Electronics I
EENG 3510

Lecture 16

Shengli Fu
5.5 Small-Signal Operation And Models

5.5.4 Separating the DC Analysis and the Signal Analysis

\[ i_D = I_D + i_d \]
\[ v_D = V_D + v_d \]

Figure 4.34 Conceptual circuit utilized to study the operation of the MOSFET as a small-signal amplifier.
5.5.8 Summary

- **Small Signal Parameters**

  Transconductance: \( g_m = \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_t) = \sqrt{2\mu_n C_{ox} \frac{W}{L} I_D} = \frac{2I_D}{(V_{GS} - V_t)} \)

  Output Resistance: \( r_O = V_A / I_D = 1 / \lambda I_D \)

- **Small Signal Equivalent Circuit Models**

  Hybrid-\( \pi \) model

  T models
5.6 The Three Basic Configurations

(a) Common Source (CS)  
(b) Common Gate (CG)  
(c) Common Drain (CD)
5.6 The Three Basic Configurations

5.6.3 The CS Amplifier

\[ \frac{v_o}{v_{sig}} = -\frac{R_D}{1/g_m} \]
5.8 Discrete-Circuit MOS Amplifiers

5.8.2 The Common-Source (CS) Amplifier

Open current sources
Short voltage sources
Plug in small-signal models
5.8 Discrete-Circuit MOS Amplifiers

5.8.4 The Common-Gate Amplifier
5.8 Discrete-Circuit MOS Amplifiers

5.8.5 The Common-Drain Amplifier (Source Follower)