CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
CHITTAGONG-4349, BANGLADESH.

Course No. EEE-182

Course Title: Basic Electrical Engineering Sessional

Experiment No. 9

STUDY OF TRANSIENT BEHAVIOUR OF RL CIRCUIT

PRELAB WORK:

- **Read this laboratory manual carefully before coming to the laboratory class, so that you know what is required.**
- Try to **follow** the lecture notes of **EEE 111.**
- **DONOT** copy others blindly!!!
- **Submit your lab report before the roll call.**

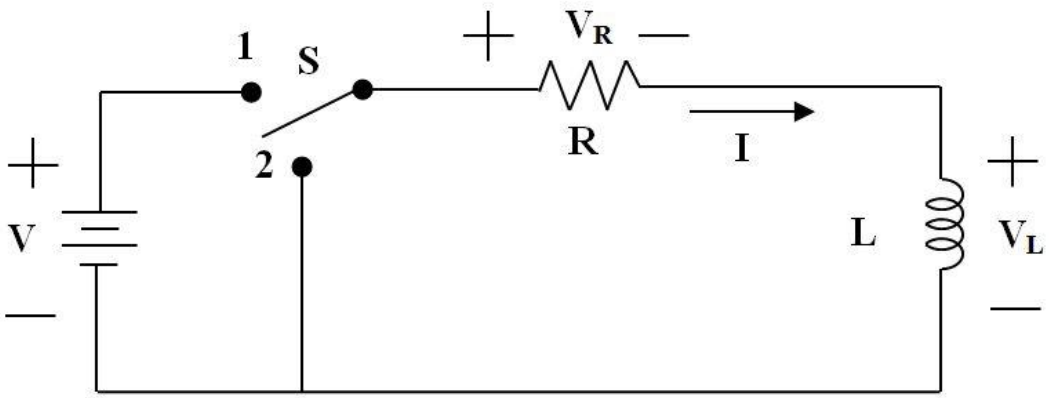
OBJECTIVE:

The objective of this experiment is to study Transient Response of RL circuit with step input. In this experiment we shall apply a square wave input to an RL circuit and observe the wave-shapes and determine the time constant.

THEORY:

The transient response is the temporary response that results from a switching operation and disappears with time. The steady state response is that which exists after a long time following any switching operation.

Let us consider an RL circuit shown in figure –



Storage Phase:

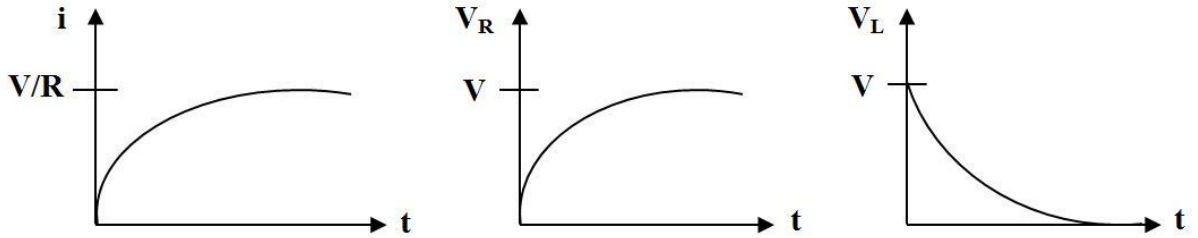
When the switch is connected to position 1, applying KVL we can write –

$$V = Ri + L\frac{di}{dt} \text{----------(1)}$$
$$i = \frac{V}{R}(1 - e^{-\frac{t}{\tau}}) \text{----------(2)}$$

Therefore the voltage across the resistor and inductor are given by –

$$V_R = V(1 - e^{-\frac{t}{\tau}}) \text{----------(3)}$$
$$V_L = V - V_R = Ve^{-\frac{t}{\tau}} \text{----------(4)}$$

Where τ = L/R and is called the time constant of the RL circuit. Equations (2), (3) & (4) are plotted below:



It is seen from the curves that the voltage across the inductor falls from V to zero volts exponentially. The current is zero at the start i.e. when the switch is just thrown to position 1, then it increases exponentially and finally reach to V/R amps when the inductor voltage becomes zero.

Decay Phase:

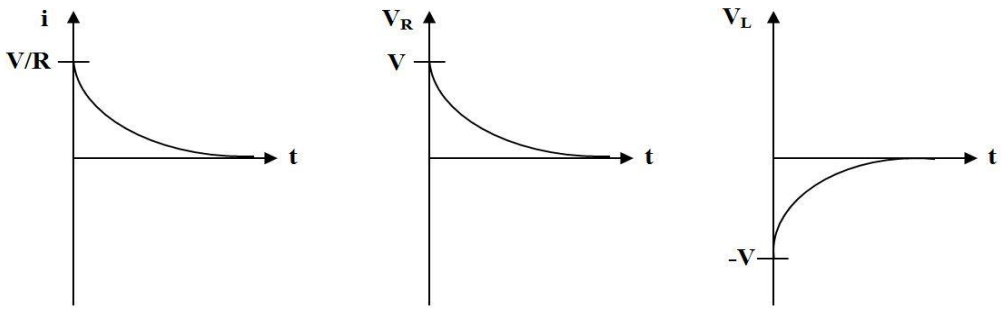
When the switch is connected to position 2, applying KVL we can write –

$$0 = \mathrm{Ri} + \mathrm{L}\frac{\mathrm{di}}{\mathrm{dt}} \text{----------(5)}$$
$$\mathrm{i} = \frac{\mathrm{V}}{\mathrm{R}}\mathrm{e}^{-\frac{\mathrm{t}}{\tau}} \text{----------(6)}$$

Therefore the voltage across the resistor and inductor are given by –

$$V_R = Ve^{-\frac{t}{\tau}} \text{----------(7)}$$
$$V_L = -Ve^{-\frac{t}{\tau}} \text{----------(8)}$$

Equations (6), (7) & (8) are plotted below:



It is seen from the curves that the voltage across the inductor rises from -V to zero volts exponentially. The current is maximum at the start i.e. when the switch is just thrown to position 2, then it decreases exponentially and finally ceases to zero when the inductor voltage becomes zero.

APPARATUS:

1. Resistance: 470Ω.
2. Inductance: 2.7mH.
3. Oscilloscope and Probes.
4. Signal Generator and Chords.
5. Wires.
6. Bread board.

CIRCUIT DIAGRAM:

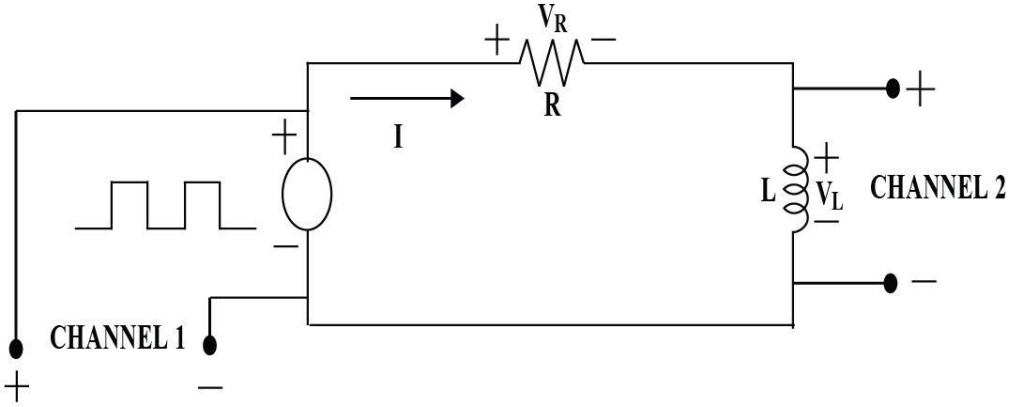


Figure 1

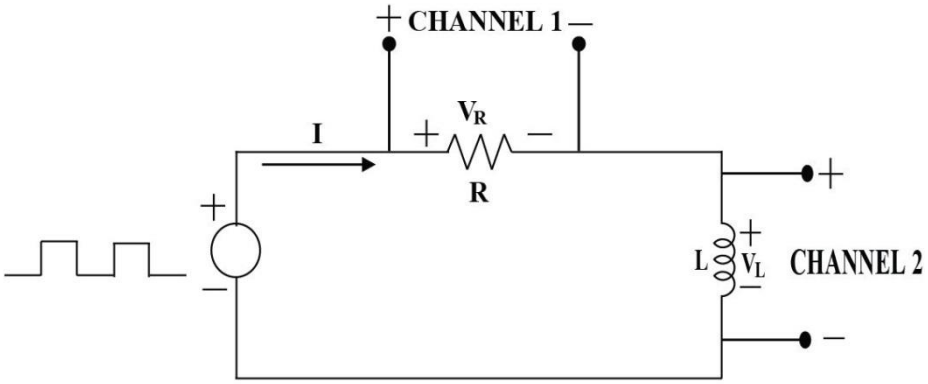


Figure 2

PROCEDURE:

1. Setup the circuit as shown in Fig. 1.
2. Apply 14 kHz square wave from signal generator.
3. Observe the wave shapes at Channel-1 and Channle-2 in DUAL mode and draw them.
4. Find the time constant from the wave shape of V_L.
5. Disconnect Channel-1 and Channle-2 and reconnect them as shown in Fig. 2.
6. Observe the wave shapes at Channel-1 and Channle-2 (INV.) in DUAL mode and draw them.

REPORT:

1. Take snaps of the waves you see in the oscilloscope with your cell phone or a camera.
2. Print those images in gray scale and attach them in your report..

HOME TASK:

Answer the following questions-

1. Define inductor and inductance. Write the features of an inductor. What does inductance measure?
2. Deduce voltage-current relationship for an inductor. Why the current in an inductor cannot change instantaneously.
3. Define time constant for an RL circuit. What is the significance of time constant? How time constant can be determined?
4. Describe the storage and decay phase of an RL circuit both qualitatively and quantitatively.