


Preliminary Work (Cont.)

4) For given circuit below using given biasing conditions,

a) Determine the Q point and calculate the V_{GSQ},I_{DQ}, V_{DS}, V_D,V_G, and V_S.

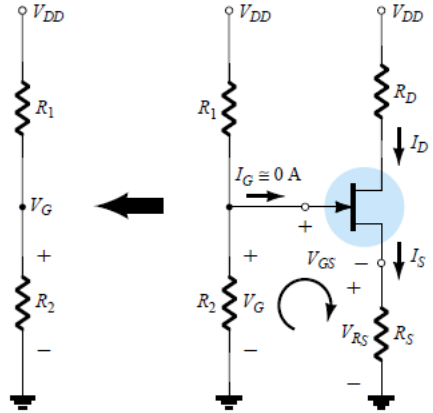
b) If, R_s = 560 Ω repeat the step a.



V_{DD} = 15 V,

R_D = 2.2 kΩ, R_S = 1.5 kΩ, R_1 = 2 MΩ, R_2 = 270 kΩ,

I_{DSS} = 8 mA, V_P = -5 V



Hints:

$$V_G = \frac{R_2 V_{DD}}{R_1 + R_2}$$

$$I_D = \frac{V_G}{R_S}\bigg|_{V_{GS} = 0\,\text{V}}$$

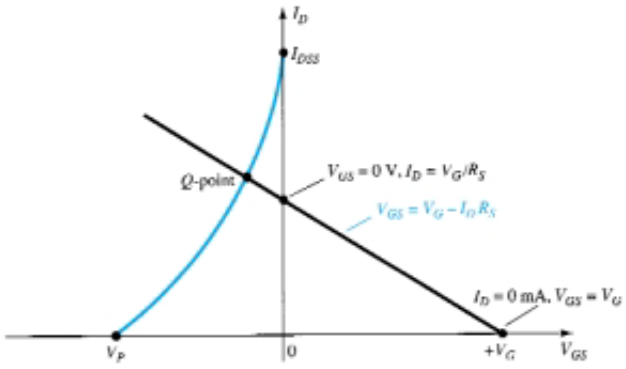
$$V_{GS} = V_G - I_D R_S$$

$$V_{DS} = V_{DD} - I_D(R_D + R_S)$$

$$V_{GS} = V_G\big|_{I_D = 0\,\text{mA}}$$

$$V_D = V_{DD} - I_D R_D$$

$$V_S = I_D R_S$$

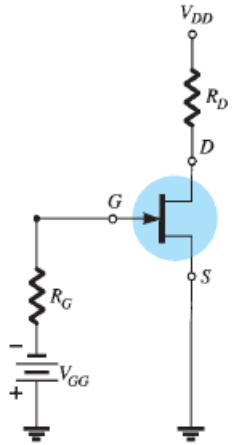


Procedure

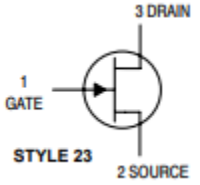
1) For given circuit below

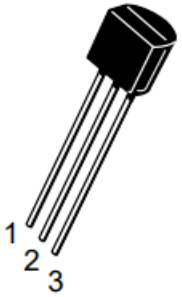
a) Adjust the V_{GG} voltage to have following V_{GS} values and measure the corresponding I_D current value.

V_{GS} (V)	0.0	-0.1	-0.2	-0.4	-0.6	-0.8	-1.0
I_D (mA)							



V_{DD} = 12 V
R_D = 1 kΩ, R_G = 560 kΩ





Procedure

b) Adjust the V_{GG} value to have V_{GS} = -0.1 V. Adjust the V_{DD} voltage value to have V_{DS} voltage shown in table and measure the corresponding I_D values.

V_{DS} (V)	1.0	3.0	6.0	8.0	10.0
I_D (mA)					

c) Adjust the V_{GG} value to have V_{GS} = -0.2 V. Adjust the V_{DD} voltage value to have V_{DS} voltage shown in table and measure the corresponding I_D values.

