

EE2CI5 LAB 3a

RC and RL Circuits

Objective

The objective of this lab is for you to become familiar with the behavior of RC and RL circuits and the characteristics of energy storing elements. It will also help to enhance measurement skills in the laboratory.

Equipment:

- 1) Function generator
- 2) Digital Oscilloscope

Components:

- 1) *Resistors*: one each: 330 Ω , 680 Ω , 4.7k Ω , 1k Ω , 10k Ω and 20k Ω
- 2) *Capacitors*: one 0.1 μF ,
- 3) *Inductor*: one, with a value to be determined through measurement

Pre-lab:

1. Design of a time constant (2 marks): Design a resistive circuit with 2 or 3 nodes or meshes that includes one 0.1 μF capacitor. The design objective is to get the time constant of the voltage waveform across the capacitor to be as close as possible to 0.1ms. Use the resistor values listed above. Explain carefully your theoretical analysis for this question. Explain how you arrived at your design.

2. Measurement of inductance (2 marks):

(a) Using a circuit involving the function generator, resistors and the inductor, propose a method to calculate the value of the inductor. *Hints*: Consider using time constants.

(b) The inductor can be modeled as an ideal inductor in series with a resistance, which is that due to the wire. Rework the above analysis to include a variable that represents the resistance of the inductor.

Experiments:

There are two experiments in the lab. However, there are only a small number of the inductors available. Therefore, half the groups should do Experiment 1 first, and half the groups should do Experiment 2 first. Please arrange for this to happen.

1. Design of a Time Constant (1 mark):

Using the square-wave output of the function generator to emulate the opening and closing of a switch, construct the circuit you designed in part 1 of the pre-lab. Measure the time constant. Compare your theoretical analysis with your measured responses. Include relevant waveforms in your report.

2. Measurement of Inductance (3 marks):

(a) Construct the circuit you designed in part 2(a) of the pre-lab and use measurements of that circuit to estimate the value of the inductance. In your report, comment on any differences between your estimated value and your calculated value. Include plots of any pertinent waveforms in your report.

(b) Using the ohmmeter, measure the resistance of the inductor. Use this value in the expression that you obtained in part 2(b) of the pre-lab, and comment on any differences between your estimated value for the inductance and your calculated value. Include plots of any pertinent waveforms in your report.

(c) Insert the supplied metal object into the interior of the inductor while viewing the voltage waveform across the inductor. Explain to the TAs, and in your report, the effect that you see. Again, include plots of any pertinent waveforms in your report.