FIXED-BIAS

JFET DC BIASING

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TOPIC OUTLINE

Fixed-Bias

- Gate-to-Source Loop
- Drain-to-Source Loop
- Transconductance Curve

FIXED-BIAS

GENERAL RELATIONSHIPS

Gate Current

$$i_G \cong 0$$

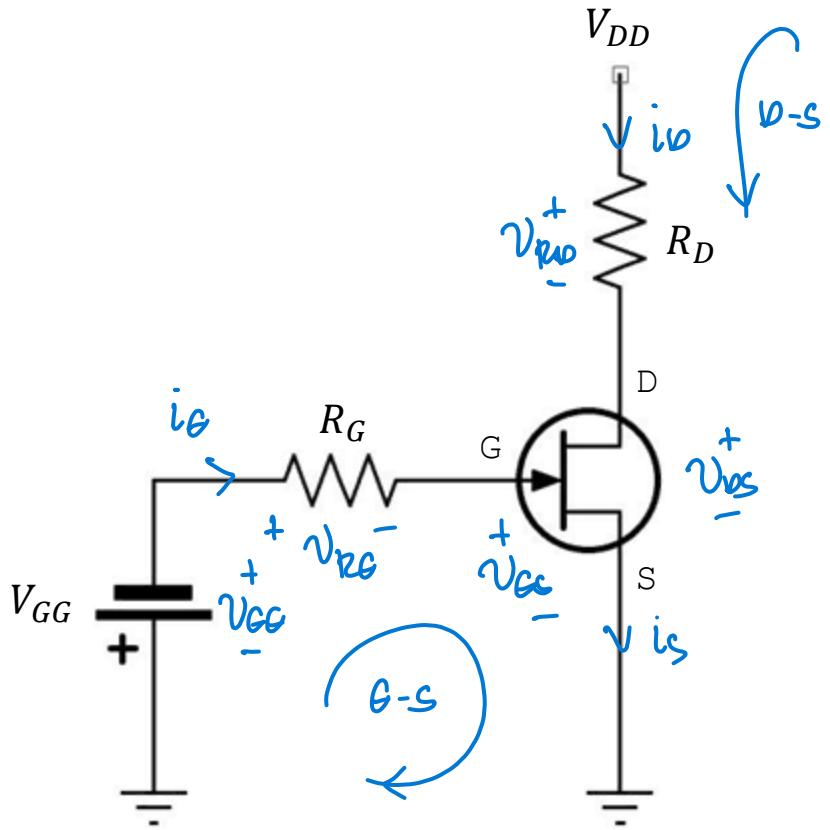
Drain Current

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

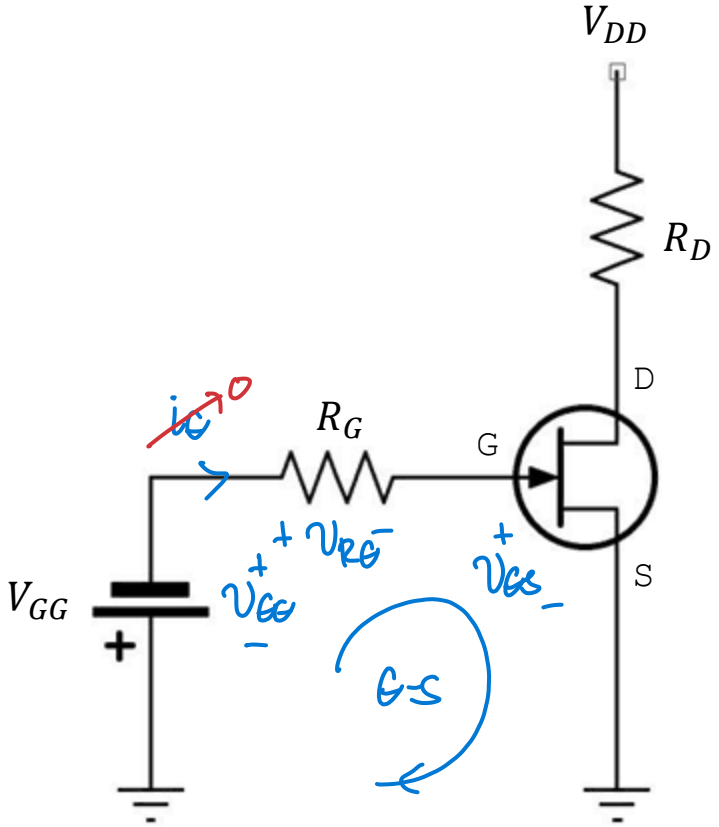
Source Current

$$i_D = i_S$$

