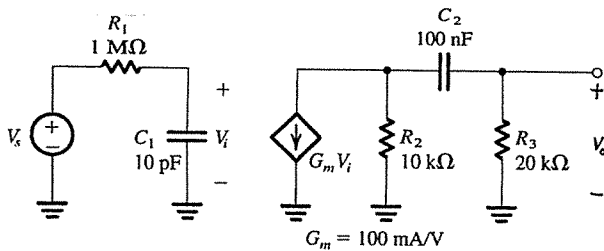
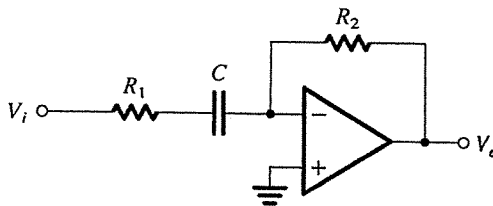


- (10%) Consider the use of an op amp with $f_i = 2\text{MHz}$, $\text{SR} = 1\text{V}/\mu\text{s}$, and $V_{\text{omax}} = 10\text{V}$ in the design of a non-inverting amplifier with a nominal gain of 10. Assume a sine-wave input with peak amplitude V_i . (f_i : unity-gain bandwidth; SR: slew rate)
 - If $V_i = 0.5\text{V}$, what is the maximum frequency before the output distorts?
 - If $V_i = 50\text{mV}$, what is the useful frequency range of operation?
- (15%) A common-gate amplifier using an n -channel enhancement MOS transistor for which $g_m = 5\text{mA/V}$ has a $5\text{-k}\Omega$ drain resistance (R_D) and a $2\text{-k}\Omega$ load resistance (R_L). The amplifier is driven by a voltage source having a $200\text{-}\Omega$ resistance R_{sig} . What is the input resistance of the amplifier? What is the overall voltage gain G_v ?
- (10%) A shunt regulator utilizing a Zener diode with an incremental resistance of $5\ \Omega$ is fed through an $82\text{-}\Omega$ resistor. If the raw supply changes by 1.3V , what is the corresponding change in the regulated output voltage?
- (10%) Please provide definitions of *line regulation* and *load regulation*.
- (25%) Provide a design of voltage follower using BJT transistors. Find the input resistance and the output resistance of your voltage follower. What is the voltage gain? Please explain how you can bias the transistor circuit using a constant-current source. Please also provide the circuit that implements the current source using BJT transistors.
- (15%) For the circuit shown in the following figure, evaluate the overall transfer function, $T(s) = V_o(s)/V_i(s)$. Provide a Bode magnitude plot for $|T(j\omega)|$. What is the bandwidth of the circuit?



- (15%) Does the circuit in the following figure perform the high-pass or low-pass function? Please derive the transfer function and find the time constant of the circuit.



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