FINAL EXAMINATION

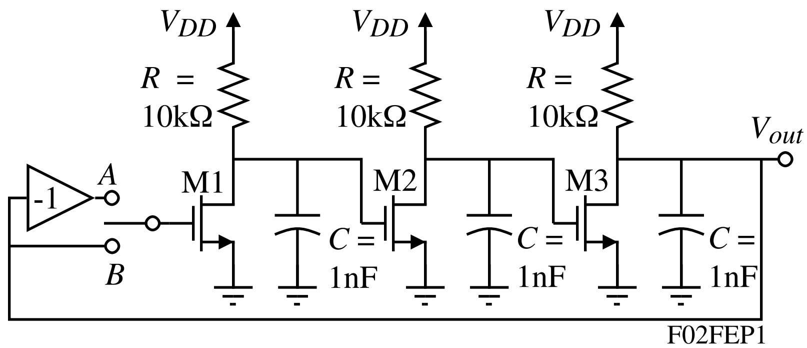
NAME______________________________P.O. Box No.__________SCORE______/100

Problem	①	②	3	4	5	6	7	8	Sum
Points									

INSTRUCTIONS: This exam is closed book with two sheets of notes permitted. The exam consists of 8, 20-point problems of which you are to work only 5 for a total of 100 points. Problems 1 and 2 must be worked and you may choose any three of the last six problems for a total of five problems. <u>Please circle the number in the table above of the five problems you wish graded.</u> If you do not indicate the problems to be graded, then problems 1 through 5 will be graded regardless of whether they are worked or not. Be sure to turn in only the 5 problems you wish graded in proper numerical order. Please show your work leading to your answers so that maximum partial credit may be given where appropriate.

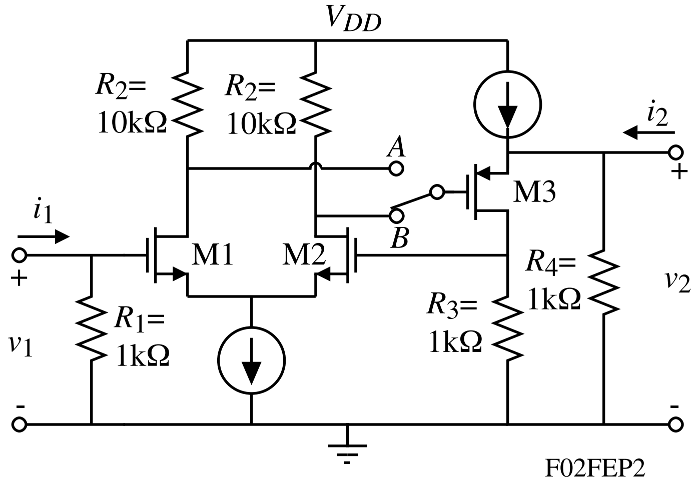
Problem 1 - (20 points - This problem must be attempted)

The circuit shown is to be an oscillator. The transistors are identical with a g_m = 1mS and $r_{ds} = \infty$. (a.) Should the switch at the gate of M1 be connected to point A or B in order to oscillate? (b.) Find the frequency of oscillation in Hertz and the value of $g_m R$ necessary for oscillation.



Problem 2 – (20 points – This problem must be attempted)

The simplified schematic of a feedback amplifier is shown. Assume that all transistors are matched and g_m = 1mA/V and $r_{ds} = \infty$. (a.) Where should the switch be connected for negative feedback? (b.) Use the method of feedback analysis to find v_2/v_1, $R_{in} = v_1/i_1$, and $R_{out} = v_2/i_2$.



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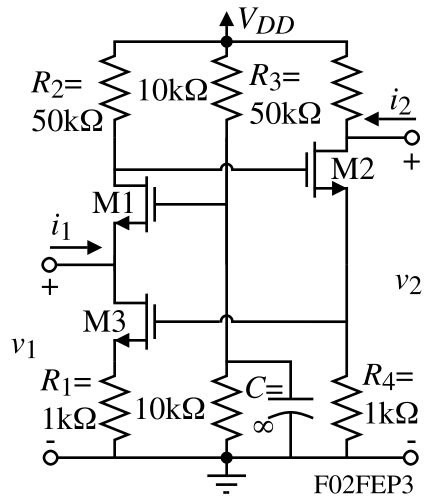
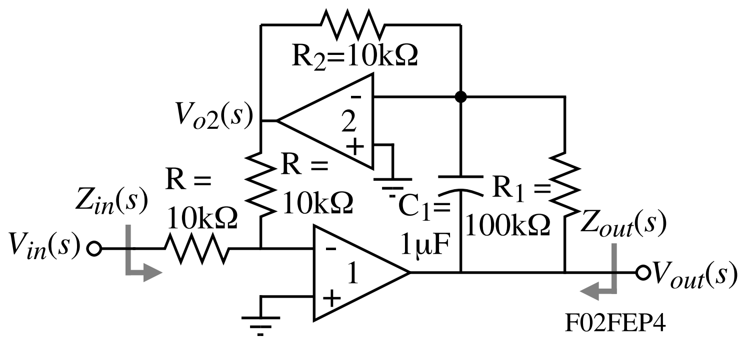
Problem 3 - (20 points - This problem is optional)

The simplified schematic of a feedback amplifier is shown. Use the method of feedback analysis to find v_2/v_1, $R_{in} = v_1/i_1$, and $R_{out} = v_2/i_2$. Assume that all transistors are matched and that g_m = 1mA/V and $r_{ds} = \infty$.