FIXED-BIAS CONFIGURATION



GATE-TO-SOURCE



KVL @ G-S

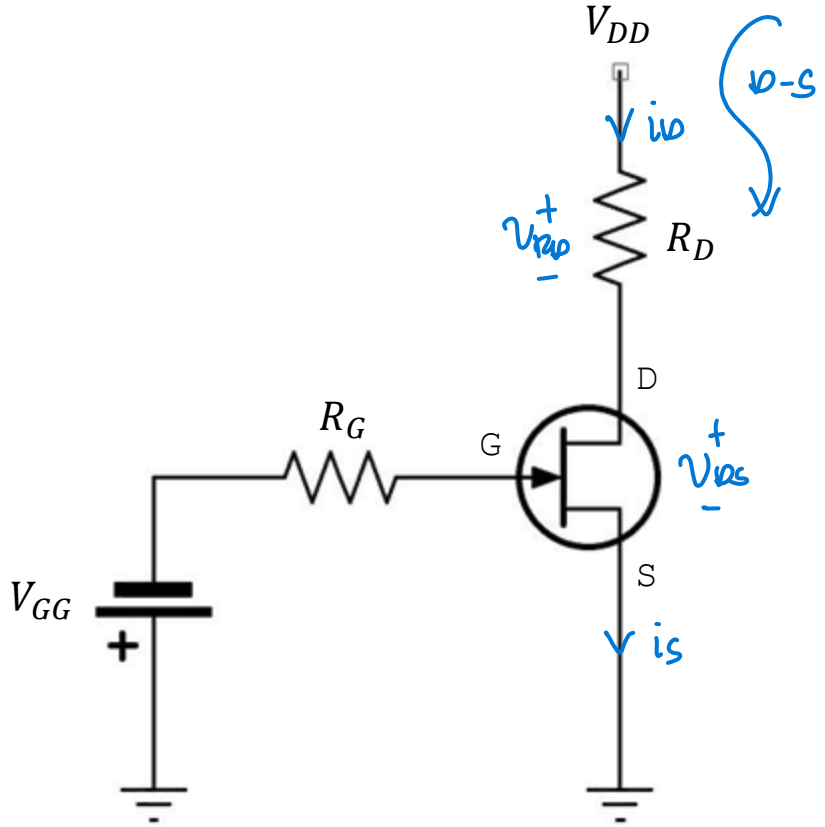
$$-V_{GG} + V_{RG} + V_{GS} = 0$$

$$V_{GS} = V_{GG} - V_{RG}$$

$$V_{GS} = -V_{GG} - i_G R_G$$

$$\boxed{V_{GS} = -V_{GG}}$$

DRAIN-TO-SOURCE



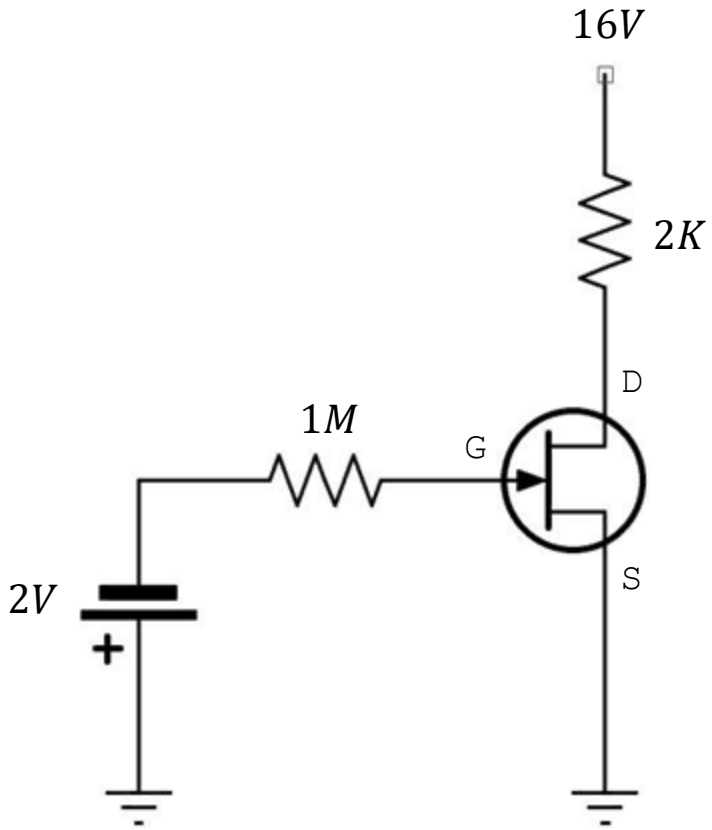
KVL @ D-S

$$-v_{DD} + v_{RD} + v_{DS} = 0$$

$$v_{DS} = -v_{DD} - v_{RD}$$

$$\boxed{v_{DS} = -V_{DD} - i_D R_D}$$

EXERCISE



$I_{DSS} = 10mA$

