

## ECE 4391 Electromagnetic Compatibility Quiz 1

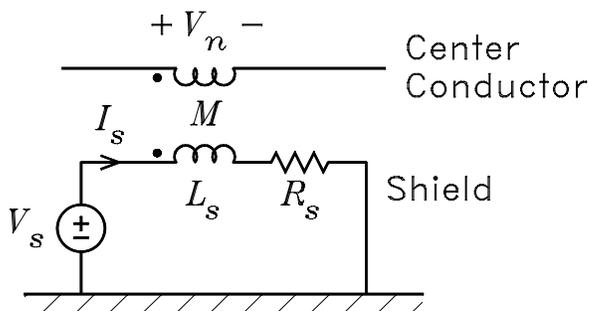
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Professor Leach

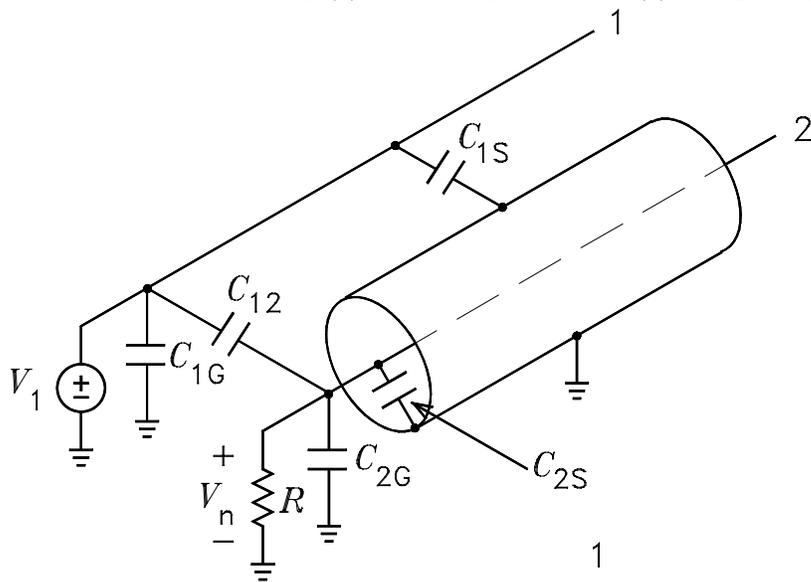
Name \_\_\_\_\_

**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 figure shows the equivalent circuit of a shielded conductor. The source  $V_s$  represents a noise voltage that is induced on the shield. (a) Derive the expressions for the shield current  $I_s$  and the noise voltage  $V_n$  coupled into the conductor as a function of  $j\omega$ . (b) Sketch the Bode magnitude plot for  $V_n/V_s$ . Label and give the equation for the shield cutoff frequency  $f_c$ . (c) If the shield noise voltage is due to an external magnetic field, what is the primary method of reducing the coupling?



- In the figure,  $V_1$  is a noise voltage on conductor 1. Conductor 2 is shielded and extends beyond the shield. The voltage  $V_n$  is the noise voltage coupled into conductor 2 from conductor 1. The parasitic capacitors between the conductors are labeled. (a) Draw the equivalent circuit and derive the transfer function for  $V_n/V_1$ . (b) Sketch the Bode magnitude plot for  $V_n/V_1$ . (c) What methods might be used to reduce the noise coupling (1) at low frequencies and (2) at high frequencies?



- What are the three primary means of noise coupling?
  - Describe two problems that can occur when different metals are in contact with each other.
  - A noise voltage is induced in a signal lead between a source and a load. Describe a simple experiment that can be used to determine if the noise voltage is coupled through an electric field or a magnetic field.