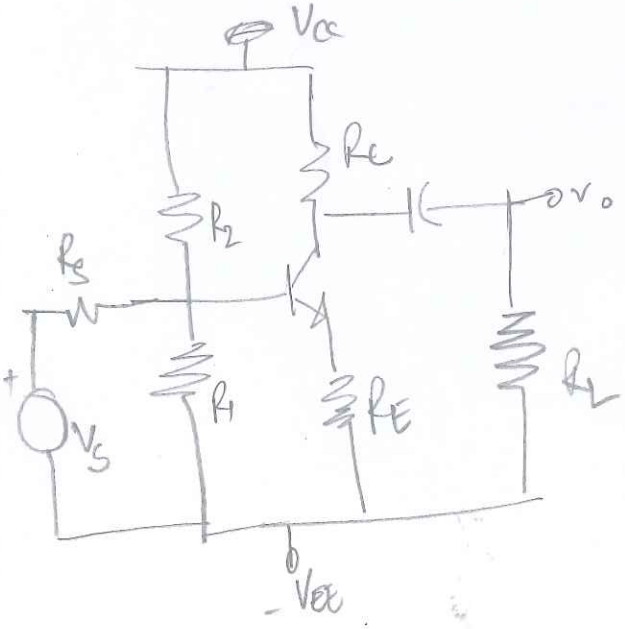
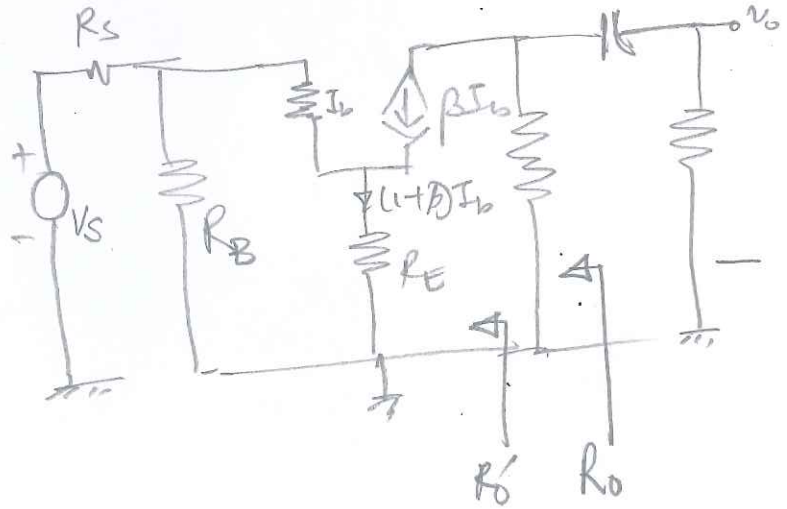
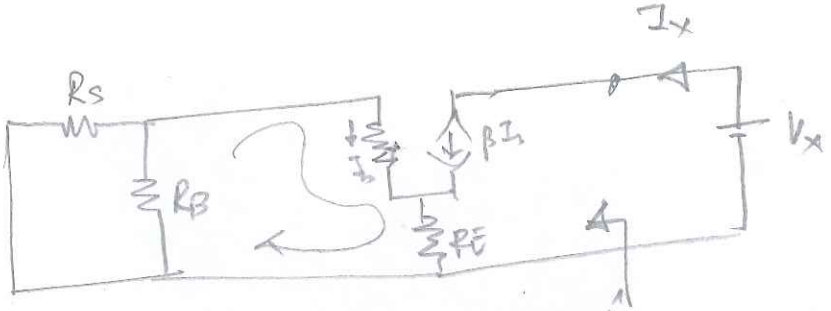
CE





