INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

Department of Electronics & Electrical Engineering

EE102: Basic Electronics Laboratory

Expt.No. 3: RC, RL and RLC Circuits

Objectives:

1. To study the step response of RC and RL circuits.
2. To study resonance in the series RLC circuit.

Materials Required:

1. Equipment: Breadboard, Function Generator, Oscilloscope
2. Components: 1kΩ (1), 4.7kΩ (1), 0.1H (1), 0.1μF (1), 1μF (1)

Precautions and Guidelines:

1. Make sure the ground terminals of the oscilloscope probes and function generator are connected together.
2. While switching on the set-up, switch on the oscilloscope first, followed by the function generator.

Pre-Lab Work:

1. Calculate the time constants for the circuits in Fig. 1 & Fig. 2.
2. Find the value of the resonant frequency for RLC circuit given in Fig. 3.

Part A: Step Response of an RC Circuit

1. Assemble the circuit shown in Fig. 1. Connect Channel 1 and Channel 2 probes of CRO to node A and node B, respectively. Use the dc coupling mode of CRO for this part of the experiment.

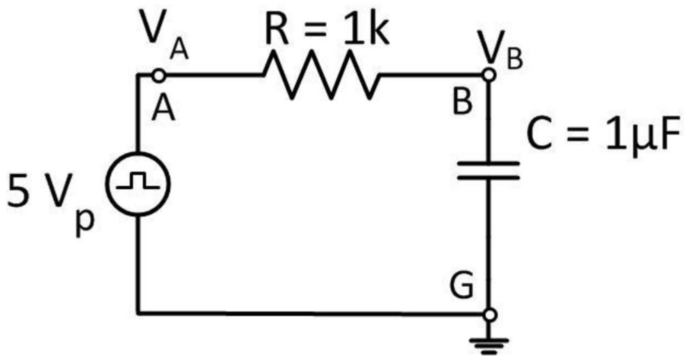

Fig. 1

2. Apply a unipolar square wave input (5V, 0.1kHz) from the function generator. Observe the voltages at node A and node B in CRO and measure the time-constant by noting the time taken by the capacitor to rise to 63% of its maximum charge voltage.
3. Increase the frequency of the input signal and note the frequency for which the capacitor just gets charged up to maximum possible voltage. Find the ratio of T/τ, where $T = 1/f$.

Part B: Step Response of an RL Circuit

1. Assemble the circuit shown in Fig. 2. Connect Channel 1 and Channel 2 probes of CRO to node A and node B, respectively. Keep using the dc coupling mode of the CRO.

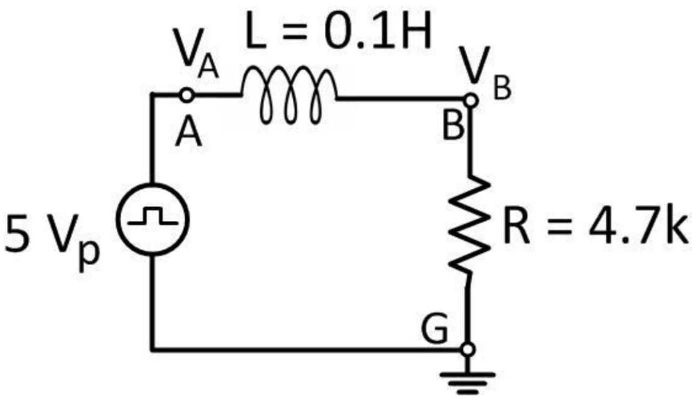

Fig. 2

2. Apply a unipolar square wave input (5 V, 0.5kHz). Observe the voltages at node A and node B in CRO and measure the time-constant by noting the time taken by the voltage drop across resistor to rise to 63% of its maximum value.

Part C: Resonance in Series RLC Circuit

1. Assemble the circuit as shown in Fig. 3. Apply a sinusoidal input (8Vpp) to the circuit. Using CRO, measure the applied input across terminals A-G in Channel 1 and the current through RLC circuit through the voltage drop across terminals B-G in Channel 2.

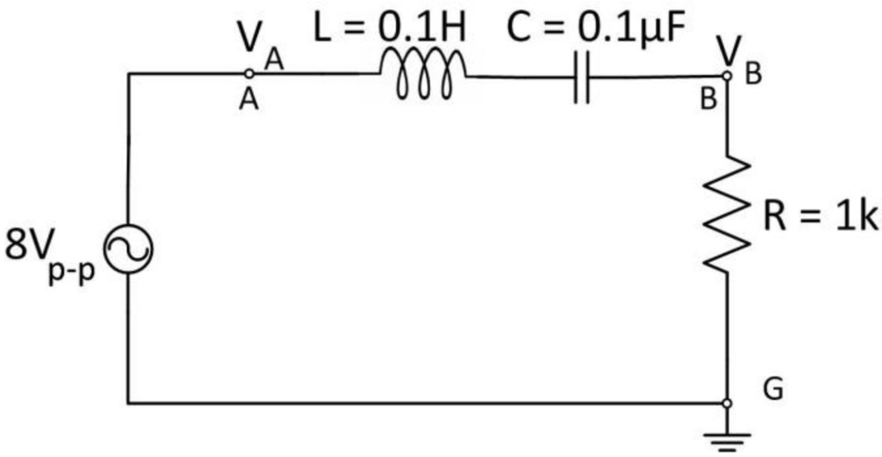

Fig. 3

2. Vary the frequency of the function generator as in Table 1 below and measure the peak-to-peak amplitude of voltage across terminals B-G (Channel 2) which is proportional to the current in the circuit.
3. Find a coarse estimate of the resonant frequency of the RLC circuit from the measurements in Table 1.

4. To refine the estimate of the resonant frequency, set the function generator to the coarse estimate of the resonant frequency and now observe the phase difference between the applied input voltage (Channel 1) and the circuit current (Channel 2). Finely vary the frequency of the function generator till voltages in Channel 1 and Channel 2 gets phase synchronized. The frequency at which synchronization is achieved is a precise estimate of the resonant frequency of the RLC circuit.
5. In the same setup, reset input frequency to 0.1kHz and observe the amount and the nature of the phase difference between Channel 1 and Channel 2.
6. Repeat step 5 for input frequency of 10kHz instead of 0.1kHz.

Frequency (kHz)	Voltage across terminals B-G
0.1	
0.5	
1.0	
1.5	
2.0	
4.0	
10.0	

Part D: Lab Report

Prepare and submit a lab report as specified in the general instructions regarding the lab. Include the answers to the following questions in the report:

1. Compare the refined estimate of resonant frequency with the theoretically computed value and comment.
2. Comment on the cause of the observations made in steps 5 and 6 of Part C.
3. Draw the phasor diagram of voltages across all three components at resonant frequency using the given nominal value of components.