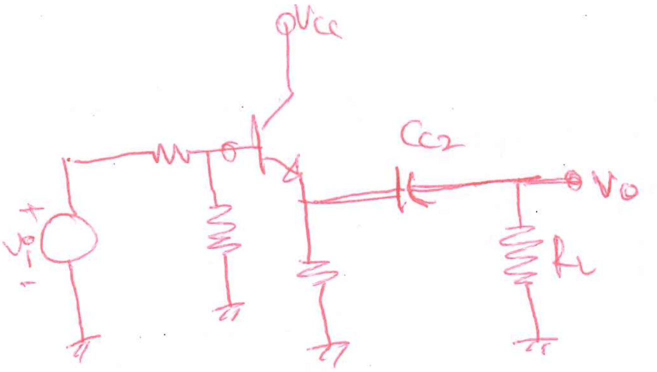
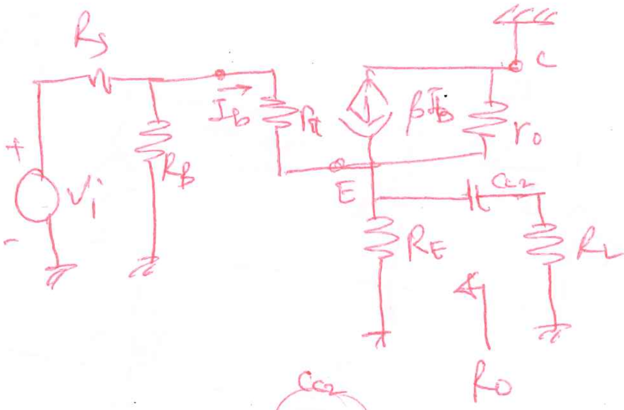
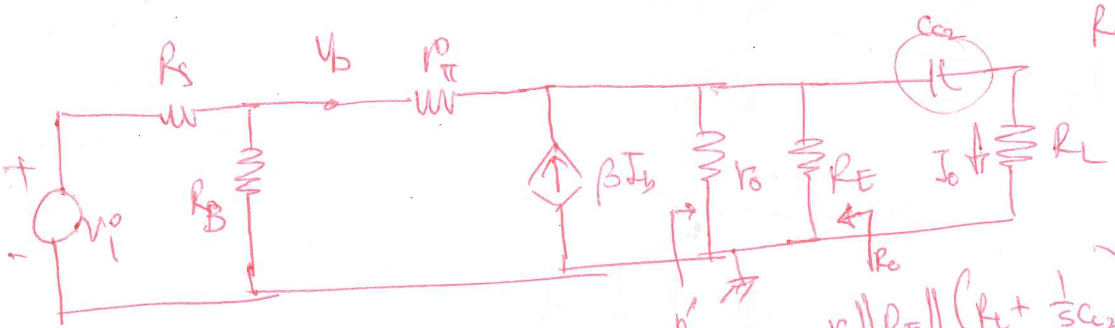
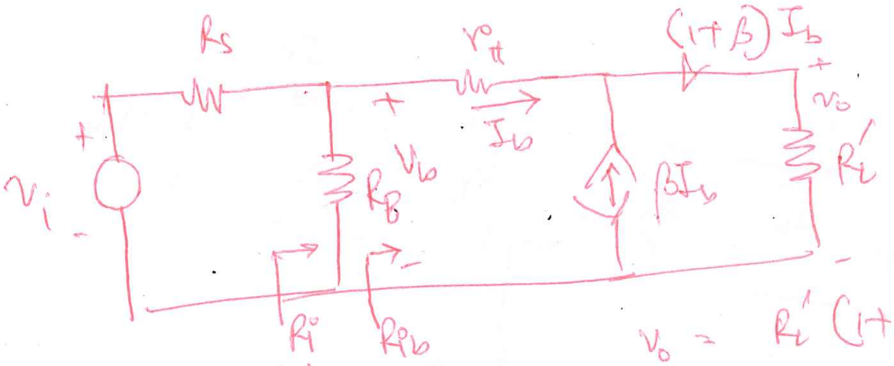