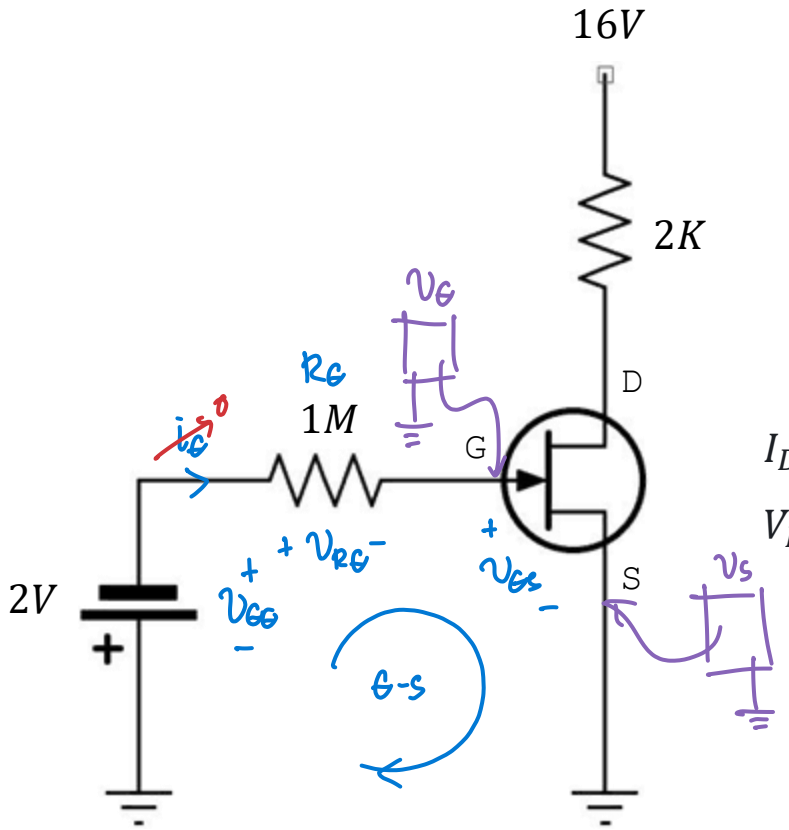
$V_P = -8V$

For the given network, determine the following :

- Gate-source voltage (v_{GSQ})
- Source voltage (v_S)
- Gate voltage (v_G)
- Drain current (i_{DQ})
- Drain-source voltage (v_{DS})
- Drain voltage (v_D)

and sketch the transconductance curve.

EXERCISE



$I_{DSS} = 10mA$

$V_P = -8V$

Solution

KVL @ θ-S

$-V_{GG} + V_{RG} + V_{GS} = 0$

$V_{GS} = V_{GG} - V_{RG}$ ($V_{RG} \to 0$)