$R_o = ?$

*



$I_x = \beta I_b$

$R_o' = \frac{V_x}{I_x} = \infty$

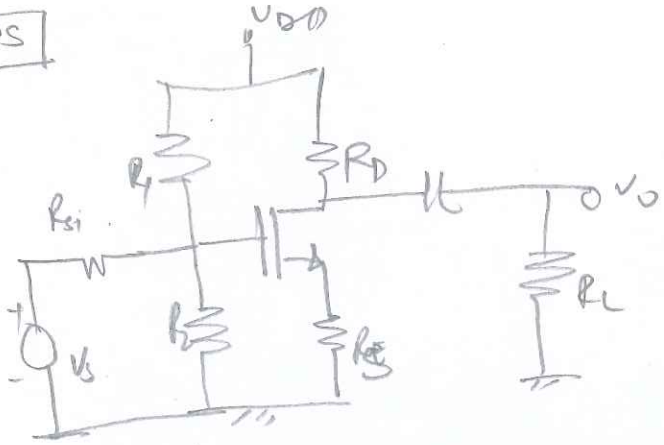
$\therefore I_b = 0$

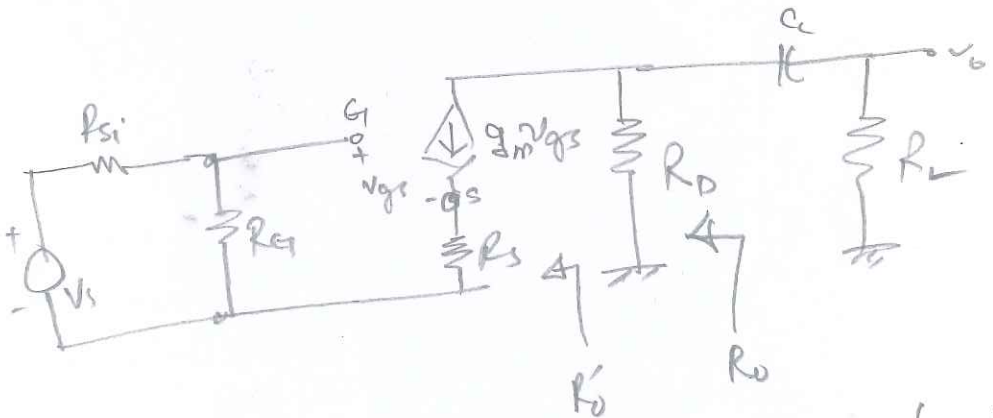
$$(R_s \| R_B) I_b + r_\pi I_b + (1+\beta) I_b R_E = 0$$

