

FACULTY OF ELECTRICAL ENGINEERING	
Course: ELECTRICAL ENGINEERING LABORATORY	Review : 7
Course Code: SKEE 2752	Release Date : October 2023
	Last Amendment : September 2023
	Procedure Number : PK-UTM-FKE-(O)-08




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UNIVERSITI TEKNOLOGI MALAYSIA

**FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA**

SKEE 2752
ELECTROTECHNICS LABORATORY

EXPERIMENT 3

**R-L AND R-C SERIES
TRANSIENT CIRCUITS**

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I. PRELIMINARY EXERCISE (10 marks)

Important Note: Students are required to do this exercise BEFORE the laboratory session.

Part 1: RL Circuit (5 marks)

- i. Explain time constant, τ in circuit analysis.
- ii. The switch in **Figure 1** has been in position ‘a’ for a long time. At $t = 0$, the switch moves to ‘b’.
 - a. Derive an expression of $V_R(t) = V_S e^{-(t/\tau)}$
 - b. If $L = 400$ mH and $V_S = 5$ V,
 - i. Determine $V_R(t)$ at $t = \tau, 2\tau, 3\tau$ and 4τ for R values of 4 k Ω , 6 k Ω and 8 k Ω .
 - ii. Sketch the response of $V_R(t)$ versus t .

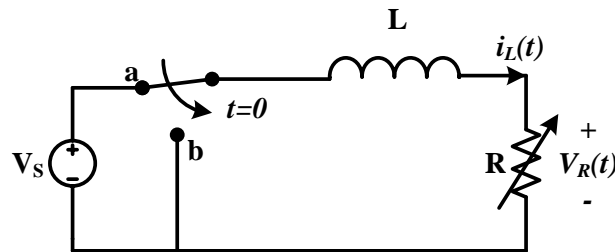


Figure 1

- iii. The switch in **Figure 2** has been in position ‘b’ for a long time. At $t = 0$, the switch moves to ‘a’.
 - a. Derive an expression of $V_R(t) = V_S (1 - e^{-(t/\tau)})$
 - b. If $L = 400$ mH and $V_S = 5$ V,
 - i. Determine $V_R(t)$ at $t = \tau, 2\tau, 3\tau$ and 4τ for R values of 4 k Ω , 6 k Ω and 8 k Ω .
 - ii. Sketch the response of $V_R(t)$ versus t .

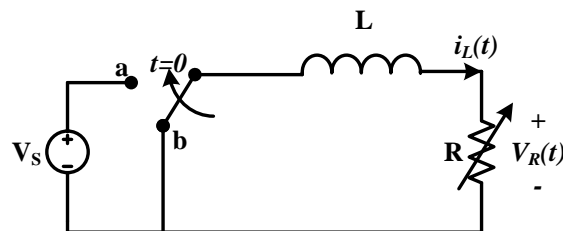


Figure 2

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- iv. Perform the above preliminary exercise using any simulation tools (PSPICE, MATLAB, Multisim, LTSpice etc.) to validate your results (use a 500 Hz, 5 V_{p-p} with +2.5V DC offset square wave signal for V_s).
- v. Suggest experimental procedures to prove the result obtained from the exercise using a square wave signal generator instead of a switch.

Part 2: RC Circuit [5 marks]

- i. Explain time constant, τ in circuit analysis.
- ii. The switch in **Figure 3** has been in position ‘a’ for a long time. At $t = 0$, the switch moves to ‘b’.
 - a. Derive an expression of $V_C(t) = V_S e^{-(t/\tau)}$
 - b. If $R = 1 \text{ k}\Omega$ and $V_S = 5 \text{ V}$,
 - i. Determine $V_C(t)$ at $t = \tau, 2\tau, 3\tau$, and 4τ for C values of $0.05 \mu\text{F}$, $0.1 \mu\text{F}$ and $0.15 \mu\text{F}$.
 - ii. Sketch the response of $V_C(t)$ versus t .

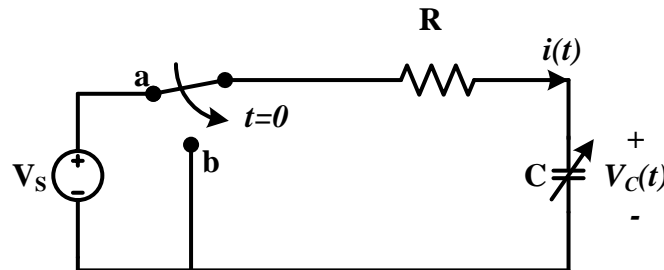


Figure 3

- iii. The switch in **Figure 4** has been in position ‘b’ for a long time. At $t = 0$, the switch moves to ‘a’.
 - a. Derive an expression of $V_C(t) = V_S (1 - e^{-(t/\tau)})$
 - b. If $R = 1 \text{ k}\Omega$ and $V_S = 5 \text{ V}$,
 - i. Determine $V_C(t)$ at $t = \tau, 2\tau, 3\tau$, and 4τ for C values of $0.05 \mu\text{F}$, $0.1 \mu\text{F}$ and $0.15 \mu\text{F}$.
 - ii. Sketch the response of $V_C(t)$ versus t .

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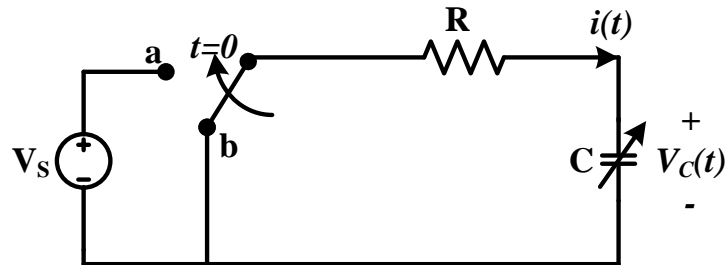


Figure 4

- iv. Perform the above preliminary exercise using any simulation tools (PSPICE, MATLAB, Multisim, LTSpice etc.) to validate your results (use a 500 Hz, 5 Vp-p with +2.5V DC offset square wave signal for V_s).
- v. Suggest experimental procedures to prove the result obtained from the exercise using a square wave signal generator instead of a switch.

Important Note: Students are required to bring their laptop to VERIFY all simulation results. Students are required to bring USB drive to capture output from the oscilloscope.

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II. EXPERIMENT

‘R-L and R-C Series Transient Circuits’

IMPORTANT: Students need to complete the PRELIMINARY EXERCISE before the laboratory session.

1. Aims:

- i. To investigate the current time response in RL circuit due to changes of resistance.
- ii. To investigate the voltage time response in RC circuit due to changes of capacitance.

2. Equipment:

Signal generator, Oscilloscope, Decade inductance (L), Decade resistance (R) and Decade capacitance/condenser (C)

3. Instructions:

Precaution:

Ensure that the ‘earth’ connections of the oscilloscope probe are at the same earth point. Failure to observe this will damage the oscilloscope.

i. Part 1: RL Circuit

Based on item (v) in the preliminary exercise (Part 1), perform the RL circuit experiment. Record/draw the results in appropriate table/graph. Find the relationship between the time constant and the voltage response. Compare and discuss the results with preliminary exercise.

ii. Part 2: RC Circuit

Based on item (v) in the preliminary exercise (Part 2), perform the RC circuit experiment. Record/draw the results in appropriate table/graph. Find the relationship between the time constant and the voltage response. Compare and discuss the results with preliminary exercise.