

1. Assume $R_1 = 2 \text{ k}\Omega$, $R_2 = 20 \text{ k}\Omega$, the open-loop gain is 10^5 V/V and the unity-gain bandwidth of the operational amplifiers is $5 \times 10^6 \text{ rad/s}$.
 - (1) For the closed-loop amplifier in Fig. 1(a), find the dc gain and 3-dB bandwidth. [10%]
 - (2) For the closed-loop amplifier in Fig. 1(b), find the dc gain and 3-dB bandwidth. [10%]
 - (3) For the closed-loop amplifier in Fig. 1(c), find the dc gain and 3-dB bandwidth. What is the transfer function $T(s) \equiv V_o/V_i$ of the amplifier? [20%]

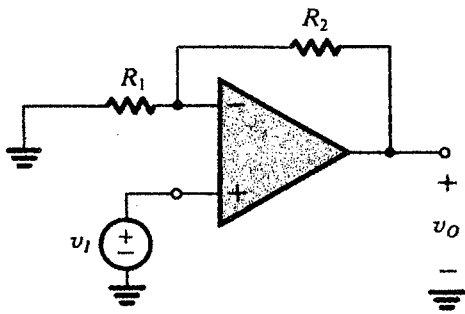


Fig. 1(a)

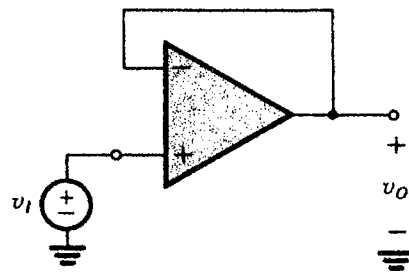


Fig. 1(b)

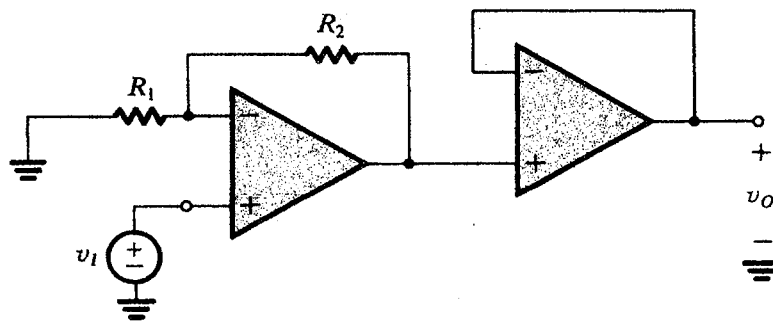


Fig. 1 (c)

2. For the common-gate amplifier in Fig. 2, $V_{DD} = 5 \text{ V}$, $-V_{SS} = -5 \text{ V}$, $R_D = 8 \text{ k}\Omega$ and C_{C1} and C_{C2} are ideal coupling capacitors. The parameters of the MOSFET are given as $\mu_n C_{ox}(W/L) = 1 \text{ mA/V}^2$ and $V_t = 1 \text{ V}$.
 - (1) If an input resistance of $1 \text{ k}\Omega$ is needed, find the value of the bias current I . [10%]
 - (2) Use the value of current I in (1). If the amplifier is used as a current amplifier, please draw the equivalent circuit model and specify the values of the parameters. [10%]

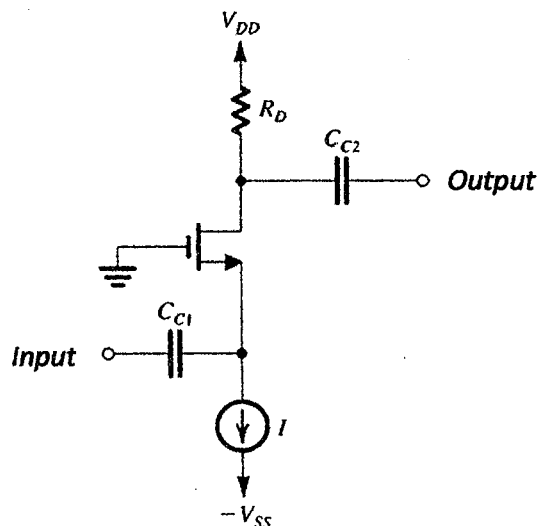


Fig. 2

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3. Assume that an open-loop amplifier has two poles. The dc gain is 10^5 V/V and the poles are given as $\omega_{p1} = 10$ rad/s and $\omega_{p2} = 10^6$ rad/s.
- (1) Find the phase margin of the open-loop amplifier. [10%]
 - (2) If the open-loop amplifier is used in a feedback system with $\beta = 0.1$, find the closed-loop transfer function. [10%]
 - (3) If the open-loop amplifier is used in a feedback system, how do you choose the value of β such that the closed-loop dc gain becomes 100 V/V? What is the 3-dB bandwidth of the closed-loop amplifier? [20%]

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