$$\therefore R_o = R_o' \| R_c = R_c$$

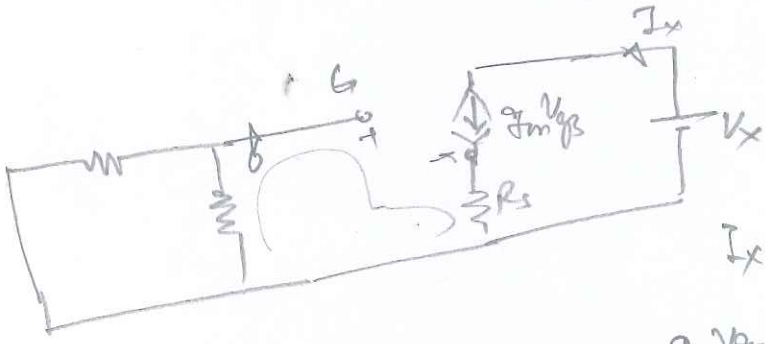
$$\therefore \tau = (R_c + R_L) C_c$$

CS





$$R_o' = \frac{V_x}{I_x}$$



$$I_x = g_m V_{gs}$$

$$(R_{si} \| R_G)\, 0 + V_{gs} + g_m V_{gs} R_S = 0$$

$$\therefore V_{gs} = 0$$

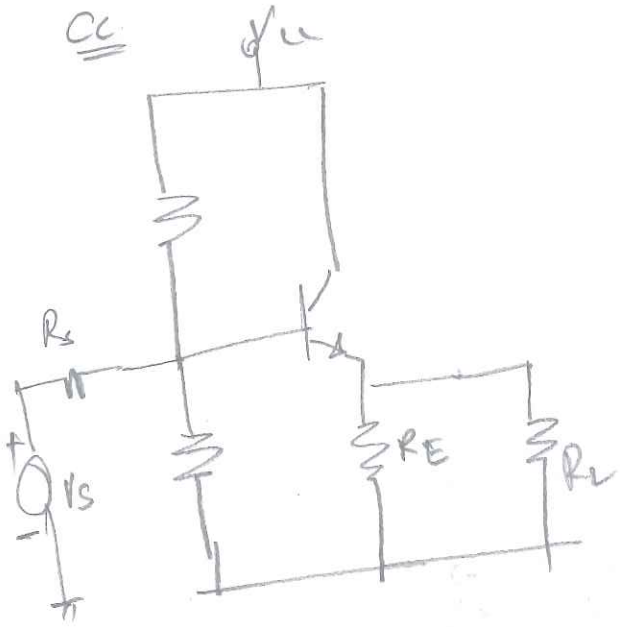
$$\therefore I_x = 0$$

$$\therefore R_o' = \frac{V_x}{I_x} = \frac{V_x}{0} = \infty$$

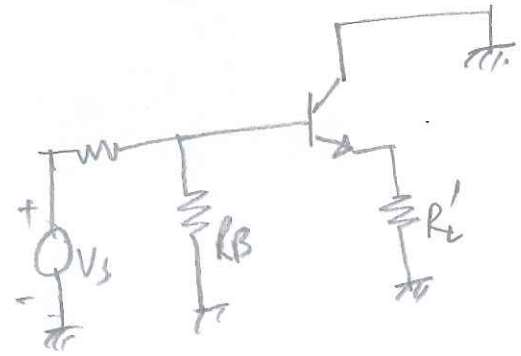
$$\therefore R_o = R_o' \| R_D = R_D$$

$$\therefore \tau = (R_D + R_V)\, C_c$$

