P5-1. Consider the RTL gate shown.

![RTL gate diagram](Figure P5-1)

- Determine $V_{IL}$, $V_{IH}$, $V_{OL}$, and $V_{OH}$.
- Determine the noise margins $V_{NML}$ and $V_{NMH}$.
- Estimate the average DC dissipation with no load.

P5-3. For the RTL inverter, $V_{IN} = 1$V as shown. No load gates are connected.

![RTL inverter diagram](Figure P5-3)

- Determine the mode of operation for the transistor.
- Determine the supply current $I_{CC}$.
- Determine the output voltage $V_{OUT}$. 
P5-6. For the RTL NOR gate, the inputs are as shown. Assume N = 5.

![Figure P5-6](image)

a. Determine the mode of operation for each of the three transistors.
b. Determine the supply current $I_{CC}$.
c. Determine the output voltage $V_{OUT}$.

P5-10. Consider the RTL inverter below.

![Figure P5-10](image)

a. Determine the maximum fanout assuming that the minimum value of the high noise margin is 0.2V. Assume $\sigma_{\text{MAX}} = 0.5$.
b. Determine the noise margins $V_{NML}$ and $V_{NMH}$ for the case of no load.
c. Determine the noise margins $V_{NML}$ and $V_{NMH}$ for the case of $N = N_{\text{MAX}}$. 
P5-12. Consider the RTL gate shown below.

![Figure P5-12](image)

Figure P5-12

a. Use SPICE to calculate and plot the unloaded VTC for this gate.
b. Hand calculate the unloaded VTC, and plot it on the same graph as the SPICE results. Compare the SPICE and hand calculations.

P5-23. Consider the unloaded RTL gate circuit.

![Figure P5-23](image)

Figure P5-23

a. Determine the propagation delays by hand calculations.
b. Determine the propagation delays using SPICE.
P5-26. Consider an RTL inverter as shown.

Choose values of $R_B$ and $R_C$ such that the average DC power dissipation is 30mW ($N = 8$) and the maximum fanout is 8 (with $V_{NMH} = 0.1V$).