Write-ups must provide a detailed description of the exercise, including diagrams of all circuits and descriptions of all procedures. Remember to have your lab TA sign and date each page of your lab notebook. With your write-up, include a concise, well-written one-page summary printed on a separate page with your names, which (1) states the objectives of the exercise, (2) describes the methods, (3) presents the results, and (4) summarizes the general conclusions drawn from the results. Your grade will be based in part upon conciseness, grammar, and spelling. **Late work will not be accepted.**

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0. **Laboratory preparation** – *Upon arrival in the lab, each lab team is to hand in to the TA a printed and filled out copy of pg 3 with match-ups of the six circuits and waveforms clearly indicated.*

In this lab, you will study and analyze the transient behavior of first-order RC and RL circuits. Prepare for the lab by matching up the circuits with the corresponding waveforms for voltage shown on the last page of this assignment. Use your knowledge of the behavior of capacitance and inductance here. You should also find analytical expressions that relate $R_s$ and the unknown resistor values to the initial ($t = 0^+$) and final ($t \to \infty$) voltage values. *Each lab pair must hand in a completed sheet to the TA upon arrival in the Gavett lab.*

1. **Transient response**

The entire lab assignment consists of using a square wave voltage input to observe the transient voltage-step response of six unknown networks provided to you by the TA. Employ the simple set-up shown below, using the dual-trace feature of the scope to display at the same time the input square wave and the voltage $v(t)$ defined in Fig. 1.

Each lab team will be given 6 networks with no duplicates, that is, one of each of the 6 types shown on

![Diagram of square-wave generator @ 10 kHz connected to an unknown first-order RC or RL network](image)

**Fig. 1.** Setup for investigating the transient response of first-order RC and RL networks. Use a square-wave input @ 1 to 10 kHz & voltage magnitude of ~10 V peak-to-peak. For the RC c茨s, $R_s \sim 10$ kΩ is recommended, while for the RL networks, $R_s \sim 1$ kΩ may be a good choice. Adjust the square-wave frequency so that period $T = 5\tau$. 
pg. 3. The tasks are (i) to identify each first-order ckt by type and then (ii) to obtain estimates for the values of all R, L, and C circuit elements.

NOTE: When reconciling waveforms observed on the scope with the simple step-response transients depicted on page 3, it is important to recognize that the initial conditions for each step change in voltage are controlled by the steady-state condition from the previous half-cycle. Also, note that the voltage step occurring each half cycle is equal to the peak-to-peak amplitude. In particular, you should put in some extra thought about the cases of parallel RC and series LR networks.

An important aspect of this assignment is to establish reliable limits for the precision of each component value in ±%.

For obvious reasons, you are not to use the LCR meter in this lab.

II. Your lab write-up

On the first page of your report, list by number the six networks you were provided and describe them with circuit diagrams and the values for the components, including your estimates of their precisions. On subsequent pages of the report, fully explain (i) how you went about identifying the type of each circuit and (ii) the data you gathered and analytical methods you used to obtain all the component values. Be sure to show all relevant waveform sketches, each properly annotated with the voltage and time data used to calculate the component values.

It is very important to account for your measurement uncertainties so that you can determine the ± uncertainties of the components inside the boxes.
TO BE COMPLETED & HANDED IN BEFORE STARTING LAB #6

The six basic first-order RC and RL networks:

- **C** series RC
- parallel RC
- **L** series RL
- parallel RL

The voltage responses to a positive voltage step of magnitude $V_o$ for the six first-order RC and RL networks shown above.

- **(a)**
- **(b)**
- **(c)**
- **(d)**
- **(e)**
- **(f)**