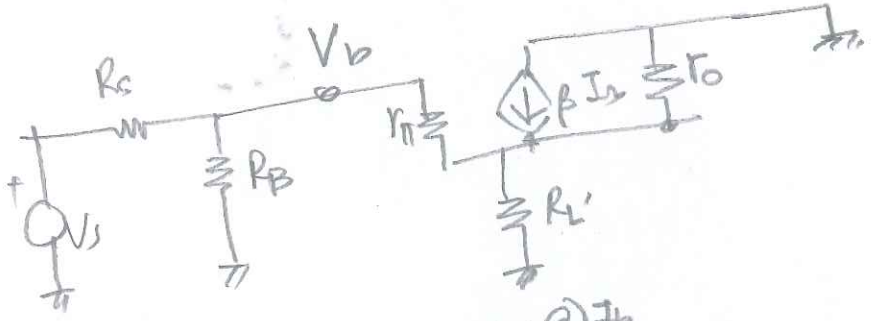
CC

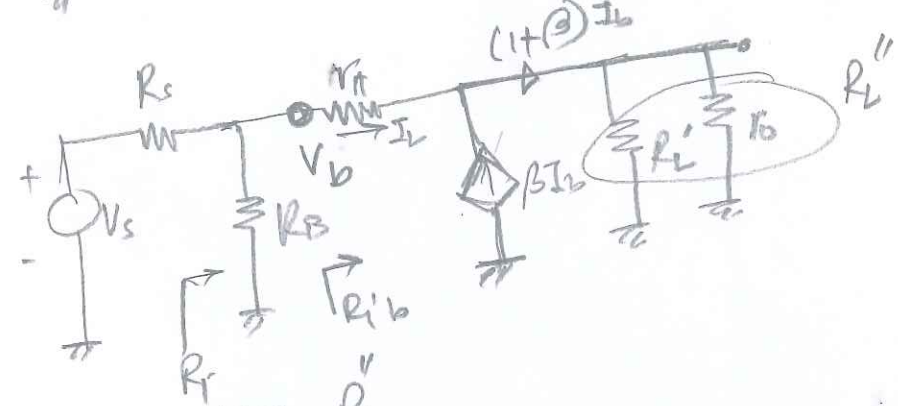


$\Rightarrow$



$R_L' = R_E \| R_L$





$V_o = (1+\beta) I_b R_L''$

$V_b = r_\pi I_b + (1+\beta) I_b R_L''$

$$A_{V_A} = \frac{V_o}{V_b} = \frac{(1+\beta) R_L''}{r_\pi + (1+\beta) R_L''}$$

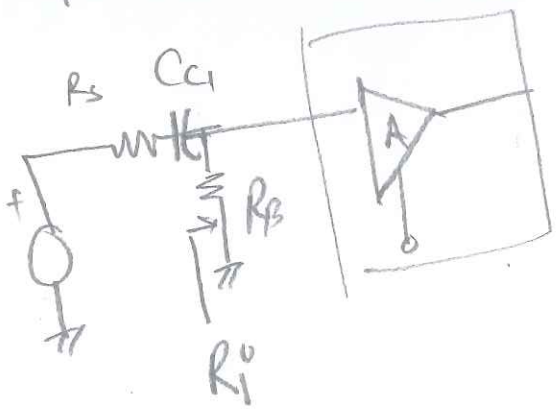
Less than 1.

$$R_{ib} = \frac{V_b}{I_b} = r_\pi + (1+\beta) R_L''$$

$$A_V = A_{V_A} \cdot \frac{R_i}{R_i + R_S}$$

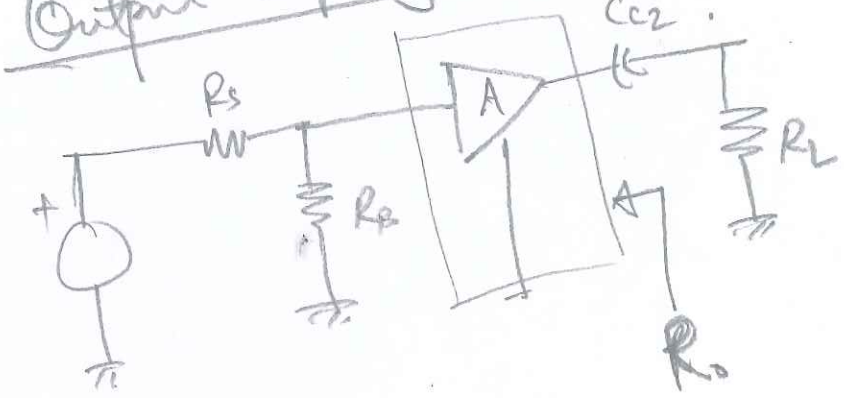
$$R_i = R_B \| R_{ib}$$

Input coupling Cap.