$$R_L' = r_o \| R_E \| \left(R_L + \frac{1}{sC_{C2}}\right)$$

For midband $R_L' = r_o \| R_E \| R_L$



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

$$A_{VA} = \frac{v_o}{v_b}$$

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

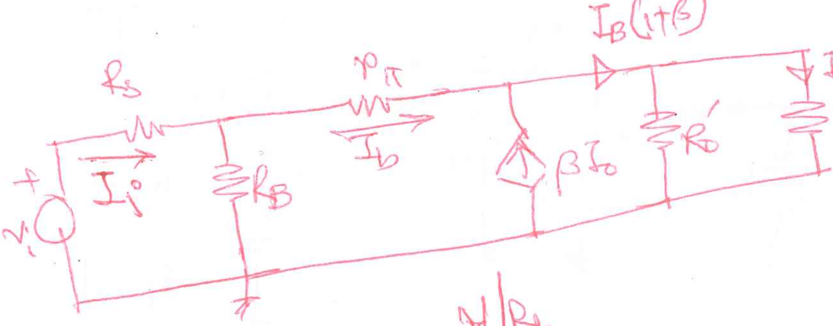
$$R_{ib} = \frac{V_b}{I_b} = r_\pi + (1+\beta) R_L'$$

$$\therefore A_{VA} = \frac{v_o}{v_b} = \frac{R_L'(1+\beta)I_b}{[r_\pi + (1+\beta)R_L']I_b} = \frac{(1+\beta)R_L'}{r_\pi + (1+\beta)R_L'} \approx 1$$

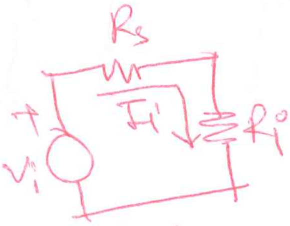
$$\boxed{R_i = R_B \| R_{ib}}$$

$$A_v = \frac{v_o}{v_i} = \boxed{A_{VA} \times \frac{R_i}{R_i + R_S}}$$

Midband current gain



$$I_o = (1+\beta) I_b \times \frac{R_o'}{R_o' + R_L}$$



$$I_i = \frac{V_i}{R_s + R_i}$$

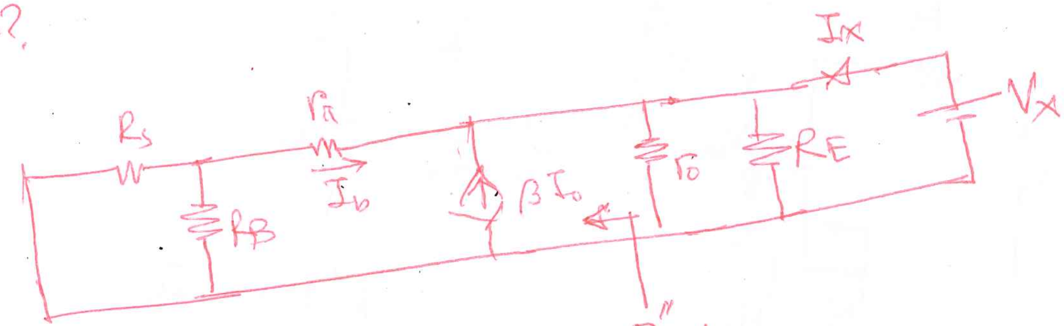
$$A_I = \frac{I_o}{I_i} = \frac{V_o / R_L}{\dfrac{V_i}{R_s + R_i}}$$

$$= \frac{V_o}{V_i} \times \frac{(R_s + R_i)}{R_L}$$

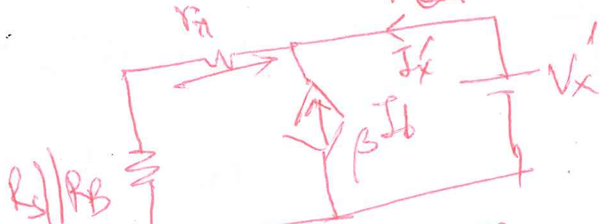
$$= A_V \cdot \frac{(R_s + R_i)}{R_L} \longleftarrow$$

$=$

$\underline{R_o} = ?$



R_o''