$V_{GS} = -V_{GG}$

$\boxed{V_{GS} = -2V}$ ans

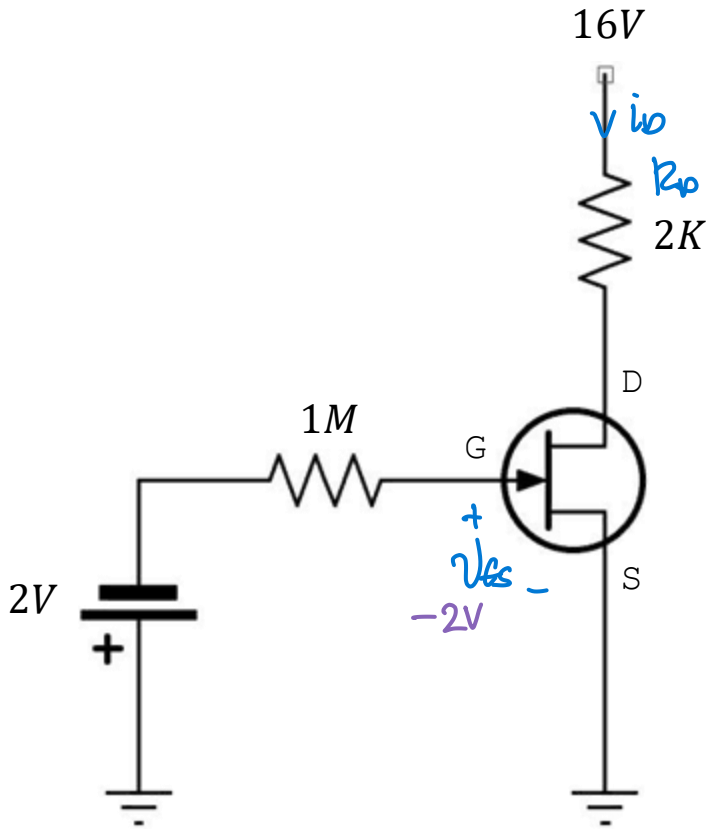
$\boxed{V_G = 0}$ ans

Node Method

$V_{GS} = V_G - V_S$ ($V_S \to 0$)

$\boxed{V_G = -2V}$ ans

EXERCISE



$I_{DSS} = 10mA$

$V_P = -8V$

Solution

Shockley's equation

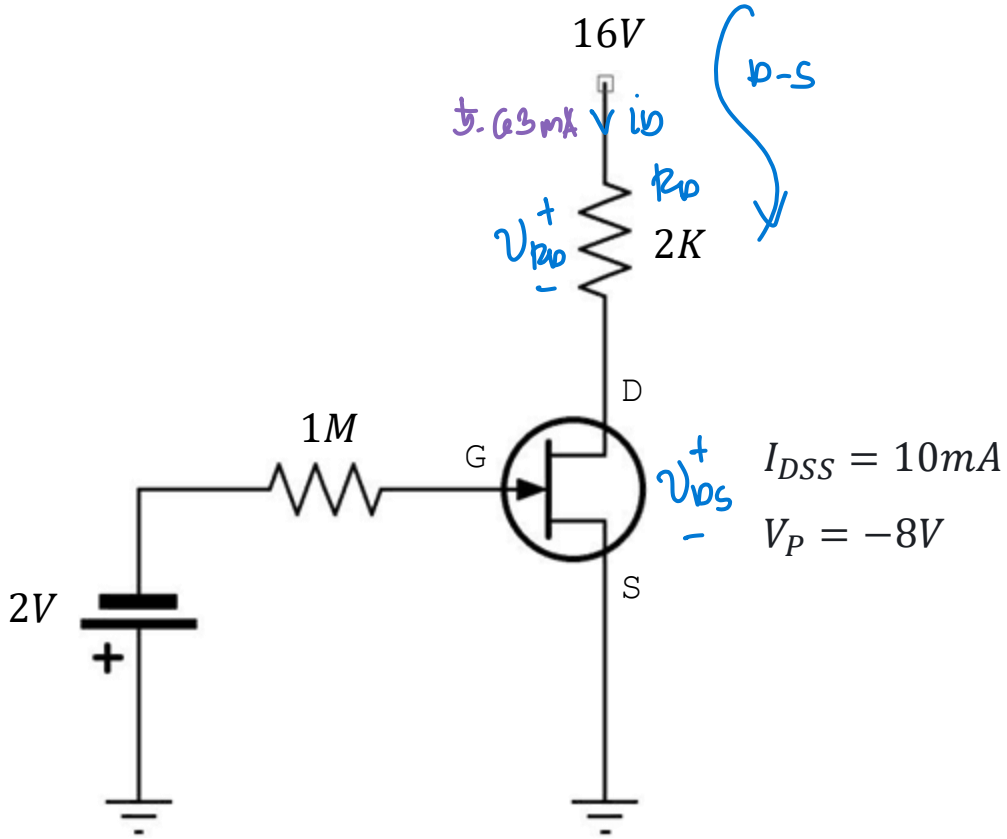
$$i_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$i_D = 10\,m\left(1 - \frac{-2}{-8}\right)^2$$

