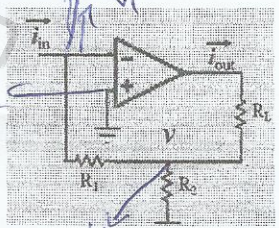
Electrical Eng. Dept.

Electronics II EE361 **Second Exam** **10/12/2013**

Your answers should be written in ink. 0127430 14 تميم حسن الخطيب
9:00 – 10:00

Q1 a) Calculate the current gain for the op-amp circuit shown.



$i_{in} + i_{out} = \frac{V_x}{R_2}$

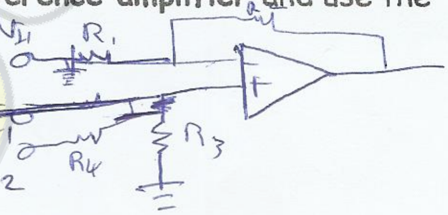
$V_2 = V_1 = 0$

$V_x = V_1 - i_{in} \times R_1 \rightarrow$

$i_{in} + i_{out} = \frac{0 - i_{in} R_1}{R_2} \rightarrow (i_{in} + i_{out}) R_2 = -i_{in} R_1$

$i_{in} R_2 + i_{in} R_1 = -i_{out} R_2 \rightarrow \frac{i_{out}}{i_{in}} = -\left(\frac{R_1 + R_2}{R_2}\right)$ ✓ 2

Q1 b) Draw the op-amp circuit implementing a **difference amplifier** and use the ideal characteristic to **derive** the output voltage.



by Super position

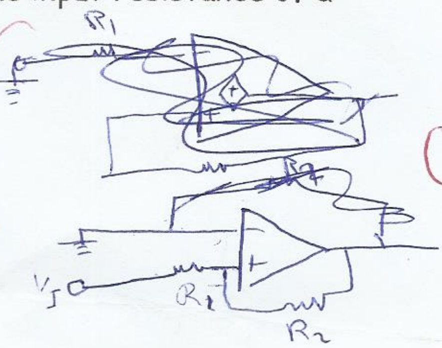
$V_{I2} = 0 \rightarrow V_{o1} = -\frac{R_2}{R_1} V_{I1} \rightarrow$ inverting

$V_{I1} = 0 \rightarrow V_{o2} = \frac{R_2}{R_1}\left(\frac{\frac{R_4}{R_3}}{1 + \frac{R_3}{R_4}}\right) V_{I2}$

$V_o = V_{o1} + V_{o2}$

$V_o = \frac{R_2}{R_1}\left(\frac{\frac{R_4}{R_3}}{1 + \frac{R_3}{R_4}}\right) V_{I2} - \frac{R_2}{R_1} V_{I1}$ 3

Q1 c) Use the ideal op- amp equivalent circuit to derive the input resistance of a non-inverting amplifier when $R_1 = \infty\ \Omega$ and $R_2 = 0\ \Omega$



$R_1 = \infty$ $R_i = \frac{V_I}{i_{in}}$

$R_{in} = \frac{V_I - 0}{i_{in}} = \frac{V_I}{0} = \infty$ because $R_1 = \infty$

~~$R_{in} = 2R_1 = \infty$~~

$\frac{\frac{x}{x+1}}{x}$

0

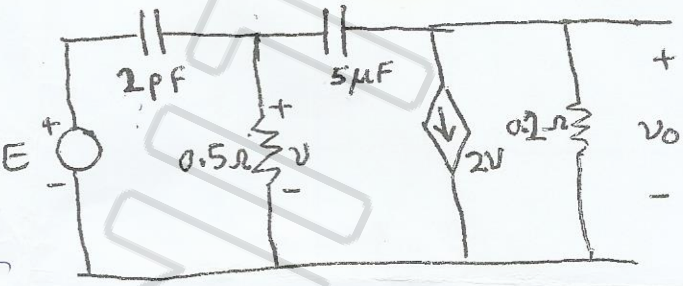
Q1 d) what are the advantages of field effect transistor over bipolar transistors?

Field effect transistors can Amplfy more than bipolar transistors

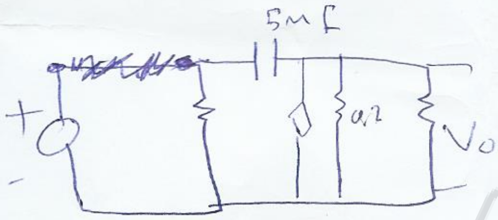
0

Q2 Use the method of approximate time constants to determine the two corner frequencies for the circuit above and to sketch the amplitude Bode diagram, based on f_L, f_H and the midband gain.

DO NOT DETERMINE THE TRANSFER FUNCTION.