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

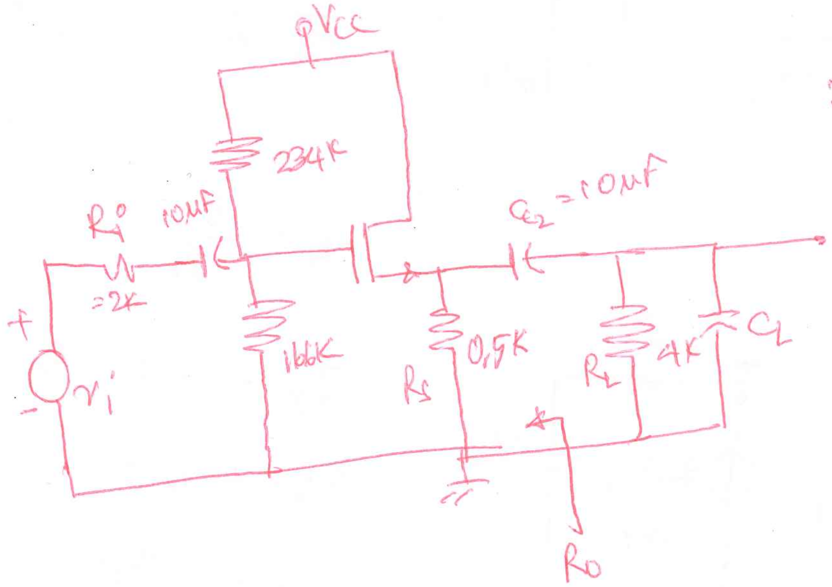
$$I_x = \frac{V_x (1+\beta)}{r_\pi + R_s \| R_B}$$

$$I_b = -\frac{V_x'}{r_\pi + R_s \| R_B}$$

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

$$\therefore R_o = r_o \| R_E \| R_o'' \longleftarrow \qquad \tau = C_{C2}(R_o + R_L) \longleftarrow$$

