KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

FIRST SEMESTER 2011-2012 (S111)

Course Title:	Electronics II
Course Number:	EE 303

Exam Type:	Exam I
Date:	Saturday October 15, 2011
Time:	6:00PM-7:30PM

Student Name: Key

Student ID: ________

Section # 5

GRADING		
Question 1	20	
Question 2	20	
Question 3	20	
Total:	60	

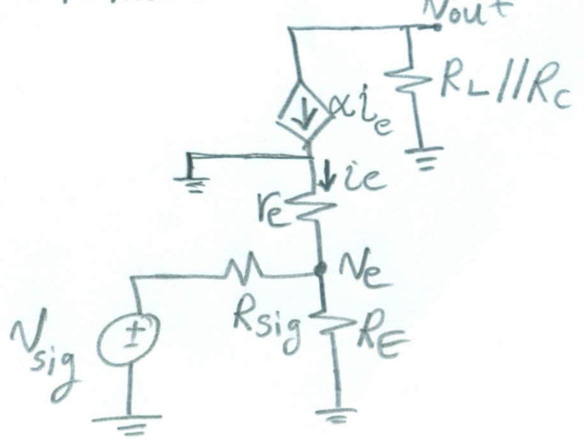
Show all your work and results. Do not give more than one answer otherwise the wrong one will be considered.

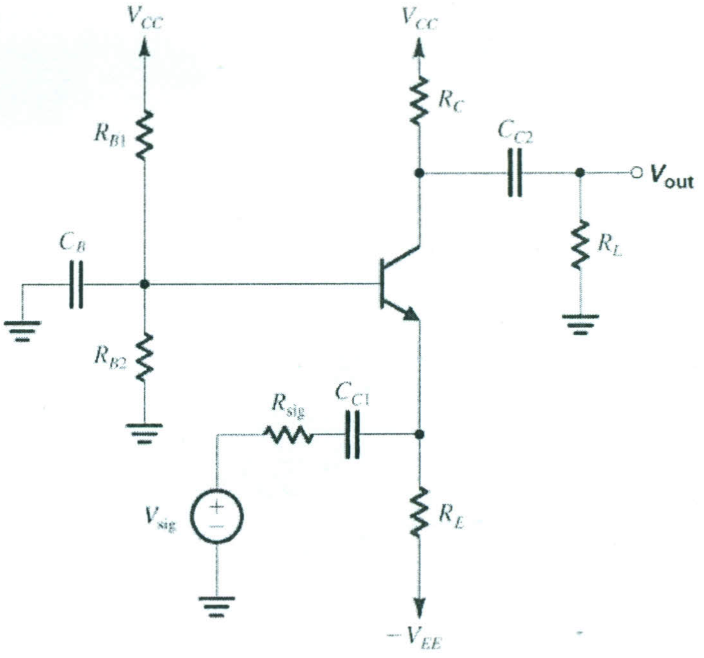
Question No.1

Consider the CB amplifier circuit shown below, neglect r_o and r_x,

A. Drive the expression for medium-frequency voltage gain (V_{out}/V_{sig}). **[5 points]**
B. Drive the expressions for all low frequency poles. **[12 point]**
C. Does this amplifier suffer from Miller's effect? **[1 point]** Without calculations how does this influence the frequency response of the amplifier? **[2 points]**

A. T-model





$$\frac{V_{out}}{V_{sig}} = \frac{V_e}{V_{sig}} \frac{V_{out}}{V_e}$$

$$= \frac{r_e \| R_E}{(r_e \| R_E) + R_{sig}} \cdot \frac{-\alpha i_e (R_L \| R_C)}{-i_e r_e} = \overset{2.5}{\frac{r_e \| R_E}{r_e \| R_E + R_{sig}}} \; \overset{2.5}{\frac{R_L \| R_C}{r_e}}$$ [5]

B. $\omega_{L_1} = \frac{1}{C_B R_{CB}}$ 2 ; $R_{CB} = R_{B1} \| R_{B2} \| [(\beta+1)(r_e + R_{sig} \| R_E)]$ 2 [4]

$\omega_{L2} = \frac{1}{C_{C1} R_{C_{C1}}}$ 2 ; $R_{C_{C1}} = R_{sig} + [R_E \| r_e]$ 2 [4]

