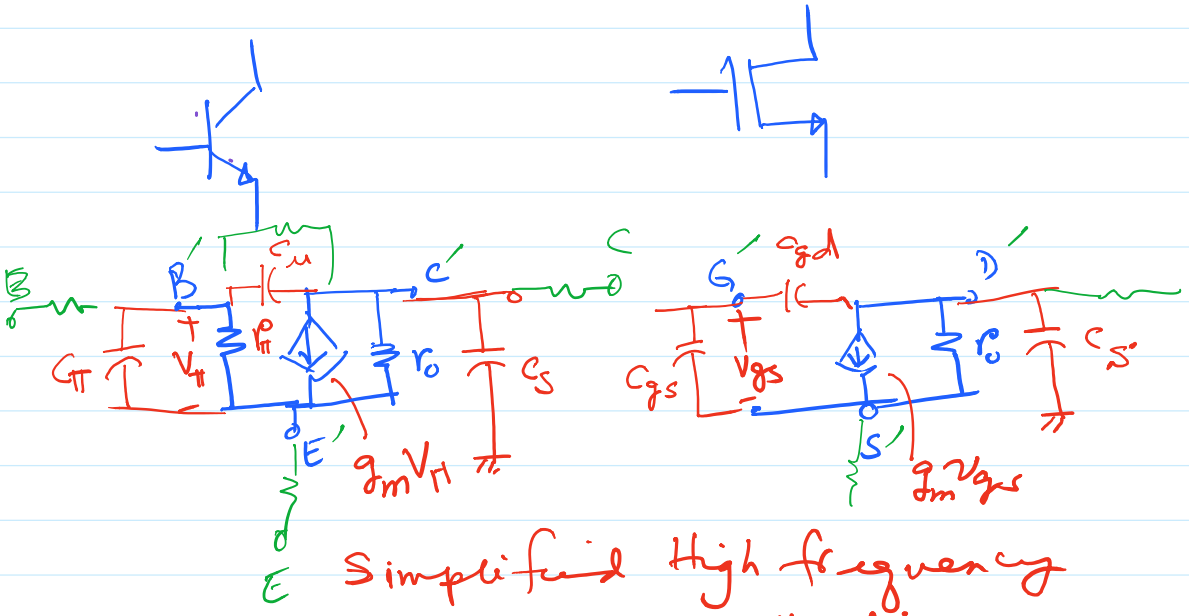
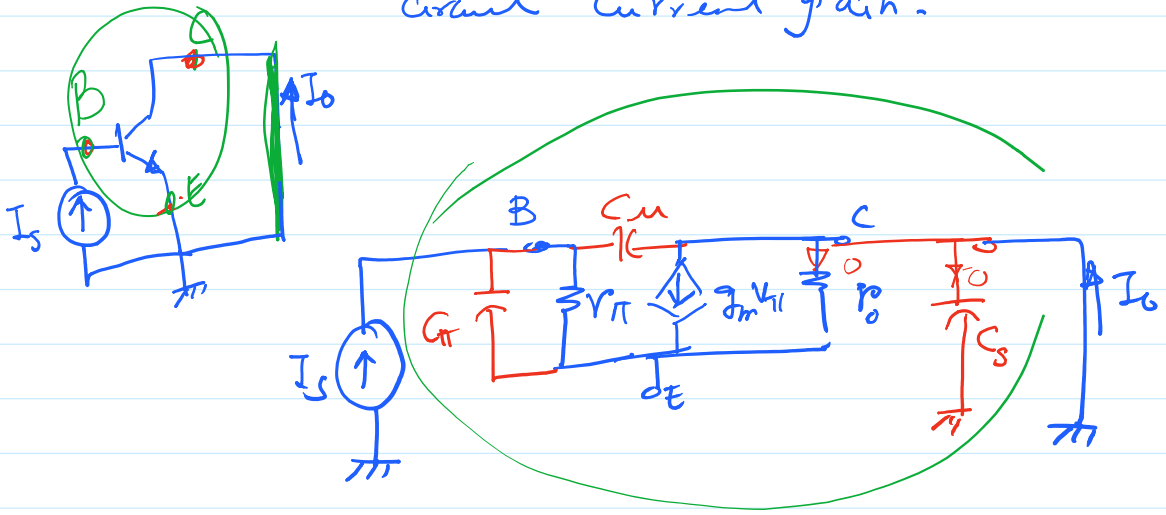
High Frequency Model

