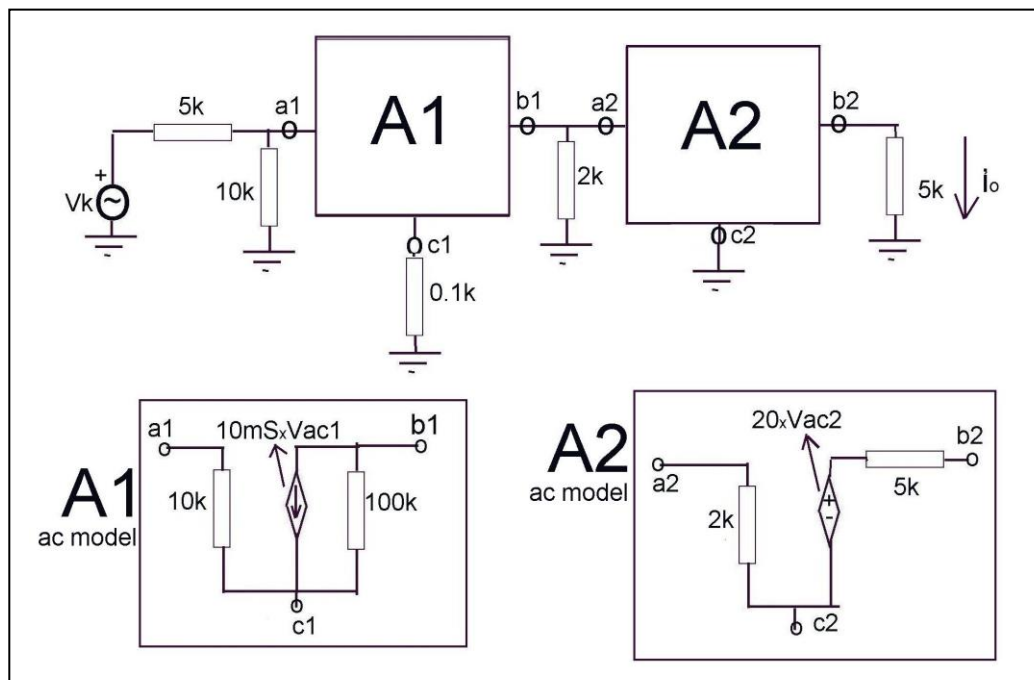Final exam includes 5 problems.

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

P1 ac case of an amplifier circuit including two amplifiers (A1 and A2) is shown in the picture, above. The ac models of A1 and A2 are given in the picture, below. Find the ac transconductance gain of the circuit (**Gm=io/vk**). (15P)
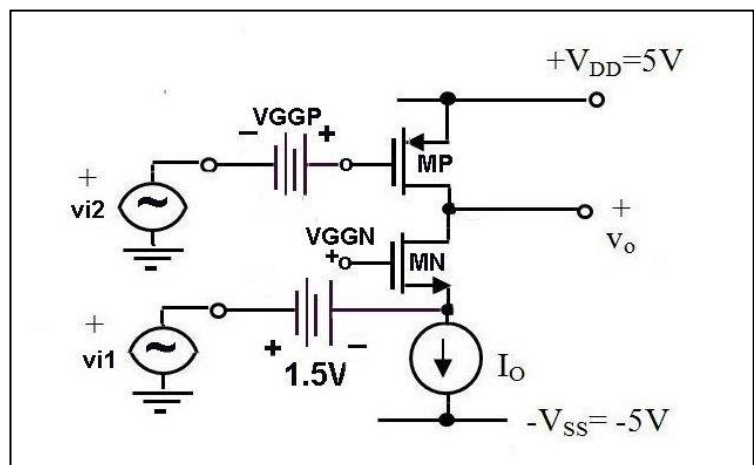
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P2 For the MOSFETs in the figure, $k_p'=\mu_p c_{ox}=40\mu A/V^2$, $k_n'=\mu_n c_{ox}=100\mu A/V^2$, $V_{An}=V_{Ap}=40V$, $V_{Th,p}=-0.5V$, $V_{Th,n}=0.5V$ are given.

Io=1mA, (W/L)$_N$=20, β$_N$= β$_P$ are given.

a) Find VGGN and VGGP.(10P)

b) Find ac differential gain of the circuit vo/(vi1-vi2).(10P)
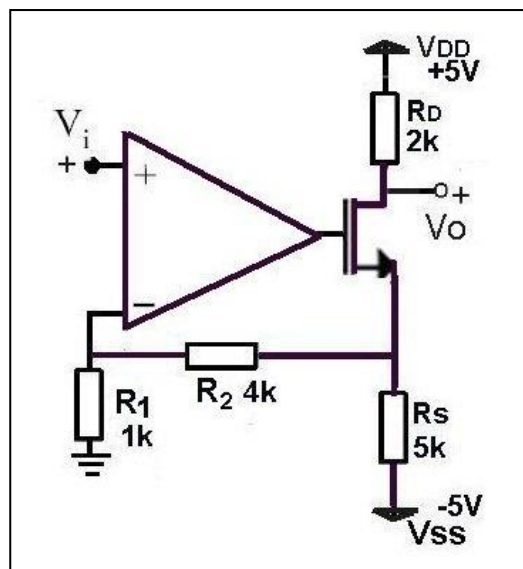
c) Find CMRR of the circuit. (10P)

P3 For the MOSFET in the figure, **β=4mA/V²** and V_{Th}**= 1V** are given. the OPAMP is **ideal**.
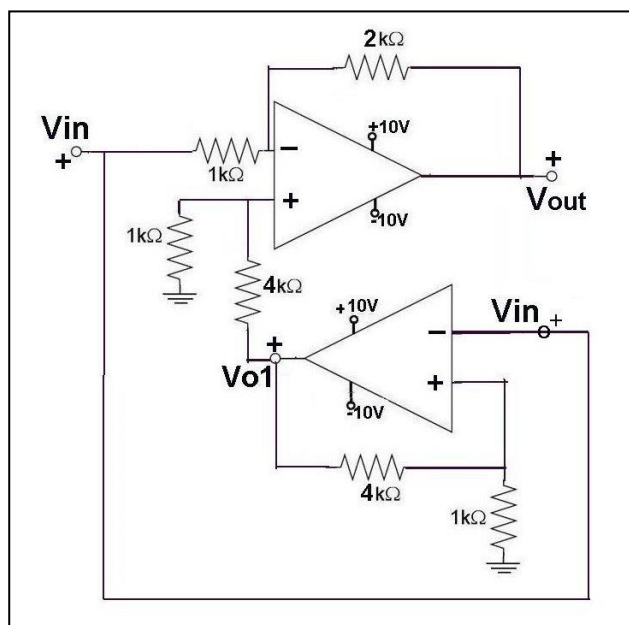The bias point for the input is given as ViDC=0V.

a) Find ac gain of the circuit (Vo/Vi).(10P)

b) Find the maximum Vi value for the amplifier application.(10P)

b) Find the minimum Vi value for the amplifier application.(10P)

P4 Draw the transfer characteristic of the circuit given in the figure (**Vout-Vin**).(15P)

P5 Draw the transfer characteristic of the circuit given in the figure (**Vout-Vin**).(15P)