ECE 275: Analog and Digital Electronics

Chapter 1: Introduction to Electronics
Fall 2005

Exercises

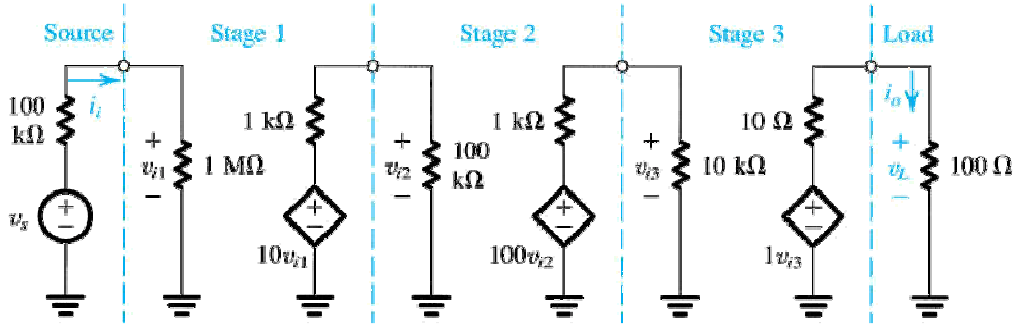
1. An amplifier has a voltage gain of 100V/V and a current gain of 1000A/A. Express the voltage and current gains in dB's and find the power gain.

2. An amplifier operating from a single 15-V supply provides a 12-V peak-to-peak sine-wave signal to a 1kΩ load and draws a negligible input current from the signal source. The DC current drawn from the 15-V supply is 8mA. What is the power dissipated in the amplifier and what is the amplifier efficiency?

3. A transducer characterized by a voltage of 1V RMS and a resistance of 1 MΩ is available to drive a 10Ω load. If connected directly, what voltage and power levels result at the load? If a unity gain amplifier (a.k.a. Buffer Amplifier) with 1MΩ input resistance and 10Ω output resistance is interposed between the source and load, what do the output voltage and power levels become? For the new arrangement, find the voltage gain from the source to load, and the power gain. Is there any advantage to putting the Buffer Amplifier in between the transducer and the load? Explain your observations.

4. The output voltage of a voltage amplifier has been found to decrease by 20% when a load resistance of 1kΩ is connected. Why did the output voltage decrease when the load was placed at the output? What is the value of the amplifier output resistance?

5. An amplifier with a voltage gain of +40dB, and input resistance of 10kΩ, and an output resistance of 1kΩ is used to drive a 1kΩ load. What is the value of the open circuit voltage gain? Find the value of the power gain in dB's.



6. What would the overall voltage gain of the cascaded amplifier be above without stage 3?

7. For the cascaded amplifier above, let v_s be 1mV. Find all of the intermediate voltages.

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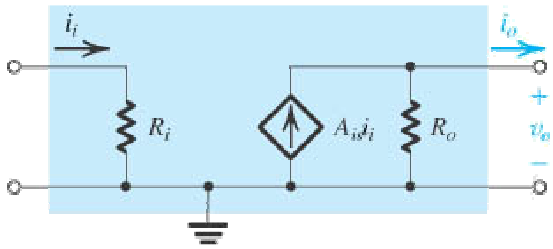
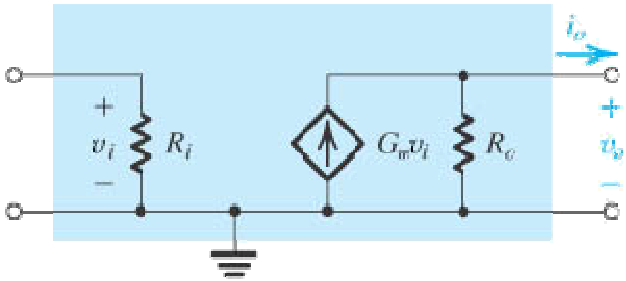
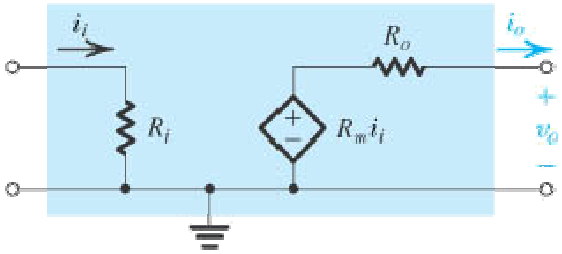
8. Instead of three stages, model the above amplifier using a 1-stage model. Give the values for the input resistance, output resistance, and the open circuit voltage gain.



9. What type of amplifier is depicted above? What are the ideal characteristics for input and output resistance? Explain your reasoning. Let the amplifier be fed with a signal current source, i_s, having an internal resistance R_s and let the output be connected to a load given by R_L. What is the overall current gain?

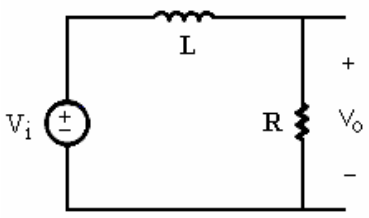


10. What type of amplifier is depicted above? What are the ideal characteristics for input and output resistance? Explain your reasoning. Let a voltage signal source v_s with an internal resistance R_s and let the output be connected to a load resistance R_L. What is the overall voltage gain?



11. What type of amplifier is depicted above? What are the ideal characteristics for input and output resistance? Explain your reasoning. Let the amplifier be fed with a signal-current source i_s having an internal resistance of R_s, and let the output be connected to a load resistance R_L. What is the overall gain, v_o / i_s?

12. Consider a voltage amplifier having a frequency response of the low-pass Single Time Constant (STC) type with a DC gain of 60 dB and a 3-dB frequency of 1kHz. Find the gain in dB at f = 10Hz, 10kHz, 100kHz, and 1MHz. What happens as the frequency increases?



13. Perform a complete frequency analysis of the circuit below. What type of frequency response does it exhibit? Plot the magnitude and phase in dB's. What is the break frequency if $R = 1.5k\Omega$ and $L = 3.0mH$. Switch the positions of R and L and re-do the frequency analysis? What is different about the frequency response? Compare and contrast the plots obtained from both circuit configurations.