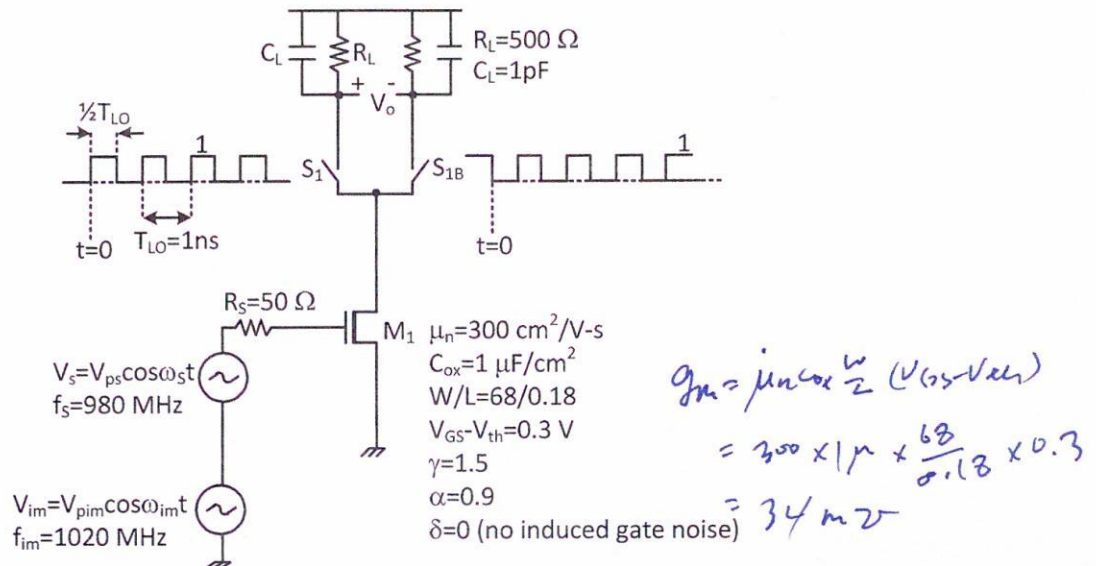


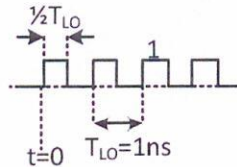
1. In the mixer shown below, DC characteristic of the NMOS, M1, is set by square-law characteristic, i.e.

$$I_{DS} = \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_{TH})^2.$$

Assume that $R_s \ll 1/\omega C_g$ and NMOS has only drain thermal noise current, i.e., no gate induced noise and parasitic gate resistance. The drain thermal noise coefficient is γ . S_1 and S_{1B} are ideal differential switches driven by ideal rectangular pulse trains whose duty cycle is 50%. R_L is noisy load resistor.



*You may need this series expression for question #1.



$$\text{rect}(t) = \frac{1}{2} + \sum_{n=1}^{n=\infty} \left(\frac{2}{(2n-1)\pi} \sin(2n-1)\omega_{LO} t \right)$$