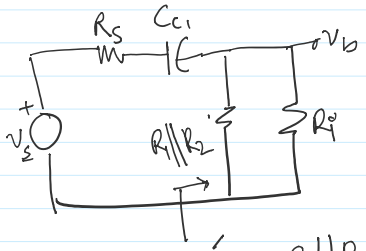
Common Drain Amplifier

Wednesday, October 11, 2017 8:13 AM

Write down the corner or 3 dB frequency of common collector amplifier

1. f_{L_1} due to C_{C_1}
2. f_{L_2} " " C_{C_2}
3. f_H " " C_L

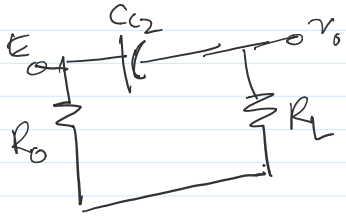
1.



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

$$R_i' = R_1 \| R_2 \| R_i \qquad f_{L_1} = \frac{1}{2\pi C_{C_1}(R_S + R_i')}$$

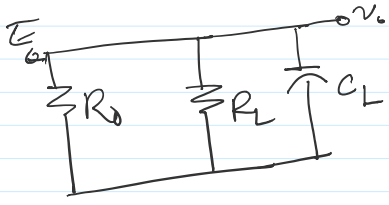
2.



$$f_{L_2} = \frac{1}{2\pi C_{C_2}(R_o + R_L)}$$

$R_o = ?$

3.



$$f_H = \frac{1}{2\pi C_L (R_L \| R_o)}$$

$$R_o' = \left(\frac{R_S \| R_B + r_\pi}{(1+\beta)} \right) \qquad R_o = R_o' \| R_E \| r_o$$

① $R_S = 1K$, $R_1 = 160K$ $R_2 = 120K$, $R_E = 1K$

$R_L = 5K$, $g_m = 40mA/V$ $r_\pi = 3K\Omega$, $r_o = 100K$

CC Amplifier

$\beta = g_m r_\pi = 40m \times 3K = 120$

Find

i) Midband voltage gain, dB

ii) " current gain dB

iii) C_1 & C_2 for 20 Hz lower corner freq

iv) C_L for 20 KHz high corner freq

$R_L' = R_E \| r_o \| R_L = 1K \| 100K \| 5K$

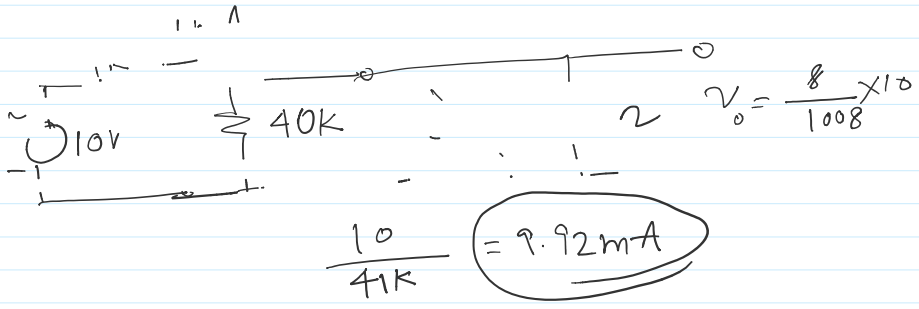
$= 0.8264K$.

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

$= 3K + (121) \times 0.8264$

$= 102.99 K\Omega$

$R_1' = R_1 \| R_2 \| R_i = 41.16 K\Omega$

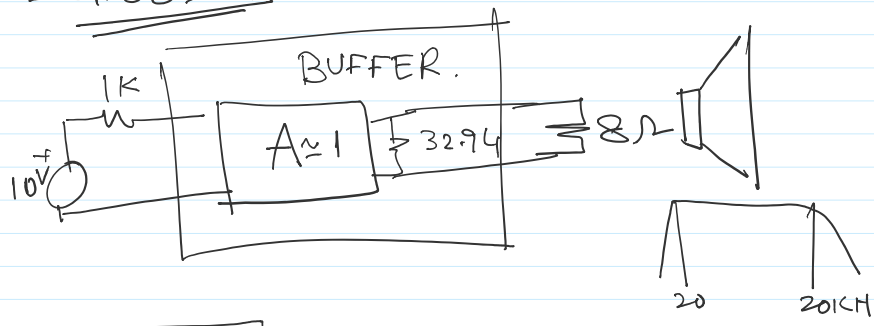


$R_o' = \dfrac{R_s \| R_1 \| R_2 + r_\pi}{(1+\beta)} = \dfrac{1 \| 160 \| 120 + 3}{121}$

$= 32.94\ \Omega$.

