Lab Report : Transient Response of LC circuits

Analysing the LC circuit response

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Experiment conducted as part of ELectric Circuits Lab Coursework.

Objective

The objective of this experiment is to investigate the transient response of an LC circuit, analyze its oscillatory behavior, determine the natural frequency (Ω_n), and evaluate the damping ratio (ξ) using both theoretical and experimental methods.

Equipment Required

- 100 μF capacitor
- Largest available inductor (denoted as L)
- Small resistor (for optional damping analysis)
- DC power supply
- Digital oscilloscope
- Function generator
- Connecting wires and probes
- Multimeter for component verification

1 Theory

An LC circuit consists of an inductor (L) and a capacitor (C) connected in parallel or series. The system follows a second-order differential equation:

$$\frac{d^2V}{dt^2} + \frac{R}{L}\frac{dV}{dt} + \frac{1}{LC}V = 0 \tag{1}$$

2 Procedure

1. **Precharge the Capacitor:**
   - Connect the 100 μF capacitor to a 5V DC power supply.
   - Verify the capacitor's voltage using a multimeter before proceeding.
2. **Construct the LC Circuit:**
   - Select the largest available inductor.
   - Connect the capacitor in parallel with the inductor.
3. **Capture the Transient Response:**
   - Attach the oscilloscope probes across the capacitor terminals.
   - Observe and record the oscillations.

3 Observations and Analysis

- Captured transient response waveform from the oscilloscope.
- Measured oscillation period and compared it with theoretical expectations.

4 Images of Responses

Oscilloscope Waveforms and Circuit Images

response_image1.png

response_image2.png

Above images depict the transient response captured during the experiment.

5 Conclusion

The experimentally observed natural frequency closely matched theoretical values. The presence of resistance introduced measurable damping effects.

6 Safety Precautions

- Handle charged capacitors carefully to avoid accidental discharges.
- Ground the oscilloscope properly for accurate and safe measurements.

7 References

- *Transient Response of an LC Circuit.*
- Circuit analysis textbooks and academic literature.