$$i_D = 5.63\,mA$$

ans

EXERCISE



Solution

KVL @ D-S

$$-V_{DD} + V_{RD} + V_{DS} = 0$$

$$V_{DS} = V_{DD} - V_{RD}$$

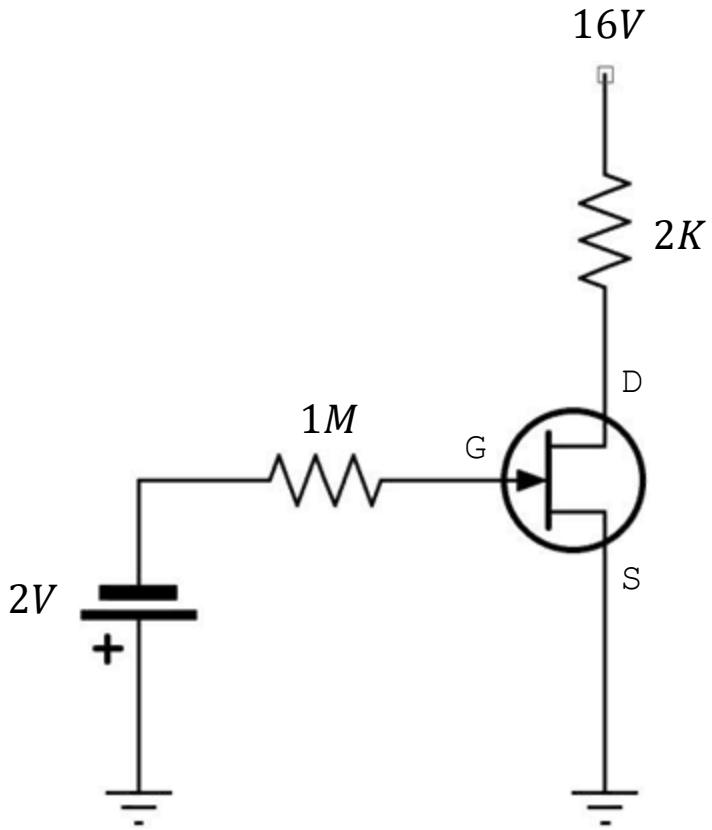
$$V_{DS} = V_{DD} - i_D R_D$$

$$V_{DS} = 16 - 5.63m(2k)$$

$$\boxed{V_{DS} = 4.74\ V}$$

ans

EXERCISE



$I_{DSS} = 10mA$

$V_P = -8V$

Solution

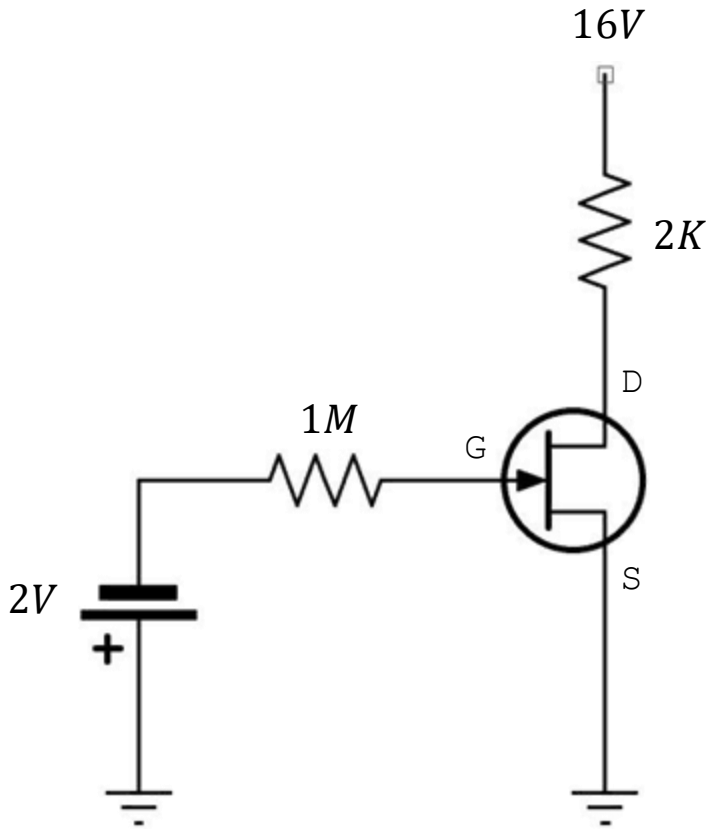
Transconductance Curve

