Problem 1

Given the circuit in Figure 1 hand derive the symbolic expressions for

1. As = vout/vs
2. Rin, that is the Thevenin equivalent resistance looking into terminals 1 and 0 (in the direction shown by the arrow)
3. Rout, that is the Thevenin equivalent resistance looking into terminals 2 and 0 (in the direction shown by the arrow)

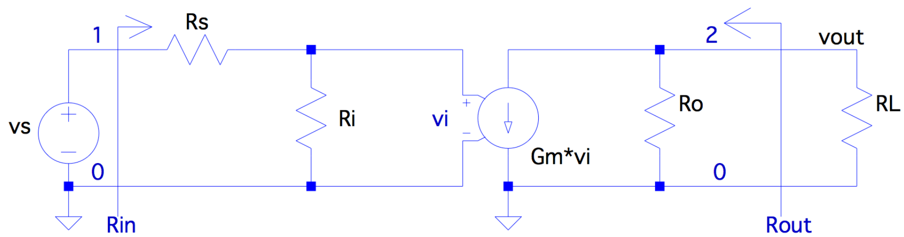

Figure 1

4. Verify your results by simulating the given circuit with LTSPICE. Assume the following values vs=1V, Rs=1Ω, Ri=1KΩ, Gm=1mS, Ro=1MΩ, RL=10KΩ. Hint: take a look at the .TF analysis. Make sure to 1) attach your LTSPICE schematic and your simulation results, and 2) explain any discrepancies.

Problem 2

Given the circuit in Figure 2 use matlab symbolic toolbox to derive an expression for

1. As = vout/vs
2. Rin, that is the Thevenin equivalent resistance looking into terminals 1 and 0
3. Rout, that is the Thevenin equivalent resistance looking into terminals 2 and 0
4. Find the <u>practical</u> conditions under which vout/vs, Rin, and Rout are approximately the same as you derived for the circuit in Figure 1

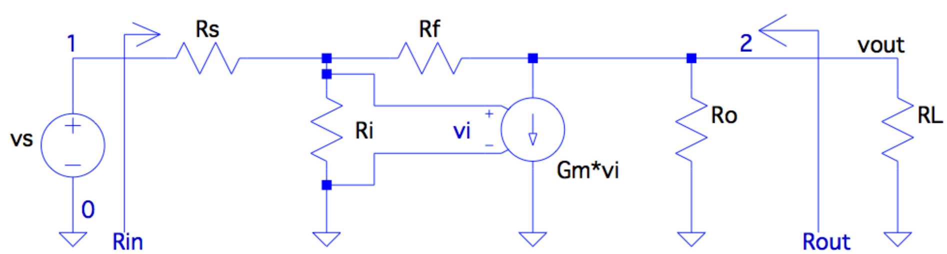

Figure 2

<u>Make sure to attach you matlab script and its output.</u>

Problem 3

Given the RC circuit in Figure 3 find out:

1. The transfer function $T(j\omega)=Vout(j\omega)/Vin(j\omega)$.
   Note: for a given value of R, C, and ω the transfer function is simply a complex number
2. The expression of the magnitude of the transfer function $M = |T(j\omega)|$
3. The expression of the phase of the transfer function Φ = angle $[T(j\omega)]$
4. What is the approximate value of M for very small values of ω (that is $\omega \rightarrow 0$)
5. What is the value of M for $\omega=1/(RC)$
6. What is the approximate value of M for very large values of ω (that is $\omega \rightarrow \infty$)
7. What is the approximate value of Φ for very small values of ω (that is $\omega \rightarrow 0$)
8. What is the value of Φ for $\omega=1/(RC)$
9. What is the approximate value of Φ for very large values of ω (that is $\omega \rightarrow \infty$)

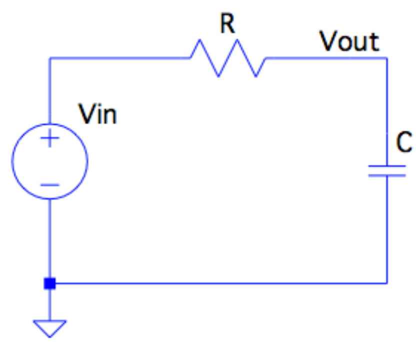

Figure 3

Problem 4

Assuming the input to the RC circuit in Figure 3 is $v_{in}(t) = V_{DD} \times [u(t)-u(t-T)]$
and $T >> \tau=RC$:

1. Draw v_{in} vs. t and v_{out} vs. t
2. What is the equation of $v_{out}(t)$ for $-\infty \leq t \leq T$
3. What is the equation of $v_{out}(t)$ for $t > T$