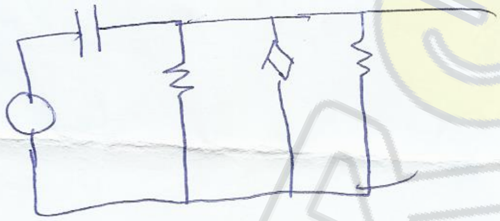


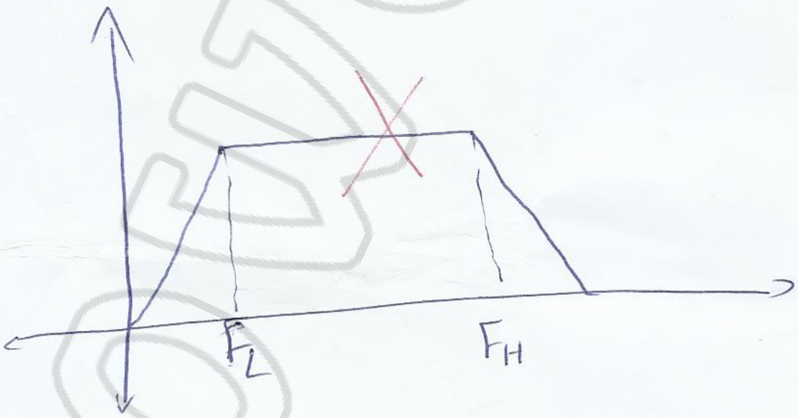
$F_L \rightarrow$



$F_L = (0.5 + 0.2) \times 5MF$
$= 3.5M$

$F_H \rightarrow$





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Q3 Consider the circuit shown in Fig. 1
Draw the small signal equivalent circuit
And use it to calculate the current
Gain defined as $\frac{i_c}{i_m}$ [redacted]

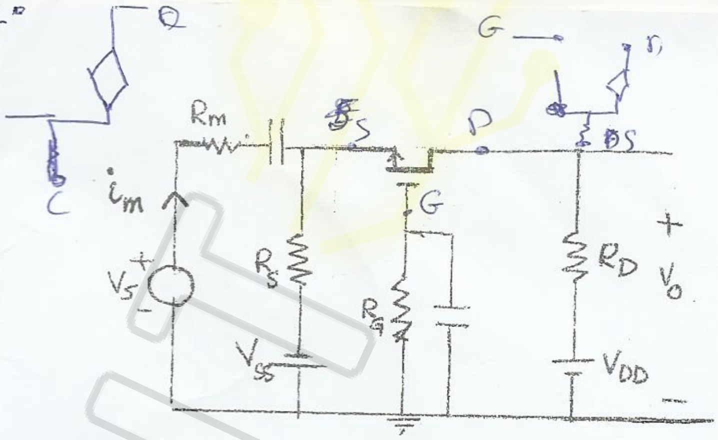
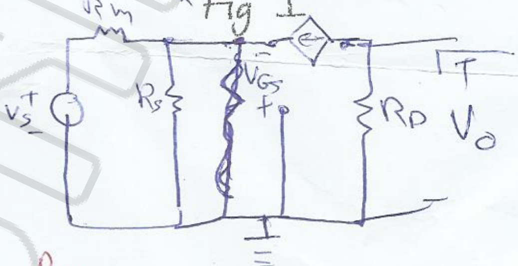
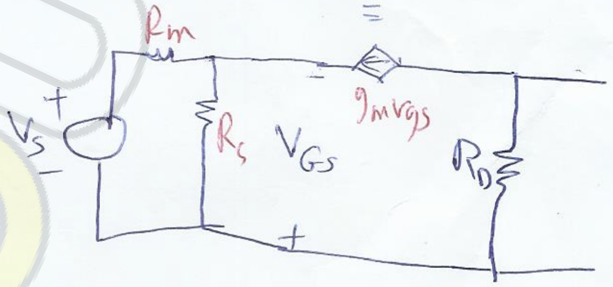


Fig 1





$$i_c = -g_m V_{GS}$$

$$\frac{V_S - V_x}{R_m} + g_m V_{GS} = \frac{V_x}{R_s}$$

$$V_x = -V_{GS}$$

$$\frac{V_S + V_{GS}}{R_m} + g_m V_{GS} = -\frac{V_{GS}}{R_s}$$

$$\frac{V_S - V_x}{R_m} = i_m$$

$$i_m = \frac{-V_{GS}}{R_S} - g_m V_{GS}$$

$$i_m = -\left(\frac{1}{R_s} + g_m\right) \times V_{GS} \rightarrow V_{GS} = \frac{-i_m}{\frac{1}{R_s} + g_m}$$

$$i_c = -g_m \times \frac{-i_m}{\frac{1}{R_s} + g_m} \rightarrow \frac{i_c}{i_m} = \frac{g_m}{\frac{1 + g_m R_s}{R_s}} = \frac{R_s g_m}{1 + g_m R_s} \#$$

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