$\omega_{L3} = \frac{1}{C_{C2} R_{C_{C2}}}$ 2 ; $R_{C_{C2}} = R_L + R_C$ 2 [4]

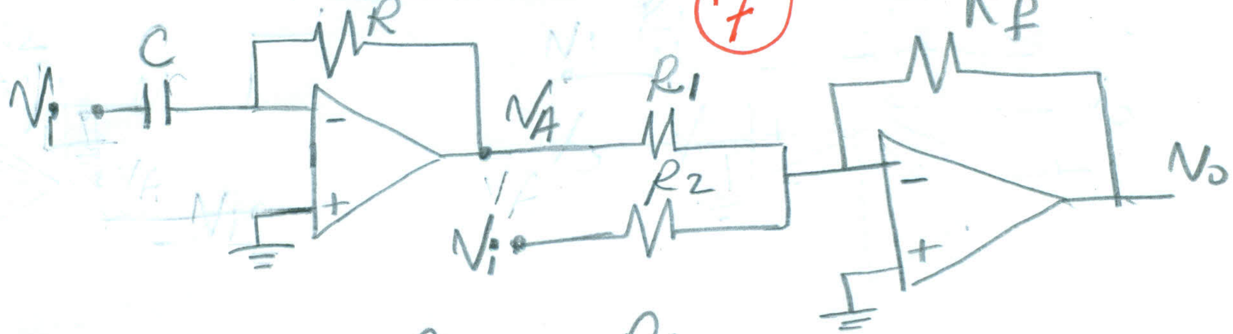
C. No, CB does not suffer from miller. Base is grounded. [1]
Thus C_π & C_μ are grounded.
Due to this, It has wide bandwidth. [2]

Question No.2

A. Design a circuit to implement the following function:

$$v_o = 4\frac{dv_i}{dt} - 3v_i$$

Use minimum number of ideal op-amps, resistors, and capacitors, draw a complete circuit showing the component values of your design. **[10 points]**



$$V_A = -CR\frac{dV_i}{dt} \; ; \; V_o = -\frac{R_f}{R_1}V_A - \frac{R_f}{R_2}V_i$$

$$V_o = CR\frac{R_f}{R_1}\frac{dV_i}{dt} - \frac{R_f}{R_2}V_i \; ;$$

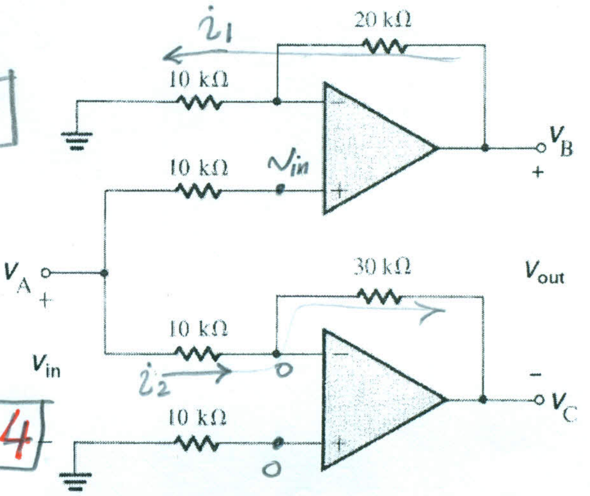
$\rightarrow \frac{R_f}{R_2} = 3 \Rightarrow R_2 = 3.33\,K\Omega$, $R_f = 10K\Omega$ (3)

$\rightarrow CR\frac{R_f}{R_1} = 4 \Rightarrow C = 10\mu F, R = 40K$, $R_f = 10K, R_1 = 1K$

B. For the circuit showing below, assuming ideal op amps find the voltage gain V_{out}/V_{in} **[10points]**

$$i_1 = \frac{V_{in}}{10K} \; ; \; V_B = 20K\, i_1 + V_{in}$$

$$V_B = 2V_{in} + V_{in} = 3V_{in}$$ [4]



$$i_2 = \frac{V_{in}}{10K} \; ; \; V_C = -30K\, i_2$$

$$V_C = -30K\frac{V_{in}}{10K} = -3V_{in}$$ [4]

$$V_{out} = V_B - V_C = 3V_{in} - (-3V_{in}) = 6V_{in}$$

$$\frac{V_{out}}{V_{in}} = 6$$ [2]

