

Q1. A silicon n-channel MOSFET has a length of 100 nm and a width of 250 nm. It has an oxide thickness of 10 nm. Calculate the MOS oxide capacitance and the drain current at a gate-source voltage of 3 volts with a drain-source voltage of 6 volts if the threshold voltage is +2 volts. Take electron mobility in silicon to be 1100 cm<sup>2</sup>/v.sec and the permittivity of silicon dioxide to be 3.5x10<sup>-11</sup> Farad/meter.

**Find**

$$C_{ox}$$

$$I_{drain}$$

**Given Values**

$$\epsilon = 3.5 * 10^{-11} F/m$$

$$L = 100 * 10^{-9} m$$

$$W = 250 * 10^{-9} m$$

$$T_{oxide} = 10 * 10^{-9} m$$

$$v_{gs} = 3V$$

$$v_{ds} = 6V$$

$$V_{TN} = 2V$$

$$\mu = 1100 \frac{cm^2}{V * S}$$

**Governing Equations**

$$C_{ox} = \frac{\epsilon}{T_{oxide}}$$

$$K_n = \mu_n C_{ox}$$

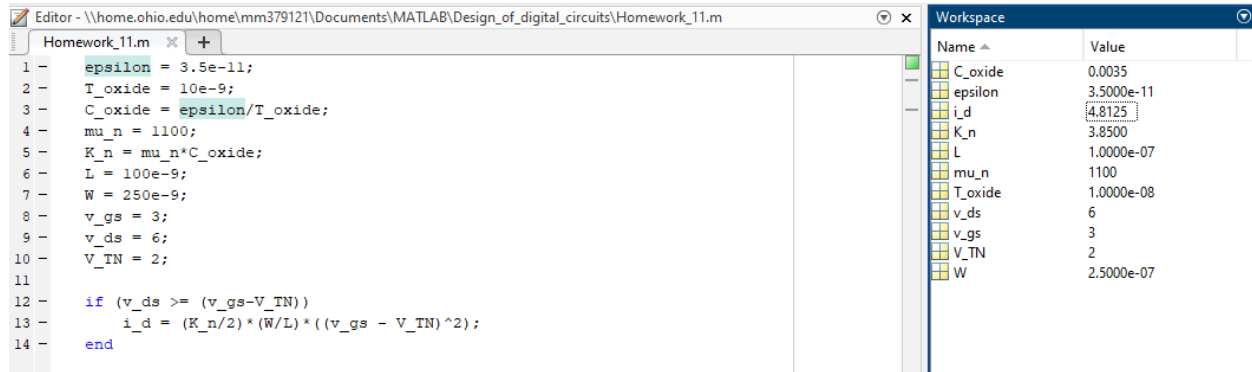
$$i_D = \frac{K_n W}{2 L} (v_{GS} - V_{TN})^2$$

$$\text{when } v_{ds} \geq v_{GS} - V_{TN}$$

### Code and Solution

$$C_{ox} = 3.5\text{mF}$$

$$I_{drain} = 4.8125 \text{ A}$$



The image shows a MATLAB Editor window with a script named 'Homework\_11.m' and a Workspace window. The script calculates the oxide capacitance  $C_{ox}$  and the drain current  $I_d$  based on given parameters. The Workspace window displays the values of the variables used in the script.

```
1 - epsilon = 3.5e-11;
2 - T_oxide = 10e-9;
3 - C_oxide = epsilon/T_oxide;
4 - mu_n = 1100;
5 - K_n = mu_n*C_oxide;
6 - L = 100e-9;
7 - W = 250e-9;
8 - v_gs = 3;
9 - v_ds = 6;
10 - V_TN = 2;
11
12 - if (v_ds >= (v_gs-V_TN))
13 -     i_d = (K_n/2)*(W/L)*((v_gs - V_TN)^2);
14 - end
```

Name	Value
C_oxide	0.0035
epsilon	3.5000e-11
i_d	4.8125
K_n	3.8500
L	1.0000e-07
mu_n	1100
T_oxide	1.0000e-08
v_ds	6
v_gs	3
V_TN	2
W	2.5000e-07