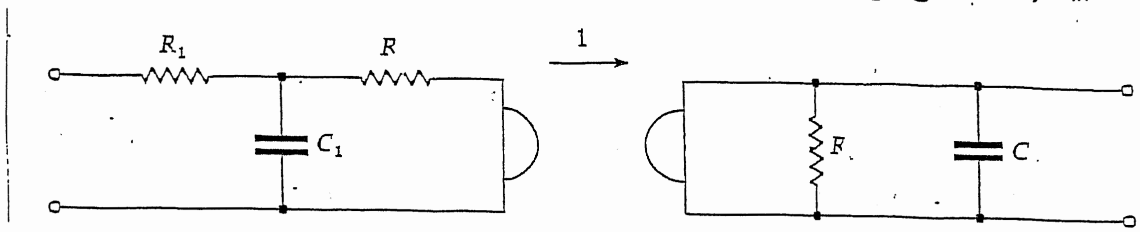
ECE 580

FINAL EXAMINATION

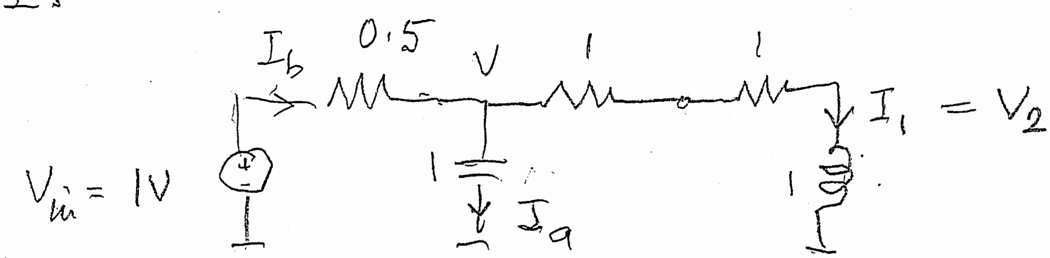
December 5, 2018

2:00 – 3:50 pm

1. In the circuit shown, $R_1 = 0.5$, $R = C = C_1 = 1$. Find the voltage gain V_{out}/V_{in}.



1.



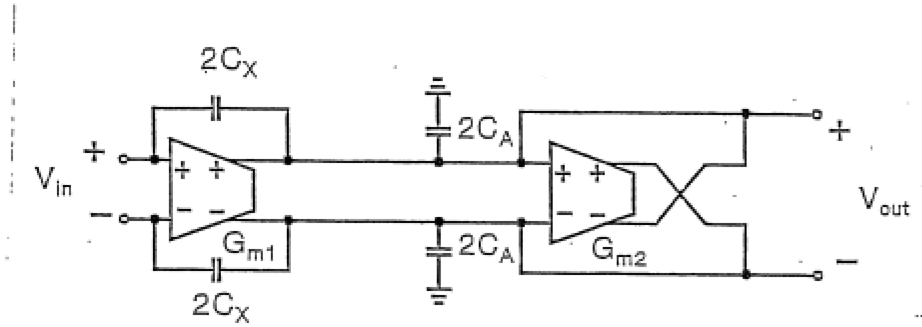
Bashkow's method:

$\hat{I}_1 = 1\,A$, $\hat{V} = 2 + s$, $\hat{I}_a = s^2 + 2s$

$\hat{I}_b = s^2 + 2s + 1$, $\hat{V}_{in} = \hat{V} + 0.5\hat{I}_b = 0.5s^2 + 2s + 2.5$

$$I_1 = \frac{1}{\hat{V}_{in}} = \frac{2}{s^2 + 4s + 5} = V_2 = V_{out}/V_{in}$$

2. Find the voltage gain and input admittance of the circuit shown.



KCL for the output node:

$G_{m1}.V_{in} + sC_x(V_{in} - V_{out}) - G_{m2}.V_{out} - sC_A.V_{out} = 0$

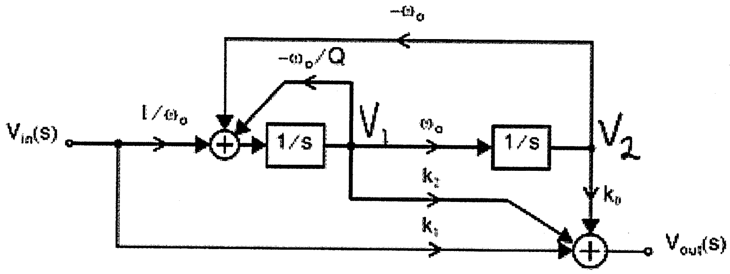
$H(s) = V_{out}/V_{in} = (G_{m1} + sC_x)/(sC_x + sC_A + G_{m2})$

