EECS 140 SPRING 96 MIDTERM 1
RW BRODERSEN

Use the following model parameters

\[ K_p' = K_n' = 100 \ \mu \text{A/V}^2 \]
\[ \Lambda_n = \Lambda_p = 0.02 \]
\[ \Gamma_n = \Gamma_p = 0 \]
\[ V_{tn} = V_{tp} = 1 \text{v} \]

1a) \( V_{t0} \)
1b) \( \Gamma \)
1c) \( k' \)
1d) \( \Lambda \)

2) \( (W/L)_{mx} \)

3a) \( I_{ds} \)
3b) \( V_{out} \)
3c) \( R_{in} \)
   \[ R_{out} \]
   \[ A_v \]

4) \( V_{out, \text{max}} \)
   \[ V_{out, \text{min}} \]

5) \( R_l \)
   \[ R_{ref} \]

6) \( I_{out}/I_{ref} \)

7) \( (W/L)_{m1} \)
   \[ (W/L)_{m2} \]
   \[ (W/L)_{m3} \]
   \[ (W/L)_{m4} \]
   \[ (W/L)_{m5} \]
   \[ R \]

8) \( R_{out} \)

9) \( R_{out} \)
   \[ A_v \]

1) Calculate \( \Lambda, k', \Gamma, \text{AND } V_{t0} \) Assuming that \( W/L = 1 \) and \( 2\Phi = 6 \text{V} \) for this n-channel mosfet.

2)
\[(W/L)m_1 = (W/L)m_2 = (W/L)m_3 = (W/L)m_4 = (W/L)m_5 = 10\]

What is the value of \((W/L)m_x\) so that \(V_{out}\) has a DC voltage of 0V? (You don't need \(R\) and remember \(\text{GAMMA} = 0\))

3)

a) What is \(I_{ds}\) of \(m_1\)?

b) What is the DC voltage at \(V_{out}\)?

c) If \(I_{ds}(m_1) = 10 \, \text{"mu" A}\), what are \(R_{in}, R_{out},\) and \(A_v\)

4)

If \(V_{in}\) can vary from 0 - 5 V, what is the range of \(V_{out}\)?

5)

Calculate the values of \(R_l\) and \(R_{ref}\) so that the DC voltage at \(V_{out} = 0V\) and the...
Assume all transistors have \( V_t = 1 \)V and \( V_{dsat} = 0.2 \)V with \( \text{LAMBDA} = 0.1 \)

What is the ratio \( \frac{I_{out}}{I_{ref}} \) if \( V_o \) is at 0V?

7)

Choose the (W/L)'s and R so that the current source gives an \( I_{out} = 100 \) "mu"A independent of the supplies. (many answers are possible)

8)

What is \( R_{out} \)?

9)

a) What is \( R_{out} \)?

b) What is \( A_v = \frac{V_{out}}{(V_i^+ - V_i^-)} \)?