AC MOSFET

$$gm \vec{V_s} e^{j0} \quad gm \vec{V_s}$$
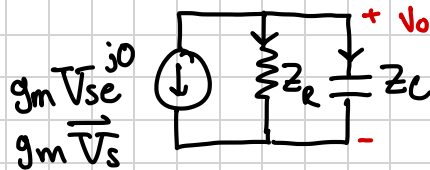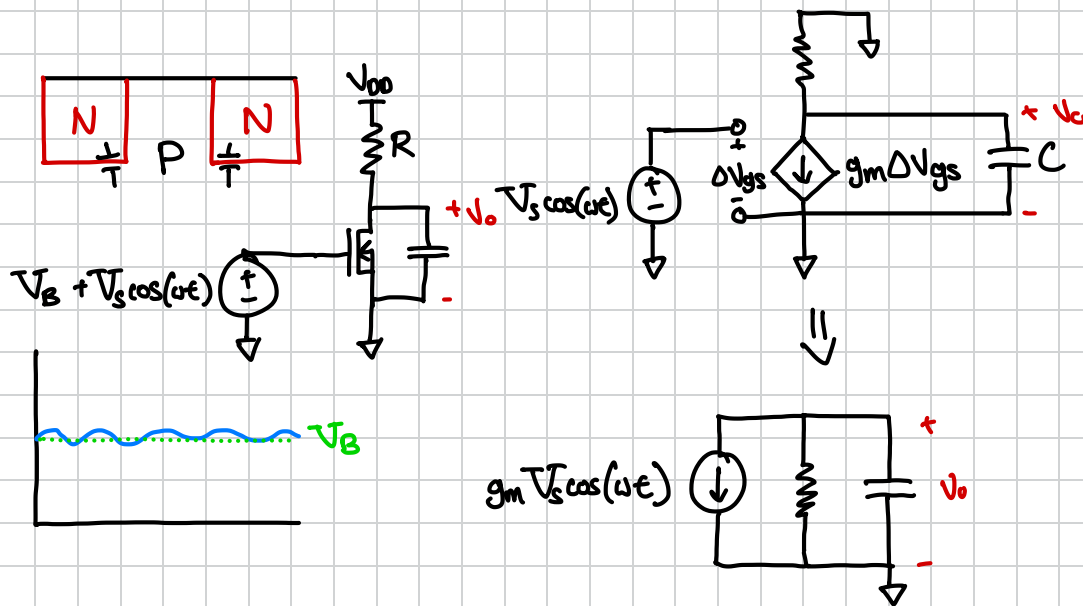
$$gm \vec{V_s} + \frac{\vec{V_o}}{Z_R} + \frac{\vec{V_o}}{Z_c} = 0$$

$$gm \vec{V_s} + \frac{\vec{V_o}}{R} + \vec{V_o} \times j\omega C = 0$$

$$R gm \vec{V_s} + \vec{V_o} + \vec{V_o} \times j\omega C = 0$$

$$TF = \frac{\vec{V_o}}{\vec{V_s}} = \frac{-gmR}{1+j\omega CR}$$

$$|TF| = \frac{gmR}{\sqrt{1+(\omega RC)^2}} = \frac{V_o}{V_s}$$

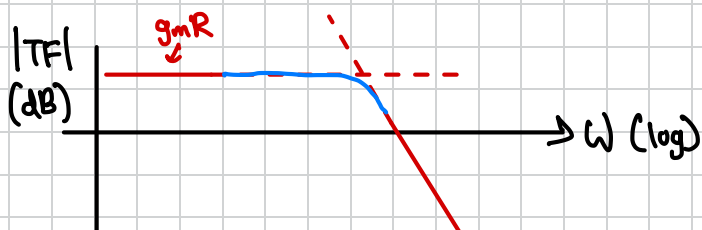$$\angle TF = \tan^{-1}\left(\frac{0}{-1}\right) - \tan^{-1}\left(\frac{\omega RC}{1}\right)$$

$$= 180° - \tan^{-1}\left(\frac{\omega RC}{1}\right)$$

$$TF = |TF| e^{j\angle TF}$$

PLOT |TF| dB VS ω log

$$|TF|_{low\,freq} \approx gmR = gmR \times \omega^0 \quad Slope = 0 \frac{dec}{dec} = 0 \frac{dB}{dec}$$

$$|TF|_{high\,freq} \approx \frac{gmR}{\omega RC} = \frac{gm}{\omega C} = \frac{gm}{C} \times \omega^{-1} \quad Slope = -1 \frac{dec}{dec} = -20 \frac{dB}{dec}$$

$$\omega = \frac{1}{RC} \quad |TF| = \frac{gmR}{\sqrt{2}}$$

$$\Delta V_o = |TF| V_i \cos(\omega t + \angle \vec{V_i} + \angle TF)$$