

1. The circuit in Fig. 1 is a Miller integrator. Please answer the following questions.
 - (a) Consider a Miller integrator with $R = 10\text{ k}\Omega$ and $C = 1\text{ nF}$. Assume the gain of the op-amp is infinite and the slew rate is $1\text{ V}/\mu\text{s}$. For a 10-kHz sinusoidal input, what is the maximum amplitude allowed? [10%]
 - (b) If the open-loop op-amp has a finite gain of A_0 , derive the transfer function of the circuit. [10%]
 - (c) For the transfer function in (b), please define its dc gain and 3-dB frequency. [10%]

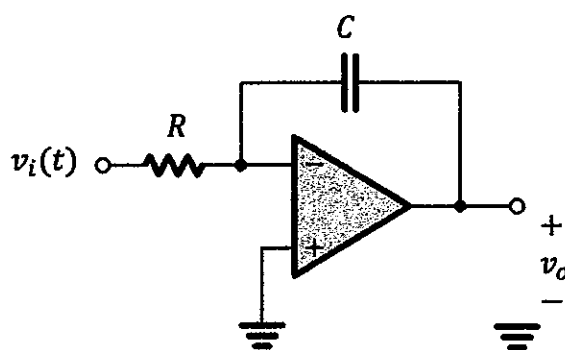


Fig. 1

2. Fig. 2 is the ac equivalent circuit of a common-base amplifier. For the BJT, assume the transconductance is g_m , current gain is β and r_o is large.
 - (a) If the circuit is treated as a voltage amplifier, please draw the two-port voltage amplifier model and specify the parameters. [5%]
 - (b) If a resistor R_B is added between the base terminal and ground, repeat (a). [10%]
 - (c) If the circuit is treated as a current amplifier, please draw the two-port current amplifier model and specify the parameters. [5%]
 - (d) If a resistor R_B is added between the base terminal and ground, repeat (c). [10%]

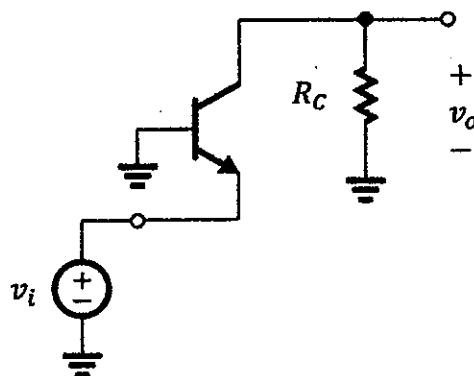


Fig. 2

3. The small-signal equivalent circuit of a two-stage op-amp is given in Fig. 3.
 - (a) Derive the transfer function of the amplifier. [10%]
 - (b) Assume $G_{m1} = G_m$, $G_{m2} = 2G_m$, $R_{o1} = R_{o2} = R$, $C_c = 10C$, $C_1 = C$ and $C_2 = 2C$, find the poles and zeros. [10%]
 - (c) Based on (b), find the phase margin of the op-amp. [10%]

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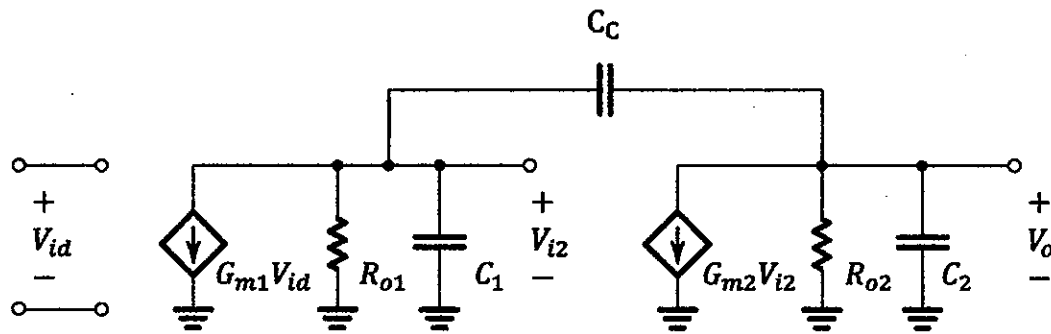


Fig. 3

4. Find the correct statements about n-channel MOSFETs. (choose all that applies) [5%]
- (a) Current conduction due to both electron and hole currents
 - (b) Current flow due to carrier diffusion
 - (c) Current flow due to carrier drift
 - (d) V_A is independent of the transistor size for a given fabrication technology
 - (e) g_m is independent of the transistor size for a given fabrication technology
5. Find the correct statements about BJTs. (choose all that applies) [5%]
- (a) Current conduction due to both electron and hole currents
 - (b) Current flow due to carrier diffusion
 - (c) Current flow due to carrier drift
 - (d) V_A is independent of the transistor size for a given fabrication technology
 - (e) g_m is independent of the transistor size for a given fabrication technology

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