FACULTY OF ELECTRICAL ENGINEERING	
Course: **ELECTRICAL ENGINEERING LABORATORY** Course Code: **SEEE 2742**	Review : **7** Release Date : **October 2023** Last Amendment : **September 2023** Procedure Number : **PK-UTM-FKE-(O)-08**

FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA

SEEE 2742

ELECTROTECHNICS LABORATORY

EXPERIMENT 3

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

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I. PRELIMINARY EXERCISE (10 marks)

<u>Important Note:</u> Students are required to do this exercise BEFORE the laboratory session.

Part 1: RL Circuit (5 marks)

i. Explain time constant, $\boldsymbol{\tau}$ 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 $t = \tau$, 2τ, 3τ and 4τ for R values of 4 kΩ, 6 kΩ and 8 kΩ.
      ii. Sketch the response of $V_R(t)$ versus t.

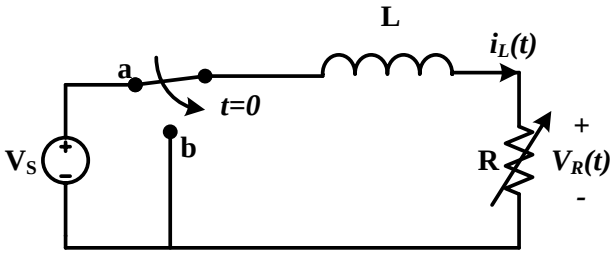

Figure 1

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 $t = \tau$, 2τ, 3τ and 4τ for R values of 4 kΩ, 6 kΩ and 8 kΩ.
      ii. Sketch the response of $V_R(t)$ versus t.

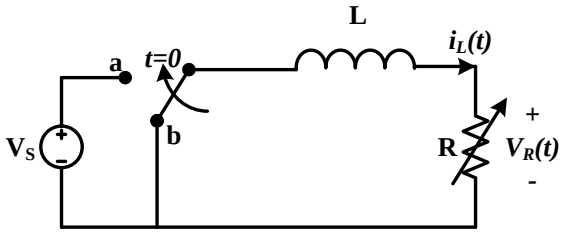

Figure 2

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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 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.

Part 2: RC Circuit [5 marks]

i. Explain time constant, $\boldsymbol{\tau}$ 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 $R = 1$ kΩ and $V_S = 5$ V,

i. Determine $V_C(t)$ at $t = \tau$, 2τ, 3τ, and 4τ for C values of 0.05 µF, 0.1 µF and 0.15 µF.

ii. Sketch the response of $V_C(t)$ versus t.

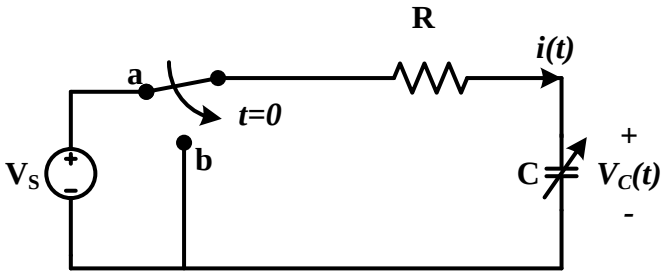

Figure 3

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 $R = 1$ kΩ and $V_S = 5$ V,

i. Determine $V_C(t)$ at $t = \tau$, 2τ, 3τ, and 4τ for C values of 0.05 µF, 0.1 µF and 0.15 µF.

ii. Sketch the response of $V_C(t)$ versus t.

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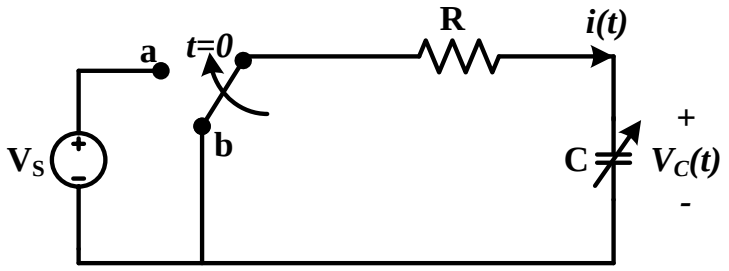

Figure 4

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.