V_{DS} (V)	1.0	3.0	6.0	8.0	10.0
I_D (mA)					

Procedure

d) Using measurements in step a plot the I_D – V_{GS} characteristic , using measurements in steps b and c plot the I_D – V_{DS} characteristic.

e) As V_{GS} = -0.15 V calculate the I_D point from the I_D – V_{GS} characteristic, measure the I_{DQ} and V_{GSQ} and compare the results.

BME212 Report#6 Results

1) a) Obtaining I_D values.

V_{GS} (V)	0.0	-0.1	-0.2	-0.4	-0.6	-0.8	-1.0
I_D (mA)							

b) Obtaining I_D values for V_{GS} = -0.1 V.

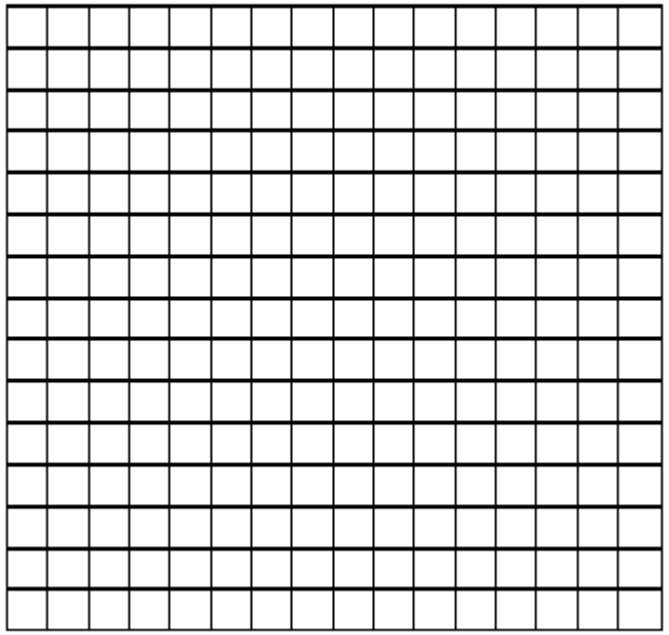
V_{DS} (V)	1.0	3.0	6.0	8.0	10.0
I_D (mA)					

c) Obtaining I_D values for V_{GS} = -0.4 V.

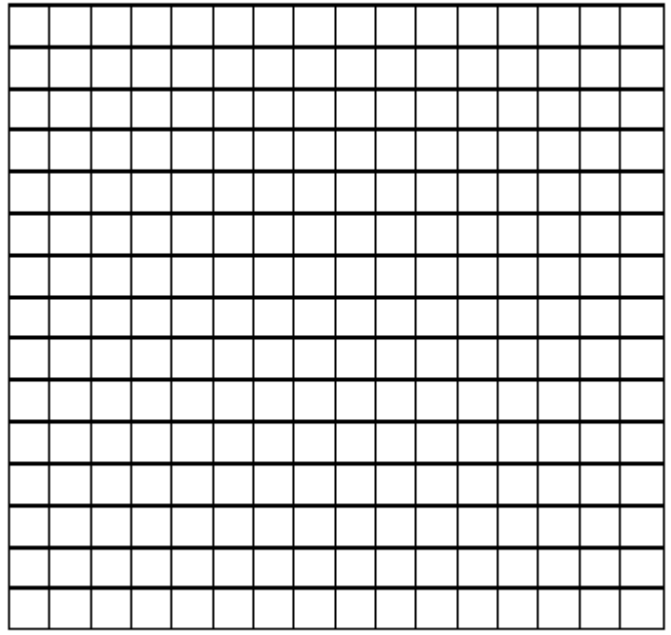
V_{DS} (V)	1.0	3.0	6.0	8.0	10.0
I_D (mA)					

d) Plot characteristics

$I_D - V_{GS}$ characteristic



$I_D - V_{DS}$ characteristic



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Results (Cont.)

e) Obtaining I_{DQ} and V_{GSQ} values

	I_{DQ}	V_{GSQ}
Calculated		
Measured		

Comment: