Report: Experiment 3 - Capacitor and Inductor Circuits

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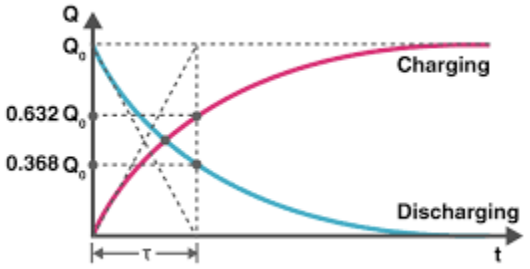
Title of Experiment: Capacitor and Inductor Circuits (DC and Square Wave Response)

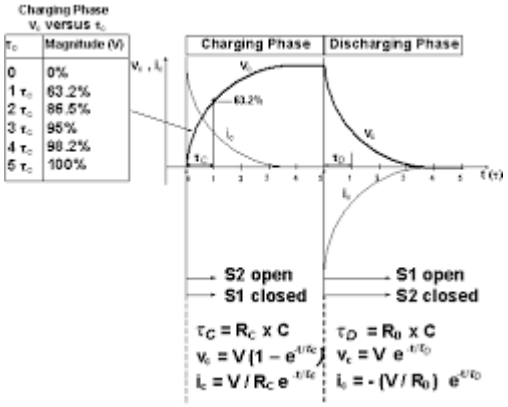
Brief Description: This experiment investigates the charging/discharging behavior of capacitors with DC sources, the response of RC circuits to square wave inputs, and the transient response of RL circuits to DC sources. Theoretical background, procedures, and expected results are discussed for each objective.

Objective 3.1: Charging and discharging characteristics of a capacitor using DC source

Theory: When a DC voltage is applied to a capacitor through a resistor, the capacitor charges and discharges exponentially. The voltage across the capacitor (Vc) follows: - Charging: Vc(t) = V(1 - exp(-t/RC)) - Discharging: Vc(t) = V * exp(-t/RC)

Procedure: 1. Connect a DC source, resistor, and capacitor in series. 2. Record voltage across the capacitor during charging and discharging using an oscilloscope or data logger. 3. Plot Vc vs. time for both processes. Expected Results: - Charging: Exponential rise. - Discharging: Exponential decay. - Time constant tau = RC.

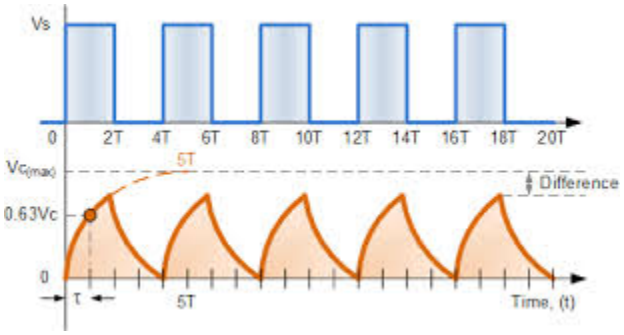


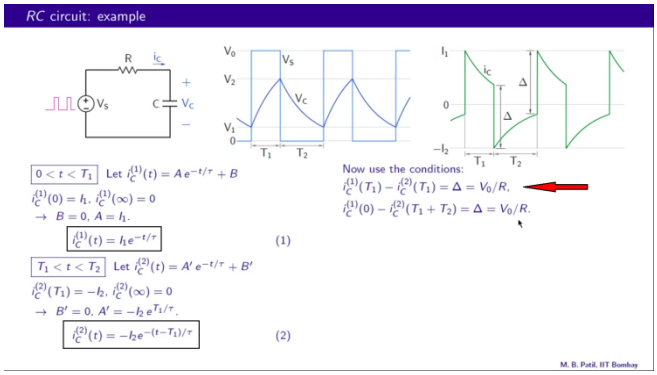


Objective 3.2: Effect on the output of RC circuit for a square wave input signal

Theory: An RC circuit acts as a filter. With a square wave input, the output across the capacitor shows exponential charging/discharging for each edge, resulting in a rounded waveform.

Procedure: 1. Connect a function generator (square wave) to an RC series circuit. 2. Record output across the capacitor using an oscilloscope. 3. Vary frequency and observe changes in output waveform. Expected Results: - Output: Series of exponential curves, not sharp transitions. - High frequency: Output resembles
input more closely.

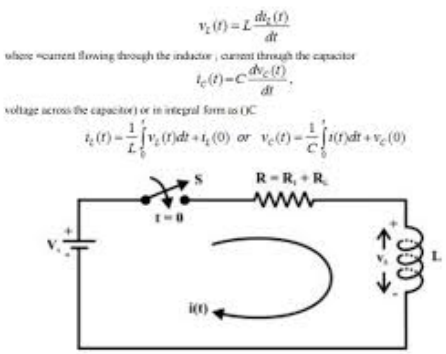


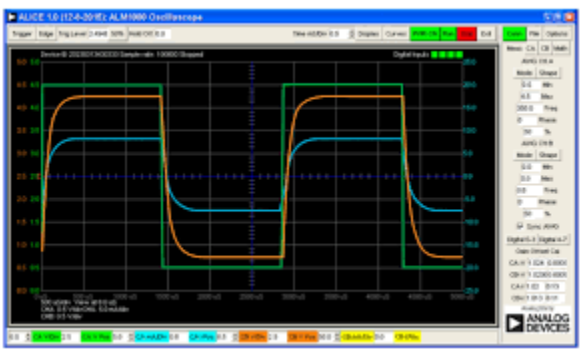


Objective 3.3: Experiment with RL circuit with DC source. Record the voltage and current across the L with time

Theory: When a DC source is applied to an RL circuit, the current through the inductor increases gradually due to inductive reactance: - i(t) = (V/R) * (1 - exp(-Rt/L)) - Voltage across the inductor drops as current increases.

Procedure: 1. Connect a DC source, resistor, and inductor in series. 2. Record voltage across the inductor and current through the circuit over time. 3. Plot voltage and current vs. time. Expected Results: - Current: Exponential rise to maximum value. - Inductor voltage: Starts high, decays to zero.





Discussion: This experiment demonstrates the transient behavior of capacitors and inductors in response to DC and square wave inputs. The results confirm theoretical predictions and highlight the importance of time constants in circuit design.