Problem 1  For the following circuit

a) Determine the small signal voltage gain $A_v = \frac{V_{OUT}}{V_{in}}$.

b) Determine the quiescent power dissipation.
Problem 2 For the amplifier shown, assume that the device dimensions are as indicated.

a) Determine the small signal voltage gain $A_v = \frac{V_{OUT}}{V_{in}}$.

b) Determine the steady state output voltage if $V_{in} = .01 \sin(2000t)$.
Problem 3  
For the circuit shown, determine the variables indicated with a ?.
Problem 4  Assume a 2-port network is characterized by the equations

\[
I_1 = 2V_1^2V_2 \\
I_2 = V_1 + 5e^{\frac{V_2}{4}}
\]

a) Determine a small-signal equivalent circuit at the operating point \( V_{1O} = 3 \), \( V_{2O} = 1 \)

b) Determine the quiescent currents \( I_{1Q} \) and \( I_{2Q} \) at the operating point given in a)
Problem 5  Using the definition for $t_{HL}$ and $t_{LH}$ given in class, obtain $t_{HL}$ and $t_{LH}$ at the output for the following circuit.
Problem 6    Determine \( W \) of the p-channel transistor so that the trip point of the following inverter is at 1.5V.

\[
\begin{align*}
5 \text{ V} & \\
\text{M}_2 & \\
W = ? & \\
L = 2 \mu & \\
\text{M}_1 & \\
W = 2 \mu & \\
L = 2 \mu &
\end{align*}
\]
Problem 7
a) Obtain the Boolean expression for the output variable $F$

$$F = \overline{(A \cdot B)} + C$$

b) Using static CMOS, design a circuit at the transistor level that implements the following Boolean function. Assume only the Boolean inputs $A, B$ and $C$ are available. You need not size the devices.