$I_{in} = sC_x (V_{in} - V_{out}) = sC_xV_{in} [1 - H(s)]$

$Y_{in} = I_{in} /V_{in} = sC_x[1 - H(s)]$

~~Q 12.2)~~

3,



$$V_1 = \frac{1}{s}\left[\frac{1}{\omega_o}V_{in} - \omega_o V_2 - \frac{\omega_o}{Q}V_1\right] \qquad (1)$$

$$V_2 = \frac{1}{s}\omega_o V_1 \qquad (2)$$

Sub. (2) into (1):

$$V_1 = \frac{1}{s}\left[\frac{1}{\omega_o}V_{in} - \omega_o\left(\frac{\omega_o}{s} + \frac{1}{Q}\right)V_1\right]$$

$$\Rightarrow s^2 V_1 = \frac{s}{\omega_o}V_{in} - \omega_o\left(\omega_o + \frac{s}{Q}\right)V_1$$

$$\Rightarrow V_1 = \frac{s/\omega_o}{s^2 + \frac{\omega_o}{Q}s + \omega_o^2}\cdot V_{in} \qquad (3)$$

$$V_{out} = k_1 V_{in} + k_2 V_1 + k_0 V_2 \qquad (4)$$

Sub (2) & (3) into (4):

$$V_{out} = \frac{\left[k_1\left(s^2 + \frac{\omega_o}{Q}s + \omega_o^2\right) + k_2\frac{1}{\omega_o}s + k_o\right]}{s^2 + \frac{\omega_o}{Q}s + \omega_o^2}\cdot V_{in}$$

$$\Rightarrow \frac{V_{out}}{V_{in}} = \frac{k_1 s^2 + \left(k_1\frac{\omega_o}{Q} + k_2\frac{1}{\omega_o}\right)s + k_o + k_1\omega_o^2}{s^2 + \frac{\omega_o}{Q}s + \omega_o^2}$$

$j\omega$ axis zeros for $k_1/k_2 = -\frac{Q}{\omega_o^2}$

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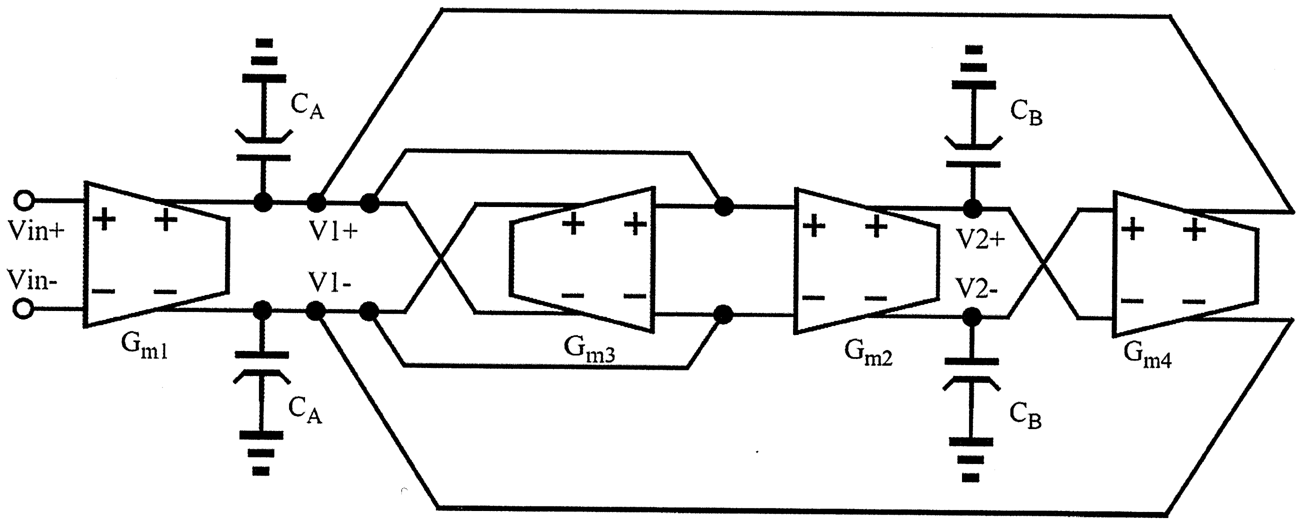
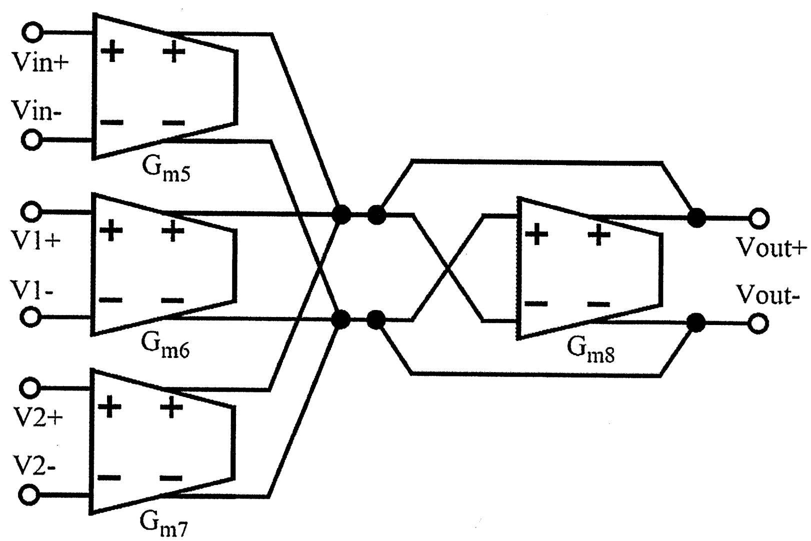
Q 12.3)


C_A
C_B
Vin+
Vin-
V1+
V1-
V2+
V2-
Gm1
Gm3
Gm2
Gm4
C_A
C_B


Vin+
Vin-
Gm5
V1+
V1-
Gm6
V2+
V2-
Gm7
Gm8
Vout+
Vout-