ANALOG ELECTRONIC CIRCUITS SUMMER-2020 Final

NAME: **Number:**

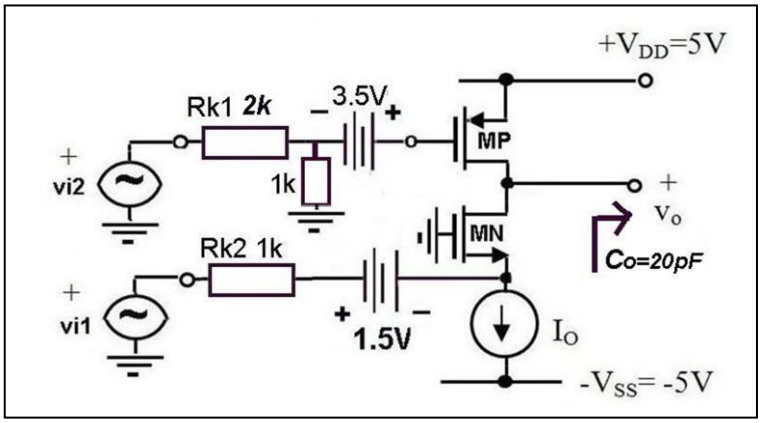
Final exam includes 5 problems.

Write your answers on A4-white papers and sign each page.

P1- For the MOSFETs in the figure, $k_p'=\mu_p c_{ox}=40\mu A/V^2$, $k_n'=\mu_n c_{ox}=100\mu A/V^2$, $V_{An}= V_{Ap} =40V$, $V_{Th,p}= -0.5V$, $V_{Th,n}= 0.5V$ are given. Cgs=10pF, Cdg=2pF for the transistors. The input of the next circuit has a parasitic capacitance of 20pF(Co=20pF).

Io=1mA, $(W/L)_N$=20, $\beta_N= \beta_P$ are given.

Find the cut-off frequency of the ac differential gain of the circuit vo/(vi1-vi2). (20P)



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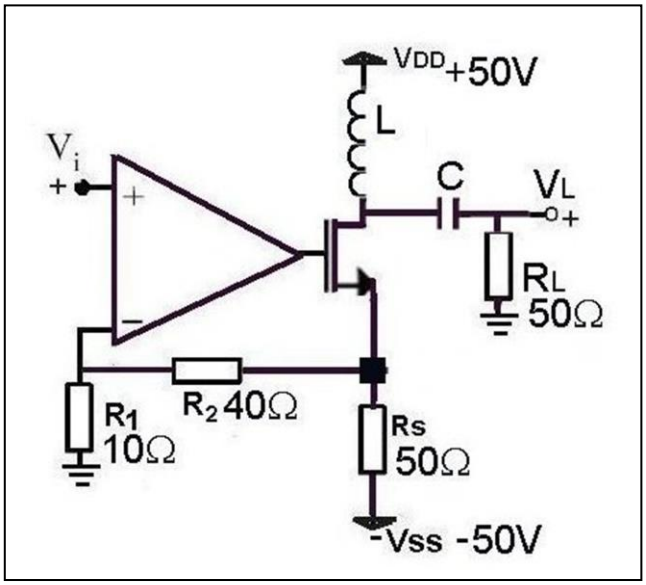
P2- For the MOSFET in the figure, **β=100mA/V^2** and **V_{Th}= 2V** are given. The OPAMP is **ideal**. The bias point for the input is given as **ViDC=0V**. **(L and C have very large values.)**

Find ac midband gain of the circuit (V_L/Vi) **by using the feedback method**.(20P)



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P3 The circuit in P2 will be used as a class-A power amplifier circuit (*in spite of that it is not a convenient circuit for power amplifier applications*);

a) Find the optimum load value for the circuit.($R_{L\text{-}OPT}$=?)(7P)

b) Find the maximum efficiency value for the sinusoidal case.(7P)

c) Find the maximum power value dissipated on the MOS transistor.(7P)

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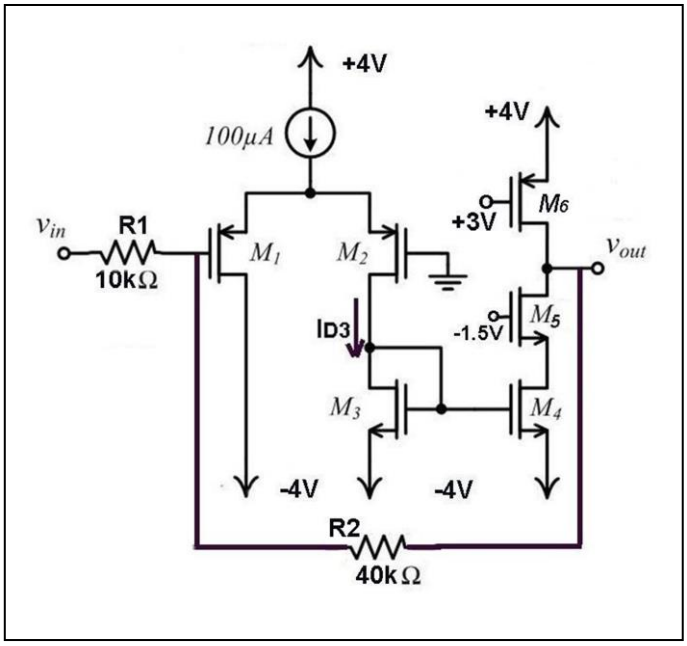
P4- For the MOS transistors in the Figure, $\beta_1=\beta_2=\beta_3=0.4mA/V^2$, $\beta_4=\beta_5=\beta_6=0.8mA/V^2$, $V_{AP}=V_{AN}=50V$ and $|V_{TH1}|=|V_{TH2}|=|V_{TH6}|=V_{TH3}=V_{TH4}=V_{TH5}=0.5V$ are given. (**Vin_{DC}=0 and $Vout_{DC}$=0**)



(Cgs6=2Cgs4=2Cgs5=2Cgs1=2Cgs2=4Cgs3= 40pF)
(Cds=Cgs/4 for all the transistors)

a) Find the loop-gain of the circuit in the figure (**Vin=0 for the loop gain**).(10P)

b) Draw the magnitude and phase characteristics of the loop-gain. Find the Phase Margin (PM).(10P)

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P5 The circuit given in the figure will be used as a relaxation oscillator after a modification. In order to obtain the oscillation behavior, a capacitor (C=1μF) will be used in place of RA or RB (which resistor?). Put the capacitor in place of the **right resistor** for the oscillation. Then;

a) Find the oscillation frequency value. (10P)

b) Draw the signals at Vout and Vo1. (10P)