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

ELECTROTECHNIC LABORATORY

EXPERIMENT 3

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

Prepared by	:	Approved by	: Department Director
Name	Assoc. Prof. Ir. Dr. Md Pauzi Abdullah Ir. Dr. Syed Norazizul Syed Nasir Ts. Dr. Mona Riza Mohd Esa Dr. Mohd Rodhi Sahid Dr. Norjulia Mohamad Nordin Dr. Razman Ayop	Name	: Assoc. Prof. Ts. Dr. Shahrin Md Ayob
Signature	:	Signature	:
Stamp	: Assoc. Prof. Eur. Ing. Ir. Ts. Dr. Lau Kwan Yiew Laboratory Academic Coordinator	Stamp	: ASSOC. PROF. Ts. DR. SHAHRIN BIN MD AYOB Director Division of Electrical Power Engineering Faculty of Electrical Engineering Universiti Teknologi Malaysia 81310 Johor Bahru, Johor
Date	: 04 September 2023	Date	: 04 October 2023

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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.

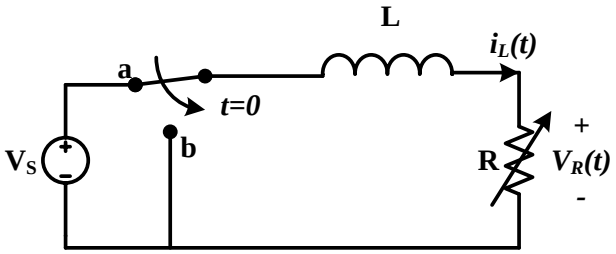

Figure 1

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.

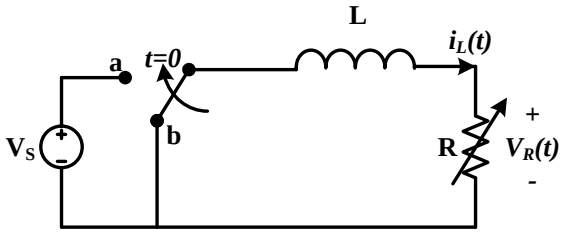

Figure 2

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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.

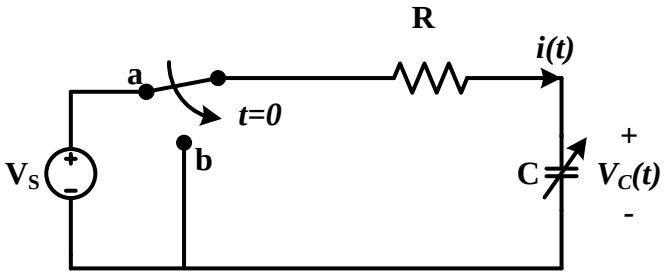

Figure 3

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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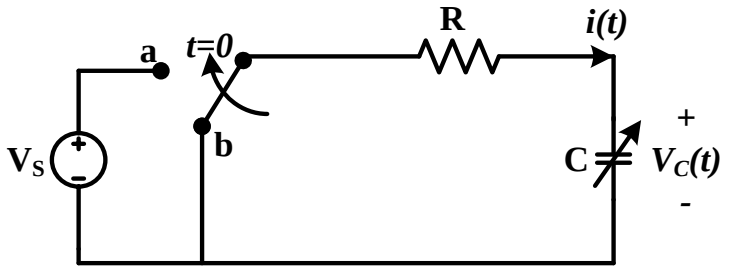

Figure 4

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 a 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.