

Full Marks = 100

1. Find the differential voltage gain of the amplifier. Ignore body effect and channel length modulation effect. [10]

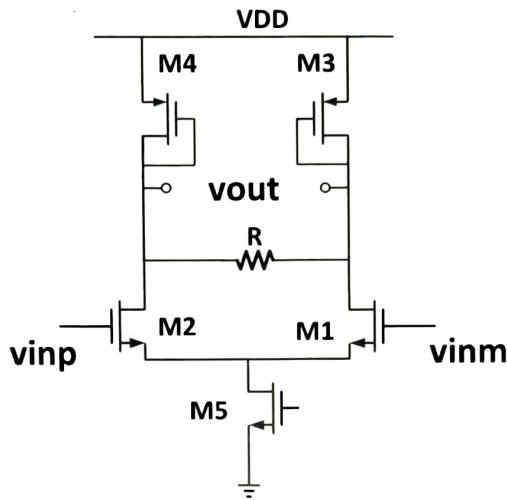


Fig. 1

2. In the circuit shown in Fig. 2, the transistors have transconductance of g_m and $g_o = g_{mb} = 0$. [4+4+4+4+4=20]

- Draw differential half circuit.
- Find $A_{dm-dm} = (v_{outp} - v_{outm}) / (v_{inp} - v_{inm})$
- Draw common mode half circuit.
- Find $A_{cm-cm} = (v_{outp} + v_{outm}) / (v_{inp} + v_{inm})$
- What is the CMRR ?

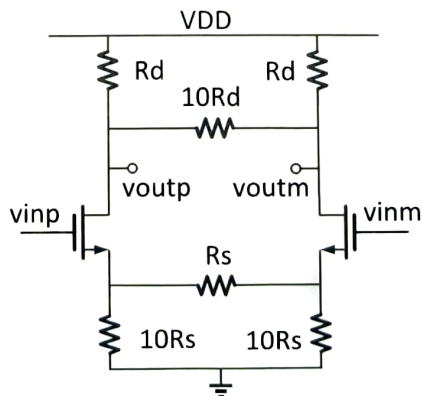


Fig. 2

3. The two stage differential operational amplifier as shown in Fig. 3 is compensated. Ignore body effect but consider channel length modulation. [4+4+4+4+5+10=35]

- Evaluate the poles [Shortcut/intuitive methods are ok; consider only C1, C2 and Cc]
- Evaluate the zero [Shortcut/intuitive methods are ok; consider only C1, C2 and Cc]
- Find the input common mode range.
- Evaluate the DC gain of the amplifier
- What is the unity gain frequency (ω_{ug}) ?
- If zero $\omega_z = 10 * \omega_{ug}$ then what should be ω_{p2}/ω_{ug} for 60 degree of phase margin? ω_{p2} is the non-dominant pole.
- Find the input referred noise of the amplifier.

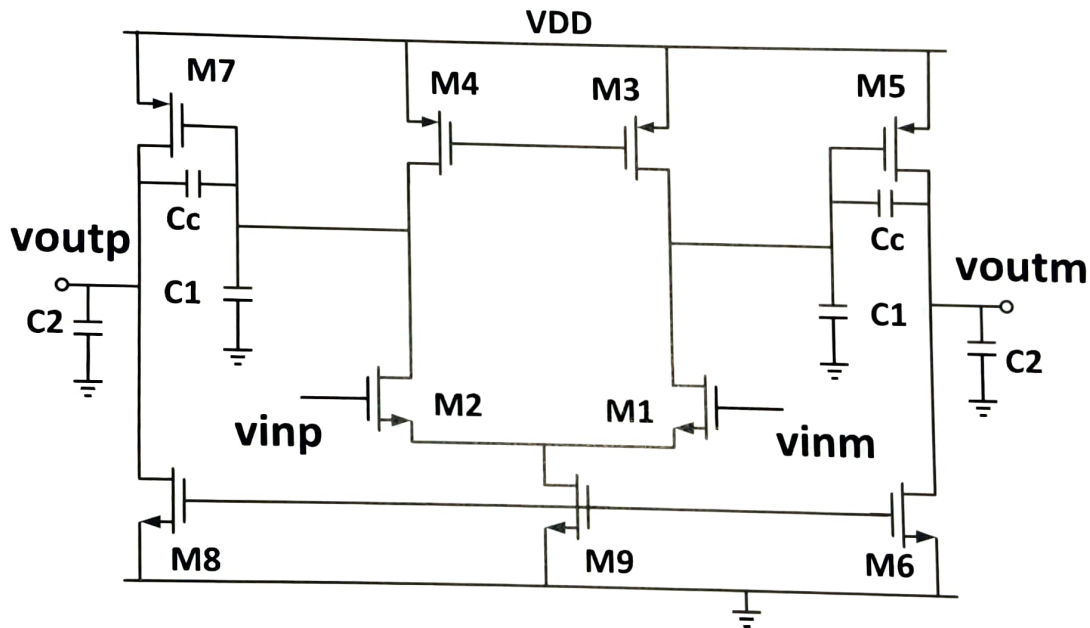


Fig. 3

4. The circuit diagram of a differential amplifier is shown in Fig. 4. The objective is to have good precision and good energy efficiency. [4 + 4 + 2 = 10]

- The overdrive of the PMOS current sources should be high or low? Why?
- The overdrive of the NMOS differential pair should be high or low? Why?
- The overdrive of the NMOS tail source should be high or low? Why?

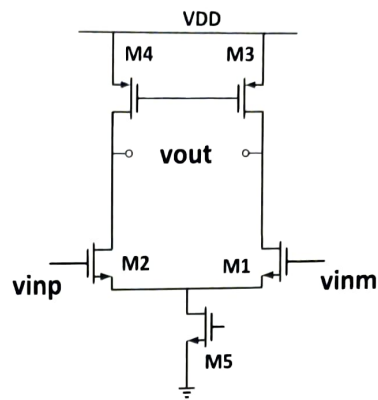


Fig. 4

5. Find an expression for the input impedance of a source follower amplifier as shown in Fig. 5 and show that it has a negative real part. Ignore any other capacitances. [10]

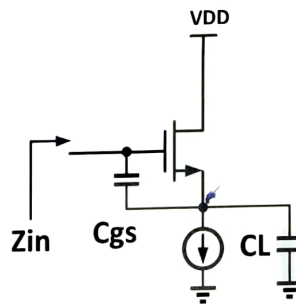


Fig. 5

6. A designer tries to set the output common mode of a fully differential circuit using the circuit shown in Fig. 6. Will this scheme work? If yes, explain the functionality intuitively OR analytically. [15]

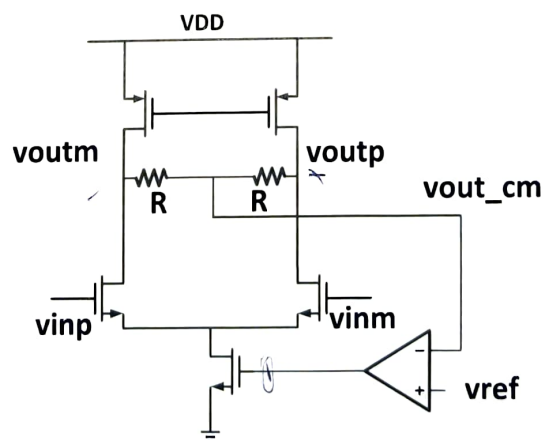


Fig. 6