Thursday, March 2, 2017 2:34 PM

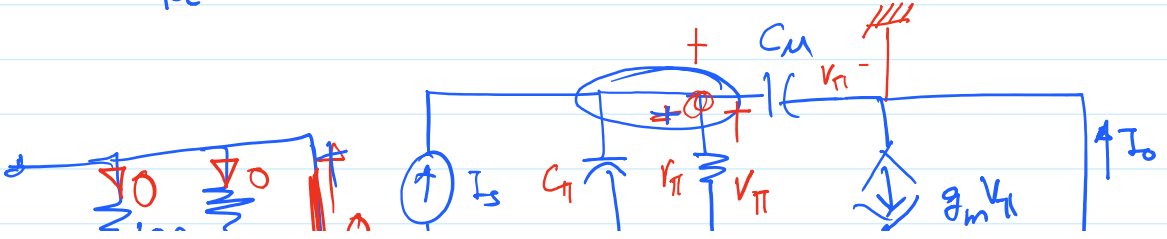


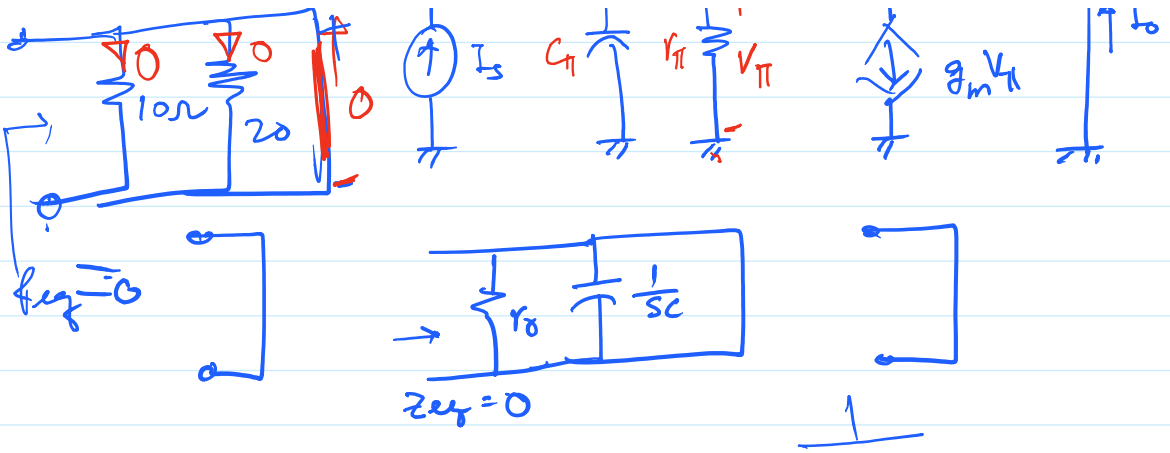
Simplified High frequency equivalent ckt diagram

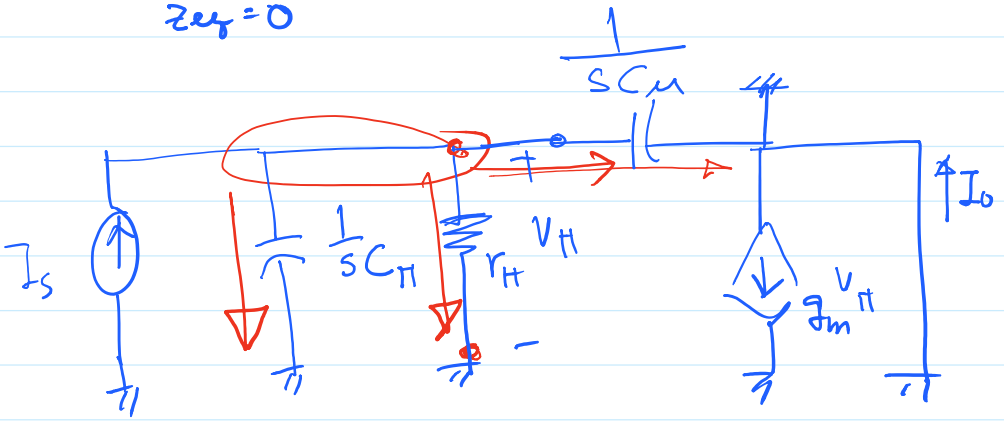
Draw the simplified high frequency equivalent circuit diagram and find the short circuit current gain.



$$A_I\Big|_{SC} = \frac{I_o}{I_S}$$







$$I_s = \frac{V_\pi}{\frac{1}{sC_\pi}} + \frac{V_\pi}{r_\pi} + \frac{V_\pi}{\frac{1}{sC_\mu}}$$

$$= sV_\pi\left[C_\pi + C_\mu\right] + \frac{V_\pi}{r_\pi}$$

$$= \frac{V_\pi}{r_\pi}\left[1 + sr_\pi\left(C_\pi + C_\mu\right)\right]$$

$$I_o = g_m V_\pi - \frac{V_\pi}{\frac{1}{sC_\mu}}$$

$$= V_\pi\left[g_m - sC_\mu\right]$$

$$A_I\Big|_{\cdots} = \frac{I_o}{I_s} = \frac{V_\pi\left[g_m - sC_\mu\right]}{V_\pi\left[1 + sr_\pi\left(C_\mu + C_\pi\right)\right]}$$

$$A_I\Big|_{sc} = \frac{I_o}{I_s} = \frac{\frac{v_\pi}{r_\pi}}{\frac{v_\pi}{r_\pi}\left[1 + s r_\pi (C_\mu + C_\pi)\right]}$$