Problem 4 - (20 points - This problem is optional)

If the op amps shown are ideal (infinite voltage gain, infinite differential input resistance, and zero output resistance) find the voltage transfer function, $V_{out}(s)/V_{in}(s)$, the input impedance, $Z_{in}(s)$, and the output impedance, $Z_{out}(s)$. Sketch an asymptotic plot for the magnitude and phase shift of the voltage transfer function, $V_{out}(i\omega)/V_{in}(j\omega)$ as a function of $\log_{10}\omega$.



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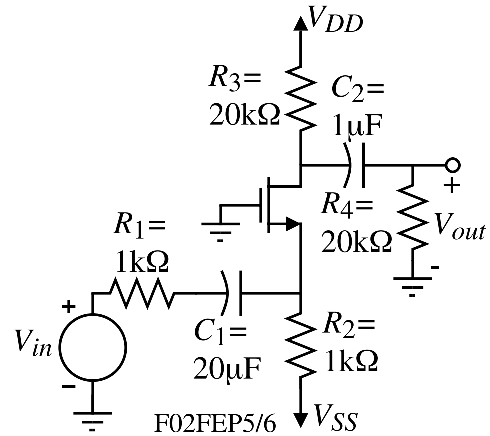
Problem 5 - (20 points - This problem is optional)

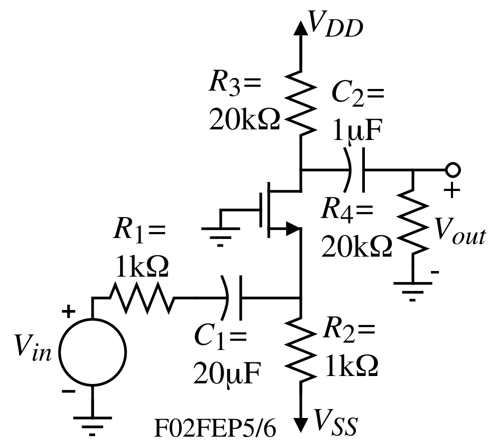
1.) If g_m = 2mA/V, what is the midband voltage gain of the amplifier shown? Assume $r_d = \infty$.

2.) Find the lower -3dB frequency (f_L) of the amplifier shown.



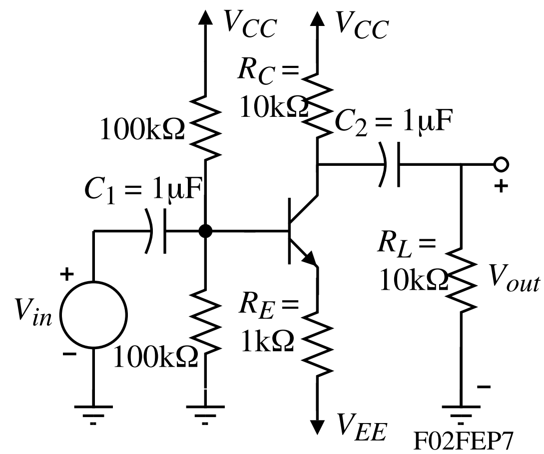
Problem 6 - (20 points - This problem is optional)

The FET in the amplifier shown has g_m = 1mA/V, $r_d = \infty$, C_{gd} = 0.5pF, and C_{gs} = 10pF. (a.) Find the midband gain, V_{out}/V_{in}. (b.) Find the upper -3dB frequency, f_H, in Hz. (Note: You cannot use the Miller's theorem on this problem because there is no bridging capacitor.)



Problem 7 - (20 points - This problem is optional).

A BJT amplifier is shown. Assume that the BJT has the small signal parameters of g_m = 50mA/V, r_π = 2kΩ, and $r_o = \infty$.



a.) Find the midband voltage gain of this amplifier, V_{out}/V_{in}.

b.) Find the numerical value of all poles and zeros of the low frequency response.

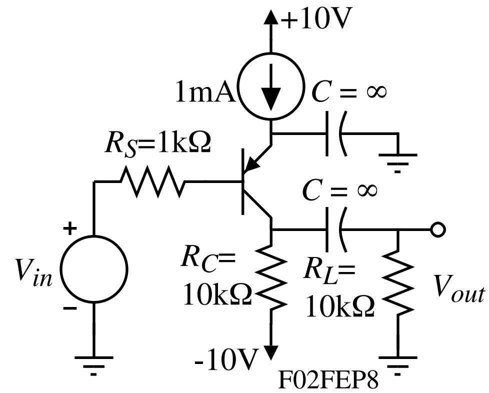
c.) Find the value of the lower -3dB frequency, f_L, in Hz.

Problem 8 – (20 points, this problem is optional)

A common-emitter BJT amplifier is shown. Assume that the BJT has a $\beta = h_{fe} = 100$, $C_\mu = 2\text{pF}$, $V_t = 25\text{mV}$, $f_T = 500\text{MHz}$, $r_b = 0\Omega$, and $r_o = \infty$.

a.) Find the numerical values of r_π, g_m, and C_π.

b.) If $r_\pi = 1\text{k}\Omega$, $g_m = 0.01\text{A/V}$ and $C_\pi = 10\text{pF}$ for the above amplifier, find the value of the upper -3dB frequency, f_H, in Hz.



Extra Sheet