Feb. 28, 2013
DEPARTMENT & COURSE NO.: PHYS 2610

EXAMINATION: Circuit Theory and Introductory Electronics

MID-TERM TEST
PAGE NO.: 1 of 1
TIME: 1.25 hours
EXAMINER: S.A. Page

Instructions: Answer all questions. Be as concise as possible with descriptive answers. Define variables clearly with reference to a labeled diagram. Ask for assistance if you require a formula that is not explicitly provided on the sheet.

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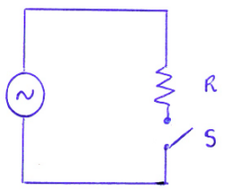
1. Output resistance: (20 marks)



An AC function generator is connected to an external resistor R = 1000 Ω (exact!) via a switch S, as shown. When the switch S is open, a DMM connected across the function generator reads an RMS voltage of 5.000 V. When the switch S is closed, the DMM reads an RMS voltage of 4.651 V. The statistical uncertainty of the DMM readings is ± 1 digit.

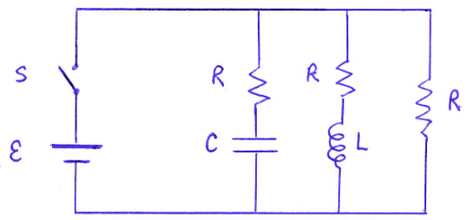
a) Assuming that the resistance of the DMM can be neglected, evaluate the output resistance of the function generator. Draw a circuit diagram to help guide your work!

b) What is the statistical uncertainty in the output resistance from part a) ?

c) If the resistance of the DMM is 2 MΩ, is the systematic uncertainty in the output resistance significant, compared to the statistical error? Why or why not?

Answer briefly! Do not peform an extensive calculation for part c)!

2. Parallel circuit: (20 marks)



The circuit shown consists of an ideal source of EMF, a switch, and 3 parallel branches.

Initially, the switch S has been open for a very long time, and it is suddenly closed at t = 0.

a) The currents in each branch of the circuit can be solved independently for t > 0 . Why is this?

b) What are the currents in each branch of the circuit as $t \to \infty$? Sketch a simpler circuit that would be electrically equivalent in this limit.

c) Set up and solve an equation to find the charge on the capacitor, and hence the current in the capacitor branch, for t > 0.

d) Set up and solve an equation to find the current through the inductor, for t > 0.

e) What relation between the component values R, L and C would result in the total current through the source being constant in time after the switch is closed?

3. Parallel circuit – Impedance analysis: (10 marks)

Suppose we replace the ideal source of EMF in question 2 with an ideal AC function generator, supplying a voltage $v = v_o \cos \omega t$ across its output terminals.

Find an expression for the current as a function of time in:

a) the resistor branch

b) the RL branch

c) the RC branch