

1. (30%) Assume that the frequency response of the op amp is given by a single-pole model with a unity-gain frequency of 10 MHz.
  - (1) The op amp is used in the closed-loop amplifier as shown in Fig. 1. If the 3-dB bandwidth is 100 kHz, what is the dc gain of the amplifier? (5%)
  - (2) Please design the values of  $R_1$  and  $R_2$  such that the closed-loop amplifier in Fig. 1 has a 3-dB bandwidth of 200 kHz and a dc gain of 43 dB. (5%)
  - (3) Given that  $R_1 = 10 \text{ k}\Omega$  and  $R_2 = 400 \text{ k}\Omega$  for the amplifier in Fig. 1. What is the voltage gain (magnitude and phase) of the closed-loop amplifier at 500 kHz? (10%)
  - (4) Consider that two identical closed-loop amplifiers are cascaded. If a minimum bandwidth of 100 kHz is needed, what is the maximum dc gain achievable for the cascaded amplifier. (10%)

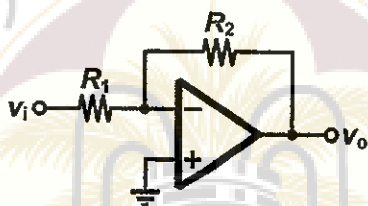


Fig. 1

2. (20%) The circuit in Fig. 2 is used as an amplifier and the circuit parameters are given as  $k_n = k_p = 800 \mu\text{A}/\text{V}^2$ ,  $V_{tn} = |V_{tp}| = 1 \text{ V}$ ,  $V_{An} = |V_{Ap}| = 50 \text{ V}$ ,  $R_1 = 7.5 \text{ k}\Omega$ ,  $R_2 = 2 \text{ k}\Omega$ ,  $V_{DD} = 5 \text{ V}$  and the input common-mode voltage is 3.5 V.
  - (1) Find the voltage gain of the amplifier ( $v_o/v_i$ ). (10%)
  - (2) If  $V_{DD}$  is increased by 10%, find the change (%) in the voltage gain. (10%)

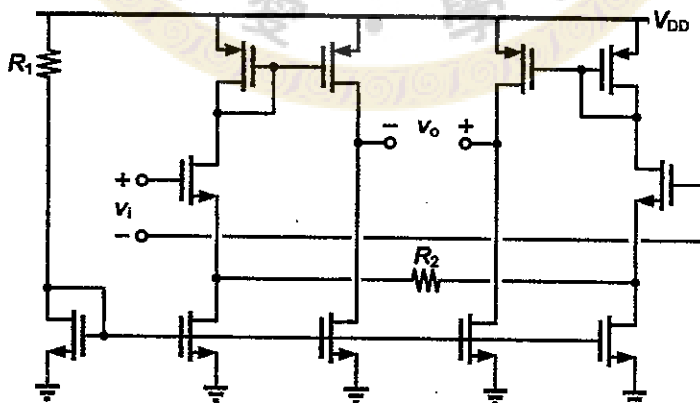


Fig. 2

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