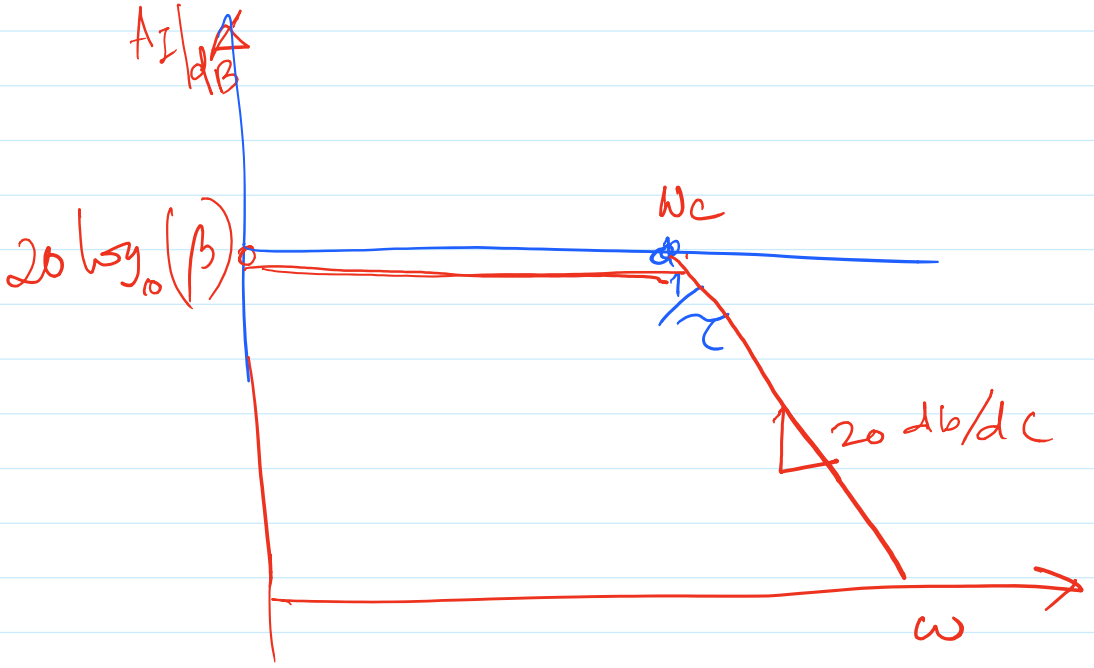
$$= \frac{\beta\left(r_\pi g_m - s r_\pi C_\mu\right)}{1 + s r_\pi (C_\mu + C_\pi)} \qquad r_\pi g_m \gg s r_\pi C_\mu$$

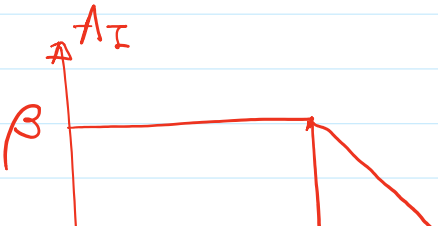
$$g_m \gg C_\mu$$

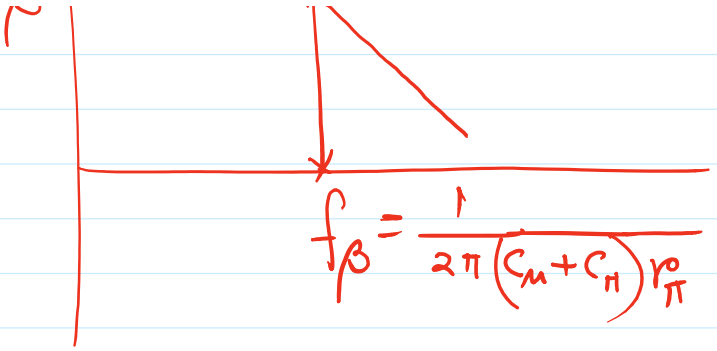
$$A_I \simeq \frac{\beta}{1 + s r_\pi (C_\mu + C_\pi)}$$

$$A_I = \frac{\beta}{1 + s\tau}$$

$$\tau = r_\pi (C_\mu + C_\pi) \qquad \omega_c = \frac{1}{\tau} = \frac{1}{r_\pi (C_\mu + C_\pi)}$$






$f_\beta = \frac{1}{2\pi(C_\mu + C_\pi) r_\pi}$