$i_D = \frac{1}{4} I_{DSS} \Big| v_{GS} = \frac{1}{2} V_P$

$i_D = \frac{1}{4}(10\,m) \Big| v_{GS} = -4V$

$i_D = 2.5\,mA \Big| v_{GS} = -4V$

EXERCISE



$I_{DSS} = 10mA$

$V_P = -8V$

Solution

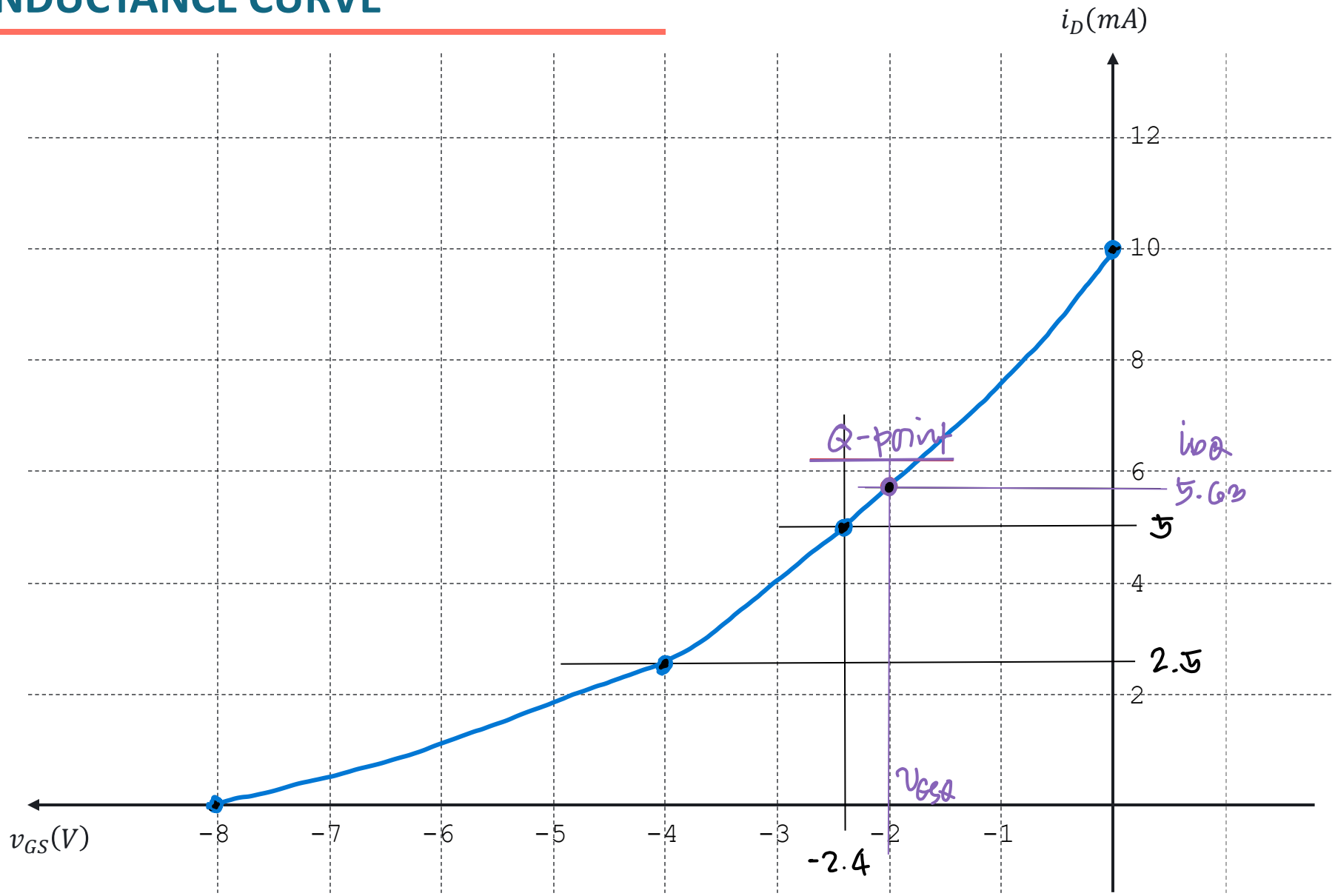
Transconductance Curve

$v_{GS} = 0.3V_P \mid i_D = \frac{1}{2} I_{DSS}$

$v_{GS} = 0.3(-8) \mid i_D = 5mA$

$v_{GS} = -2.4V \mid i_D = 5mA$

TRANSCONDUCTANCE CURVE



LABORATORY