7.39



* find the maximum value of C_L such that the BW is at least $BW = 5MHz$

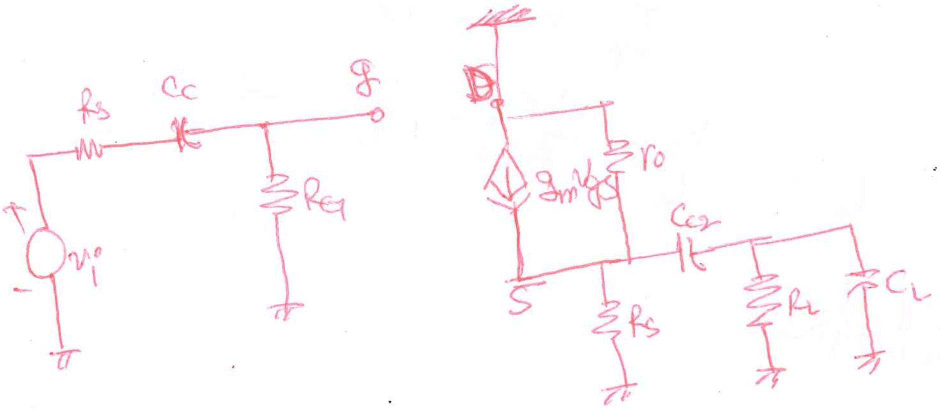
$g_m = 1.55 mA/V$

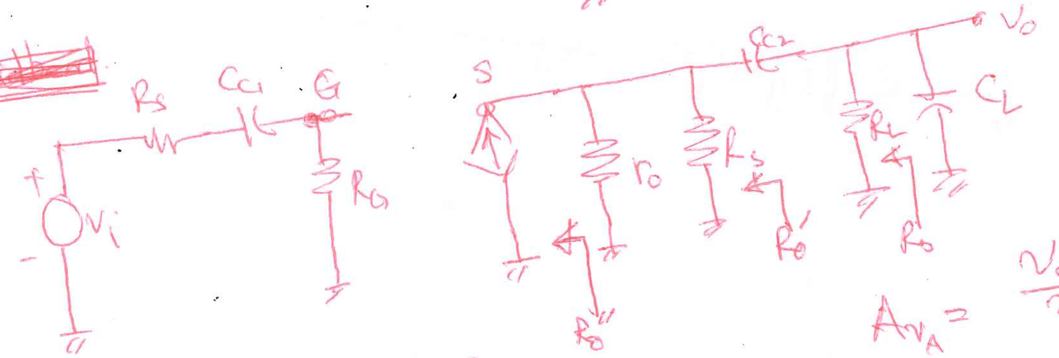
$r_o = 100 k\Omega$

$$f_H = \frac{1}{2\pi\tau} = \frac{1}{2\pi\tau}$$

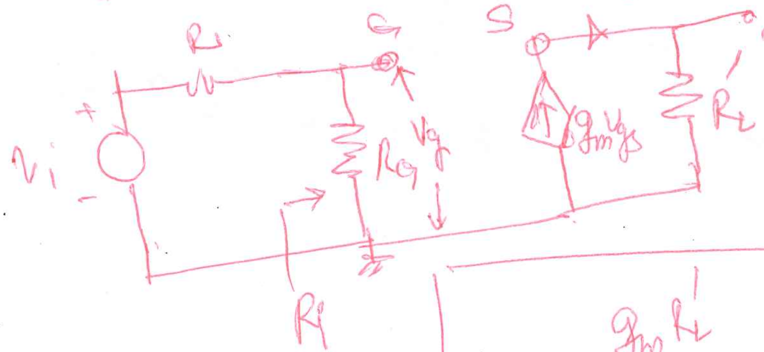
$$= \frac{1}{2\pi C_L (R_{eq})}$$

$$R_{eq} = R_L \| R_o$$





$$Av_A = \frac{v_o}{v_g}$$



$$v_o = g_m v_{gs} R_L'$$

$$v_g = v_{gs} + g_m v_{gs} R_L'$$

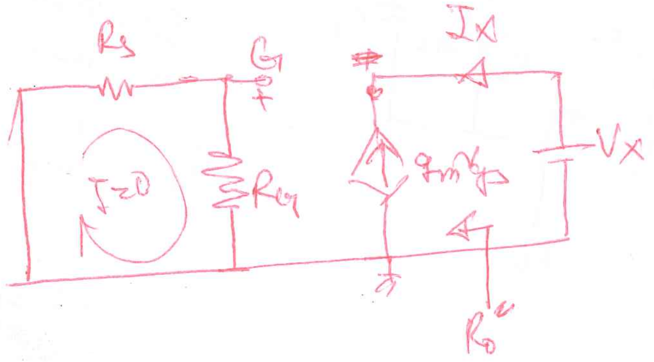
$$= (1 + g_m R_L') v_{gs}$$

$$\boxed{Av_A = \frac{g_m R_L'}{1 + g_m R_L'}}$$

$$A_v = A_{v_A} \times \frac{R_i}{R_i+R_s} = \frac{g_m R_L'}{1+g_m R_L'} \times \frac{R_G}{R_G+R_s} \qquad \boxed{R_i = R_G}$$

$R_o'' = ?$

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



$$I_x = -g_m V_{gs}$$

$$V_{gs} + V_x = 0$$

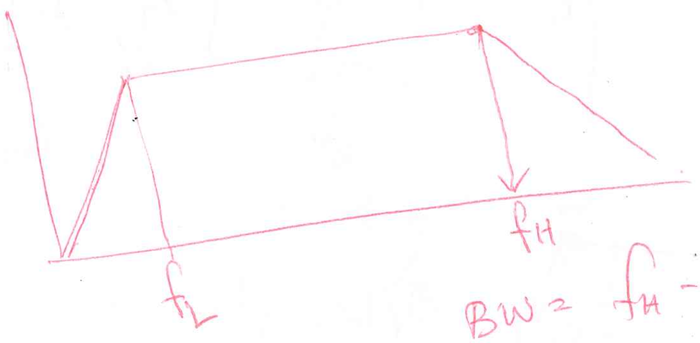
$$\therefore V_x = -V_{gs}$$

$$\therefore I_x = g_m V_x$$

$$R_o'' = \frac{V_x}{I_x} = \frac{V_x}{g_m V_x} = \frac{1}{g_m}$$

$$R_o' = R_o'' \| r_o \| R_s$$

$$R_o = R_o'' \| r_o \| R_s \| R_L$$



$$BW = f_H - f_L \approx f_H$$