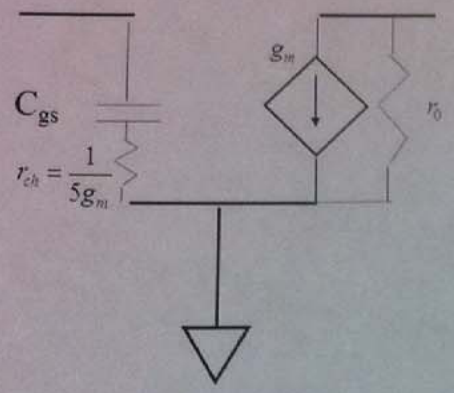
3) For the circuit below, find the y-matrix. Next, fin
terms of the circuit elements. Find f_T and f_{Max}.



$$u = \frac{|y_{21} - y_{12}|^2}{4[\mathrm{Re}(y_{11})\mathrm{Re}(y_{22}) - \mathrm{Re}(y_{12})\mathrm{Re}(y_{21})]}$$

$$= \frac{g_m^2}{4\frac{1}{r_0}\mathrm{Re}\left[\frac{j\omega C_{gs} 5g_m}{(5g_m + j\omega C_{gs})}\right]}$$

$$= \frac{g_m^2 r_0}{4} \Big/ \mathrm{Re}\left(\frac{j\omega C_{gs} 5g_m (5g_m - j\omega C_{gs})}{(5g_m + j\omega C_{gs})(5g_m - j\omega C_{gs})}\right)$$

$$= \frac{g_m^2 r_0}{4} \Big/ \mathrm{Re}\left(\frac{\cdots + (\omega C_{gs})^2 5g_m}{(5g_m)^2 + (\omega C_{gs})^2}\right)$$

$$= \frac{g_m^2 r_0}{4} \frac{(5g_m)^2 + (\omega C_{gs})^2}{(\omega C_{gs})^2 5g_m}$$ 10pts

$$u = \frac{g_m r_0}{20\omega^2 C_{gs}^2}\left(25g_m^2 + \omega^2 C_{gs}^2\right)$$

CORRECTION

$$u = \frac{g_m r_0}{20\omega^2 C_{gs}^2}\left(25g_m^2 + \omega^2 C_{gs}^2\right)$$

$$u|_{f_{MAX}} = 1$$

$$1 = \frac{g_m r_0}{20 C_{gs}^2 \omega_{MAX}^2}\left(25g_m^2 + \omega_{MAX}^2 C_{gs}^2\right)$$

$$1 - \frac{g_m r_0}{20} = \frac{25}{20}\, g_m r_0 \frac{g_m^2}{C_{gs}^2 \omega_{MAX}^2}$$

$$\omega_{MAX}^2 = \frac{25}{20} g_m r_0 \frac{g_m^2}{C_{gs}^2 \omega_{MAX}^2} \Big/ 1 - \frac{g_m r_0}{20}$$

$$\omega_{MAX} = 5\frac{g_m}{C_{gs}}\sqrt{\frac{g_m r_0}{20 - g_m r_0}} = 2\pi f_{MAX}$$