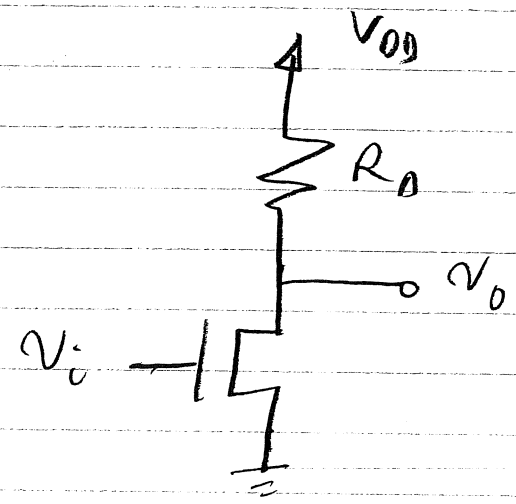
LAB 1



1) SMALL SIGNAL GAIN $A_v = -g_m R_D$ (1)

$$g_m = \frac{2I_D}{V_{OV}} \quad (2)$$

FOR MAX SWING

$V_{D\_MAX} = V_{DD}$

$V_{D\_MIN} \cong V_{OV}$ ← THIS IS AN APPROXIMATION (DEPENDS ON GAIN)

SO BIAS V_D AT MIDDLE OF V_{D_MAX} & V_{D_MIN}

$$V_D = \frac{V_{DD} + V_{OV}}{2} \quad (3)$$

ALSO

$$V_D = V_{DD} - I_D R_D \quad (4)$$

COMBINE (3) & (4)

$$R_D = \frac{V_{DD} - V_{OV}}{2I_D} \quad (5)$$

PUT (5) & (2) INTO (1)

$$A_V = \left(\frac{-2I_D}{V_{OV}}\right)\left(\frac{V_{DD} - V_{OV}}{2I_D}\right) = -\left(\frac{V_{DD} - V_{OV}}{V_{OV}}\right)$$

$$A_V = -\left(\frac{V_{DD} - V_{OV}}{V_{OV}}\right) \quad (6)$$

2) FOR FIRST 2 LINES OF TABLE 1

1) CALCULATE $V_{OV} = \sqrt{(2I_D)/(\mu_n C_{ox} W/L)}$

2) CALCULATE g_m USING (2)

3) CALCULATE R_D USING (5)

4) CALCULATE A_V USING (1) OR (6)

5) CALCULATE V_O USING (4)

(V_D BIAS)

2) FOR SWING = 0.2 V_{pp}

d GIVEN I_D, TO MAX GAIN SHOULD MAXIMIZE R_D

TO MAX R_D SET V_D AS LOW AS POSSIBLE SUCH THAT TRANSISTOR STAYS ACTIVE

$V_{D\_MIN} = V_{OV}$

$V_{o\ pp} = 0.2V$ SO SET

$V_D = V_{D\_MIN} + \left(\frac{1}{2}\right) V_{o\ pp}$

$V_D = V_{OV} + 0.1$

SOLVE FOR REST OF PARAMETERS.