EXAMINATION NO. 3

NAME____SCORE________/100

INSTRUCTIONS: This exam is closed book with one sheet of notes permitted. The exam consists of 4 questions for a total of 100 points. Please show your work leading to your answers so that maximum partial credit may be given where appropriate. Be sure to turn in your exam with the problems in numerical order, firmly attached together.

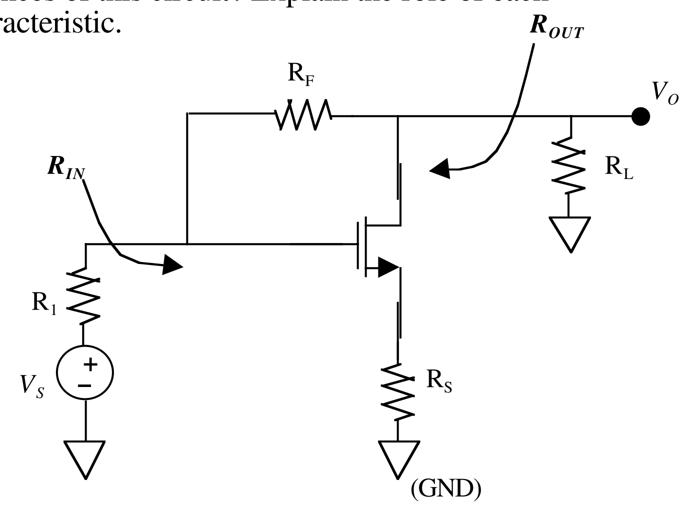
Problem 1 - (25 points)

For the feedback circuit shown below:

a. Identify the types of feedback topologies used.

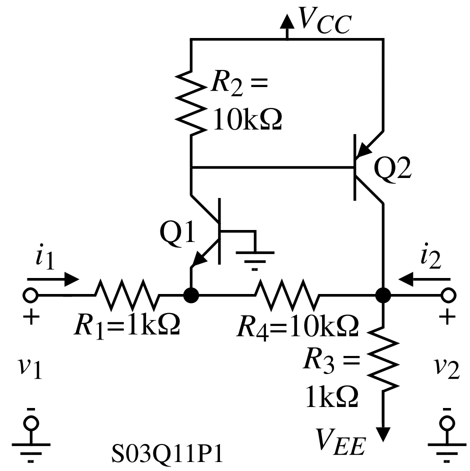
b. Using the Blackman's formula, derive expressions for the input (R_{IN}) and the output (R_{OUT}) resistances of this circuit (neglect the output resistance of the transistor r_o). Simplify your expressions as much as possible with the assumption that $g_mR_E >> 1$.

c. If the source (R_1) and load (R_L) resistances are equal, what relationship will hold between the input and output resistances of this circuit? Explain the role of each feedback loop in achieving this characteristic.



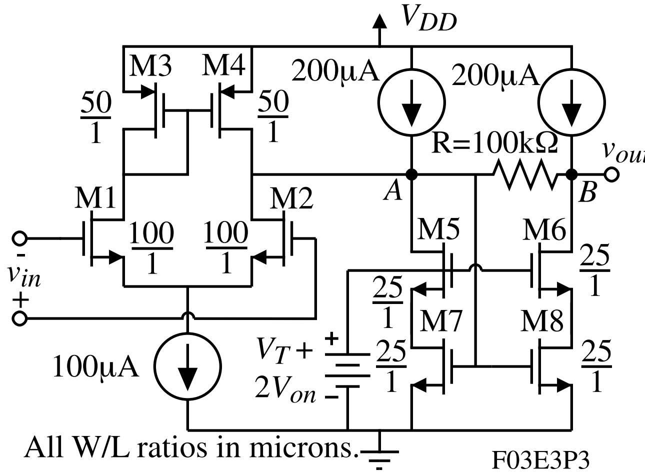
Problem 2 - (25 points)

A shunt-shunt feedback amplifier is shown. Use the methods of feedback analysis to find the numerical values of v_2/v_1, v_1/i_1, and v_2/i_2. Assume that all transistors are matched and that V_t= 25mV, β (of the BJT) = 100, $I_{C1} = I_{C2}$ = 100μA, and $r_o = \infty$.



Problem 3 - (25 points)

A low-gain, high-bandwidth voltage amplifier is shown. Find the low frequency voltage gain, v_{out}/v_{in}, and the unity-gainbandwidth, GB, if the sum of the capacitance connected to nodes A and B is 0.5pF each. Assume that the independent current sources used have infinite resistance. The transistor model parameters are $K_N' = 110\mu A/V^2$, $V_{TN} = 0.7V$, $\lambda_N = 0$, $K_P' = 50\mu A/V^2$, $V_{TP} = -0.7V$, $\lambda_P = 0$.



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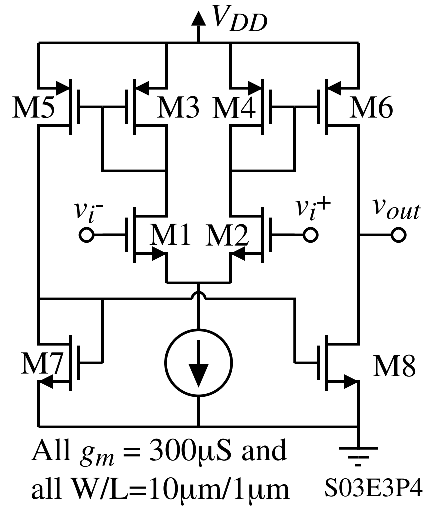
Problem 4 - (25 points)

For the amplifier shown assume that all transconductances are equal. Find (a.) the equivalent input noise voltage in units of V^2/Hz for thermal noise (k = 1.38x10^{-23} J/K), (b.) the equivalent input noise voltage in units of V^2/Hz for 1/f noise (B_N = 8x10^{-22} (V-m)^2 and B_P = 2x10^{-22} (V-m)^2), and (c.) the noise corner frequency in Hz. Using $\int_a^b \frac{1}{f}\,df = \ln(b) - \ln(a)$, find the rms noise voltage in a bandwidth of 1Hz to 100kHz in V(rms).



Extra Sheet