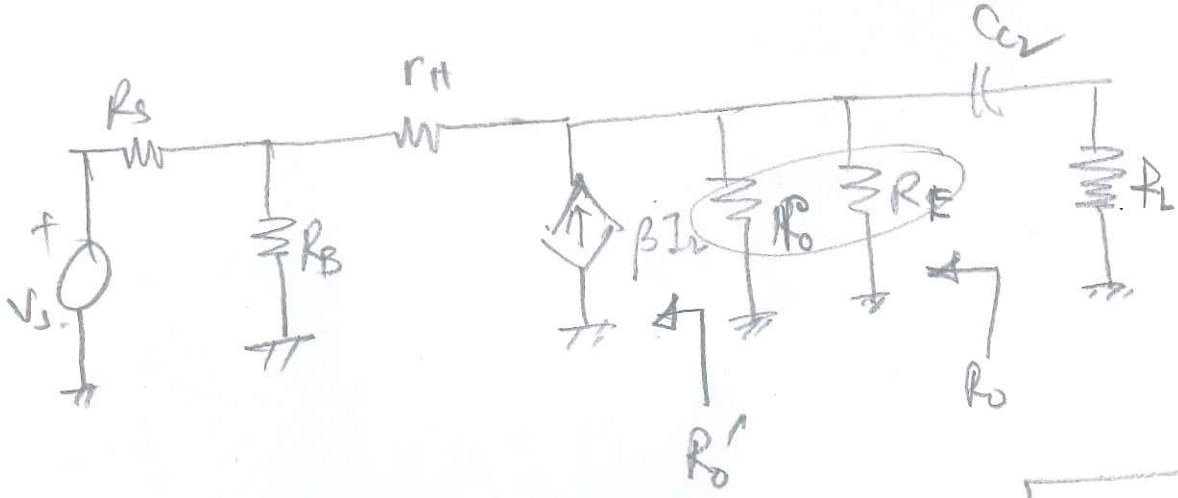


$$\tau = (R_s + R_i')\, C_{C1}$$

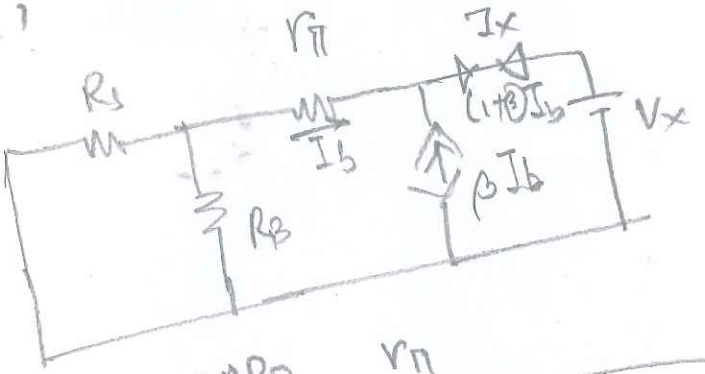
Output coupling Cap.



$$\therefore \tau = (R_o + R_L) C_{C2}$$

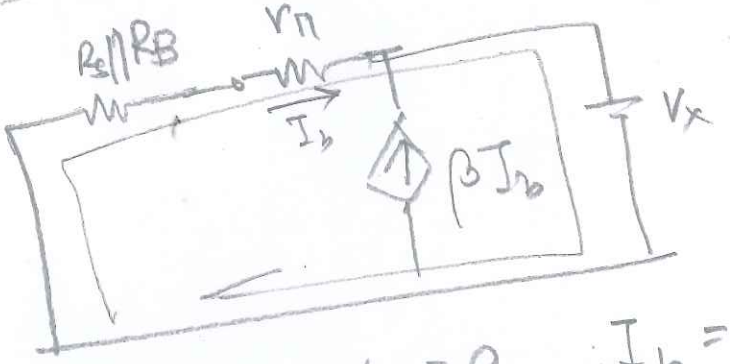


$R_o' = ?$



$$I_x = -(1+\beta) I_b .$$

$$R_o = R_o' \| r_o \| R_E$$



$$(R_S \| R_B + r_\pi) I_b + V_x = 0 \qquad \therefore I_b = -\frac{V_x}{(R_S \| R_B + r_\pi)}$$

