

**ECE 4391 Electromagnetic Compatibility Quiz 2**

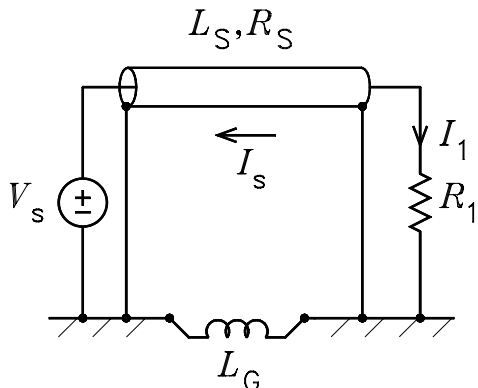
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Professor Leach

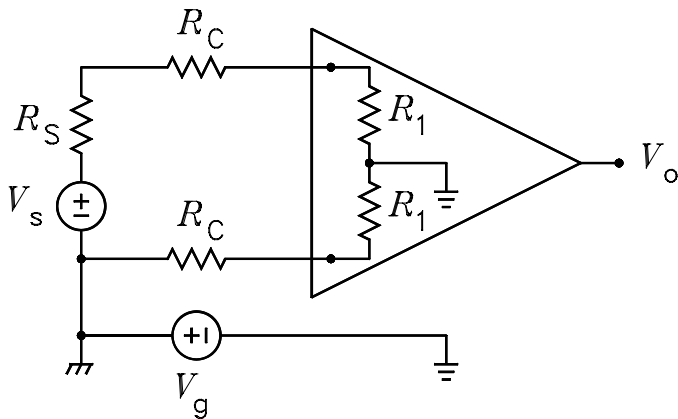
Name \_\_\_\_\_

**Instructions.** *Problem 3 is on the back of this page.* Print your name in the space above and at the top of all other pages in your quiz. Be brief with your answers. Draw simple diagrams that illustrate your answers. The quiz is closed notes and closed calculator. **Honor Code Statements:** *I have neither given nor received help on this quiz.* Initials \_\_\_\_\_

- The shield in the figure is characterized by the inductance  $L_S$  and the resistance  $R_S$ . An equivalent ground inductance  $L_G$  is associated with the circuit



- Derive the transfer function for  $I_s/I_1$ .
  - Sketch and label the Bode magnitude plot of  $|I_s/I_1|$  versus frequency.
  - Above what frequency does 98% of the current  $I_1$  return through the shield?
- For the circuit shown, it is given that  $V_S = 25$  mV,  $R_S = 600 \Omega$ ,  $R_C = 1.2 \Omega$ , and  $V_g = 1.5$  V, where  $V_g$  is a ground noise voltage between the source ground and the amplifier ground.



- For  $R_1 = 10$  k $\Omega$ , solve for ratio of the differential signal voltage to the differential noise voltage across the inputs to the differential amplifier. Express the ratio in dB.
  - What is the restriction on the resistors labeled  $R_1$  in order to keep the ground noise coupled across the inputs to less than 0.1% of the signal voltage  $V_s$ ?
  - If a guard is added to the amplifier, show how the circuit would be modified and show where the guard should be connected.
- XX
    - What is the principle characteristic of noise in a balanced system that makes it possible to be canceled out at the load?

- (b) Decoupling capacitors are used to correct what problem that occurs with power supply leads?
- (c) What is the principal difference between the low-frequency impedance and high-frequency impedance of a power supply bus on a printed circuit board?
- (d) What is the most important consideration in choosing a capacitor type?
- (e) What is the reason for putting a copper strap around the outside of the transformer in a power supply?
- (f) Name the two types of noise that resistors exhibit.