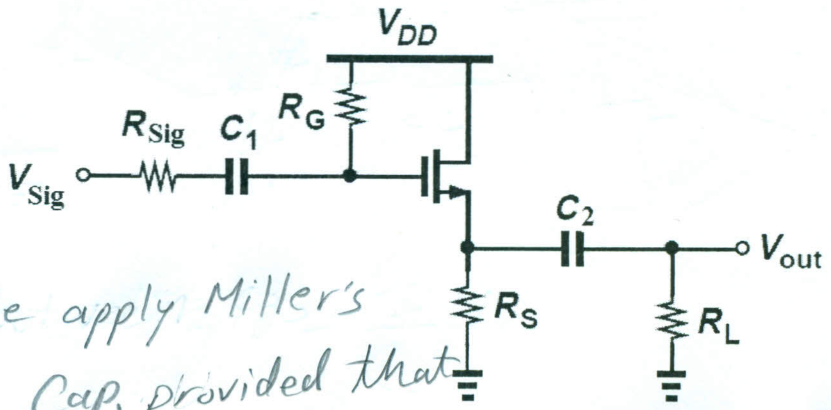
Question No. 3

In the circuit shown, g_m =3ms, Cgs=10pF, Cgd=1pf, Rsig=1kΩ RG=4.3KΩ, Rs=1.3kΩ and RL=24KΩ, C1=C2=10uf.

A. Can you apply Miller's theorem to the capacitor C_{gs}? Why? **[4 points]**

B. Determine and then calculate all of the high frequency poles. **[14 points]**

C. Estimate the upper 3dB frequency. **[2 points]**

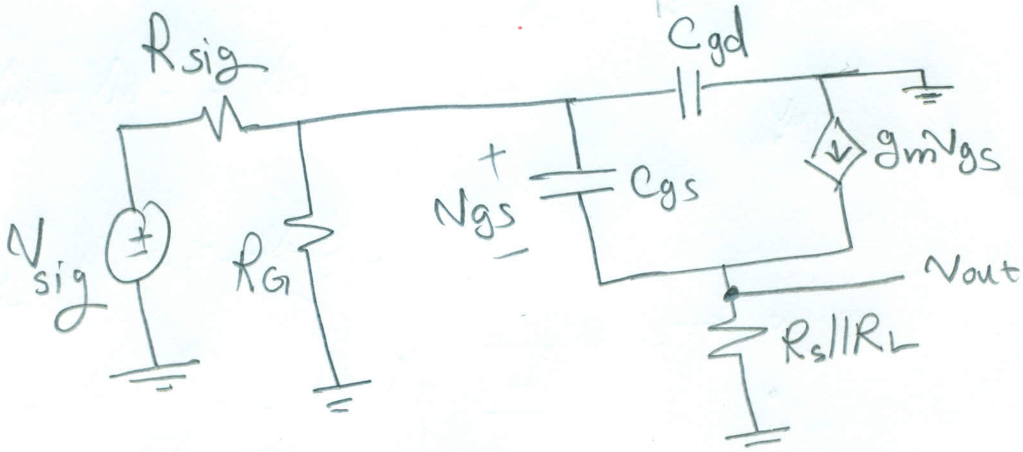


A. you can alawayse apply Miller's theorem to bridging Cap. provided that you have K. In this case using routian analysis will give more accurate answer than miller approach.

(4)

B.

π- model



(3)

$$\omega_{H_1} = \frac{1}{C_{gd}(R_{sig} \| R_G)}$$

(5)

$$\omega_{H_1} = 1.235 \text{ G rad/s}$$

$$f_{H_1} = 196.6 \text{ MHz}$$

$$\omega_{H_2} = \frac{1}{C_{gs}\left[\frac{(R_{sig} \| R_G) + (R_s \| R_L)}{1 + g_m(R_s \| R_L)}\right]}$$

(6)

$$\omega_{H2} = 230 \text{ M rad/s}$$

$$f_{H2} = 36.6 \text{ MHz}$$

C.

$$f_{3dB} = f_{H2} = 36.6 \text{ MHz}$$

(2)