$$\therefore I_x = \frac{V_x (1+\beta)}{(R_S \| R_B + r_\pi)}$$

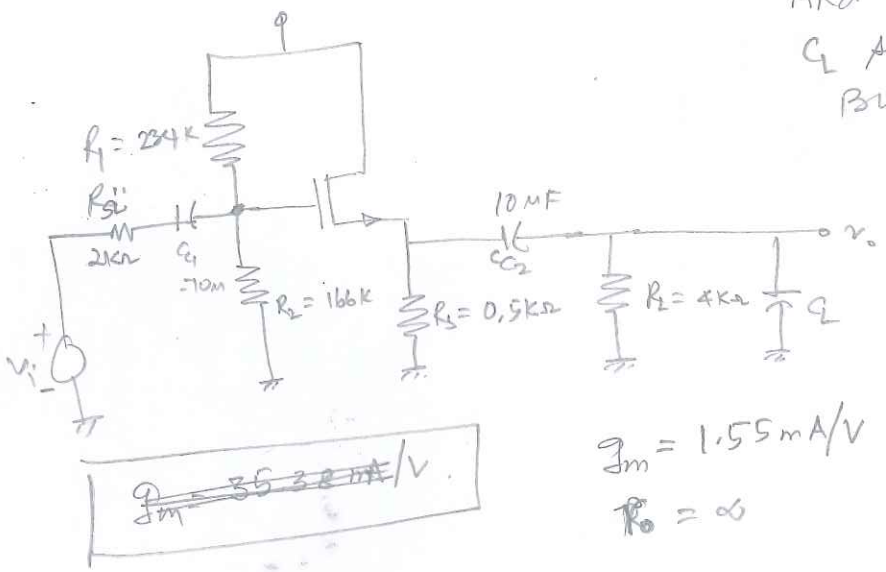
$$\therefore R_o' = \frac{V_x}{I_x} = \frac{(R_S \| R_B + r_\pi)}{(1+\beta)}$$

$$\therefore R_o = \frac{R_S \| R_B + r_\pi}{(1+\beta)} \| r_o \| R_E \longleftarrow$$

$$\tau = (R_o + R_L) C_{C2} \longleftarrow$$

7.39

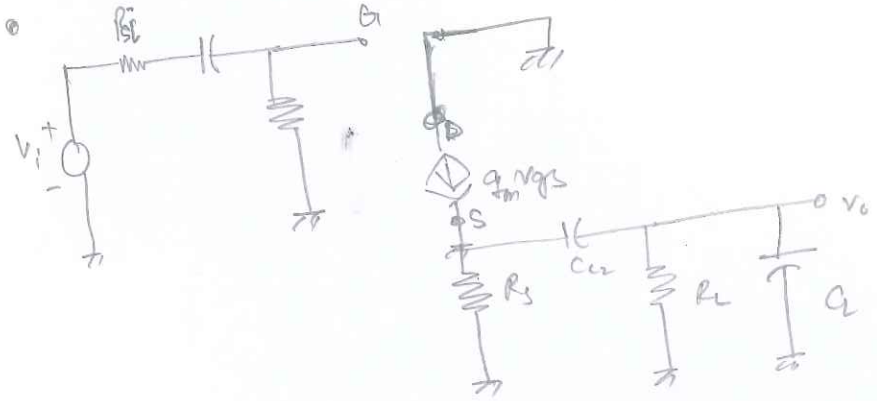
Find the max^m value of C_L such that the BW is at least BW = 5MHz.

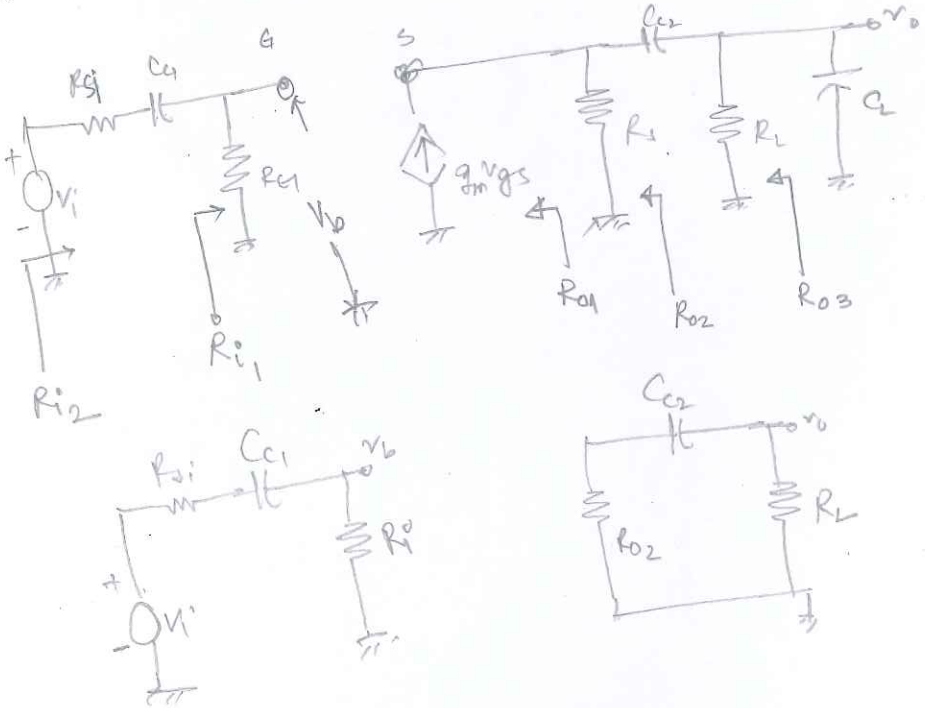


~~g_m = 35.38 mA/V~~

$g_m = 1.55\ mA/V$

$R_o = \infty$





* Midband Voltage gain

$V_o = g_m V_{gs} R_L'$

$R_L' = R_S \| R_L$

$V_b = V_{gs} + g_m V_{gs} R_L'$

$A_{V_A} = \frac{V_o}{V_b}$

$\therefore A_{V_A} = \frac{g_m R_L'}{(1 + g_m R_L')}$

$R_{i_1}^o = R_{G_1} = R_i^o$

$\therefore A_V = A_{V_A} \times \frac{R_i^o}{R_{Si} + R_i}$ ⇝ $\boxed{R_i^o = R_G}$

$\tau_{C_1} = (R_{Si} + R_i^o) C_{C_1}$ ←

$\tau_{C_2} = (R_{O_2} + R_L) C_{C_2}$ ←

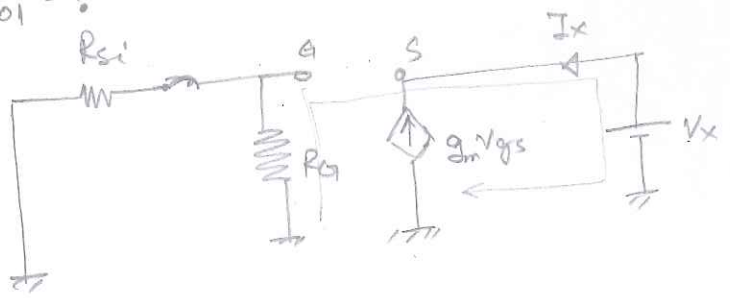
$\tau_{C_L} = R_{O_3} C_L$ ←

$f_{L_{C_1}} = \frac{1}{2\pi \tau_{C_1}}$

$f_{L_{C_2}} = \frac{1}{2\pi \tau_{C_2}}$

$f_{H_{C_L}} = \frac{1}{2\pi \tau_{C_L}}$

$R_{O_1} = ?$



$I_x = -g_m V_{gs}$

$R_G \times 0 + V_{gs} + V_x = 0$

$\therefore V_{gs} = -V_x$

$\therefore I_x = g_m V_x$

$\therefore R_{O_1} = \frac{V_x}{I_x} = \frac{1}{g_m}$

$\boxed{\begin{aligned} R_{O_1} &= \frac{1}{g_m} \\ R_{O_2} &= R_{O_1} \| R_S \\ R_{O_3} &= R_{O_1} \| R_S \| R_L \end{aligned}}$

$Q_L = \frac{\tau_{C_L}}{R_{O_3}}$ $\quad \tau_{C_L} = \frac{1}{2\pi f_{H_{C_L}}}$

P.746