$R_o = R_E \| r_o \| R_o' = 1K \| 100K \| 32.94\Omega$

$= 31.88\ \Omega$.



$C_{C_1} = 0.188 MF$

$C_{C_2} = 1.58 MF$

$C_L = 0.25\mu F$

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

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

$$= \frac{121 \times 1K \| 100K \| 5K}{102.99K}$$

$$= 0.97$$

$$A_V = A_{V_A} \times \frac{R_o'}{R_s + R_i'} = 0.97 \times \frac{41.16K}{1K + 41.16K}$$

$$= 0.95$$

$$20\log_{10}(0.95) = -0.47 dB$$

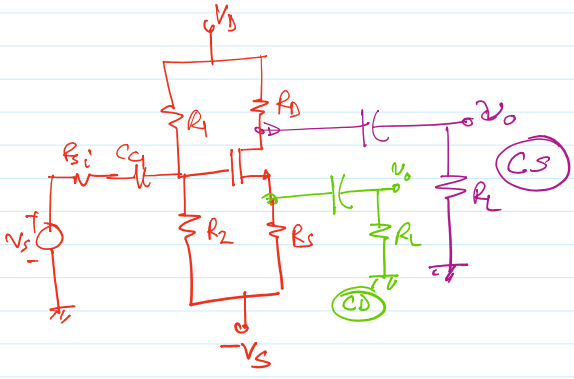
$$A_i = \frac{i_o}{i_s} = \frac{\frac{v_o}{R_L}}{\frac{v_s}{R_s + R_i'}} = \frac{v_o}{v_s} \cdot \frac{(R_s + R_i')}{R_L} = A_V \times \frac{(R_s + R_i')}{R_L}$$

$$= 0.95 \times \frac{1K + 41.16K}{5K}$$

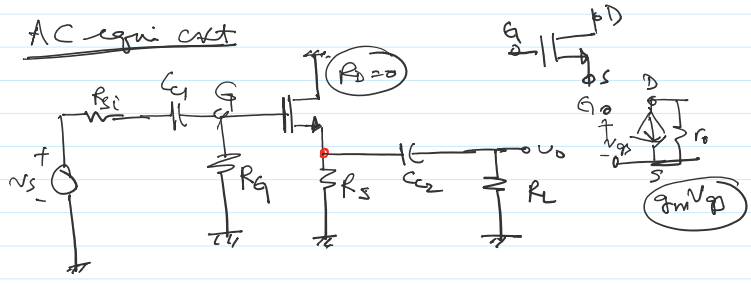
$$= 8.01$$

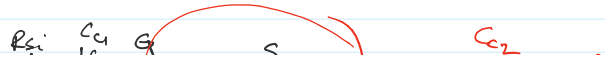
$$A_i|_{dB} = 18.1 dB$$

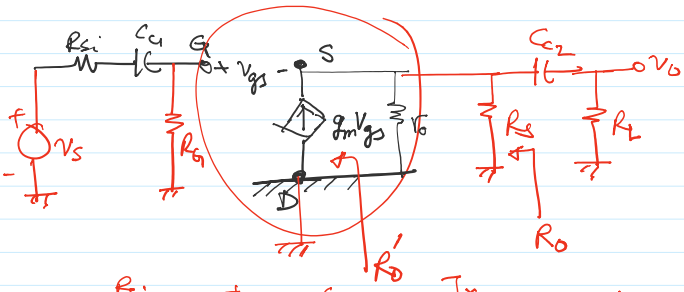
Common Drain Amplifier circuit

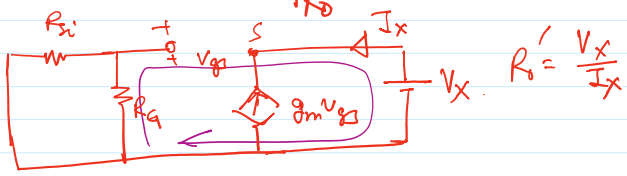


AC equi ckt









$I_x = -g_m V_{gs}$

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

$V_{gs} = -V_x$

$\therefore I_x = g_m V_x$

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

$v_o = g_m v_{gs} \times r_o \| R_s \| R_L$

$v_g = v_{gs} + g_m v_{gs} r_o \| R_s \| R_L$

$A_{VA} = \frac{v_o}{v_g} = \frac{g_m R_L'}{(1 + g_m R_L')}$