PROBLEM 1

The drain characteristics for Q1 are displayed in Fig A and Fig B are its transfer characteristics. Figure C are the drain characteristics of Q2 for 0 \leq V_{in} \leq 6V, plot \text{Vout} \text{ vs. } V_{in}.

PROBLEM B

The MOSFET is used:

\[ I_D = 0.8 \left( V_{gs} - 2 \right)^2 \text{ mA and } V_{g} \leq V_{th} \]

1) Determine the dc values of \text{I}_1 \text{ and } \text{I}_2.

2) What is \text{I}_D ?

Note: This can be solved analytically if one writes and equation for \text{I}_D in the gate loop and another for \text{I}_D in the drain-source loop.

PROBLEM C

1. For the circuit in (B), draw the small-signal model indicating all values.

2. Solve for \text{A}_{v1} = \frac{\text{V}_1}{\text{V}_0} \text{ when } \text{R}_0 = 0

3. Solve for \text{A}_{v2} = \frac{\text{V}_2}{\text{V}_0} \text{ when } \text{R}_0 = 0

4. Solve for \text{A}_{v3} = \frac{\text{V}_3}{\text{V}_0} \text{ when } \text{R}_0 \text{ is included.}

5. Solve for \text{A}_{v4} = \frac{\text{V}_4}{\text{V}_0} \text{ when } \text{R}_0 \text{ is included.}

6. In (A), if \text{R}_0 = 0, do you get the result in (1)?

7. In (5), if \text{R}_0 = 0, do you get the result in (2)?
ENHANCEMENT MOSFETS

**FIG A**

- NMOS
- $I_D, \mu A$
- $V_{DS}, V$
- $V_{GS} = 2$

**FIG B**

- PMOS
- $I_D, \mu A$
- $V_{DS}, V$
- $V_{GS} = 1$
Characteristics of Q2

Depletion NMOS
PROBLEM 1

1. With both $R_s$ and $R_D$ present in the circuit of Prob. B, evaluate $R_{o1}$ and $R_{o2}$ (small-signal).

2. How is $R_{o1}$ affected by the inclusion of $R_s$?
3. How is $R_{o2}$ affected by the inclusion of $R_D$?

PROBLEM E

1. What change or changes must be made to the circuit in Prob. B if the NMOS transistor is replaced by a PMOS transistor?

2. If the characteristics of the PMOS and NMOS are completely complementary, what changes, if any, in Prob. C exist?