FACULTY OF ELECTRICAL ENGINEERING	
Subject **ELECTRICAL ENGINEERING LABORATORY** Subject Code **SKEE 2742**	Review : **6** Release Date : February **2020** Last Amendment : March **2023** Procedure Number : **PK-UTM-FKE-(O)-08**

FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA

SKEE 2742

ELECTROTECHNIC LABORATORY

EXPERIMENT 3

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

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I. PRELIMINARY EXERCISE (10 marks)

<u>Important Note:</u> Student required to do this exercise BEFORE the lab 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. Derived 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.

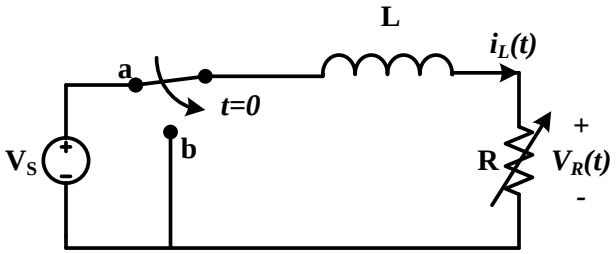

Figure 1

iii. The switch in **Figure 2** has been in position 'b' for a long time. At $t = 0$, the switch moves to 'a'.
   a. Derived 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 $t = t = \tau$, 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.

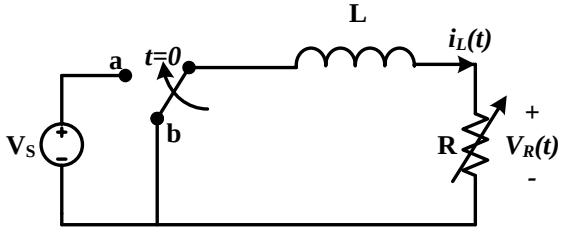

Figure 2

iv. Suggest experimental procedures (with appropriate software) to prove the result obtained from the exercise using square wave signal generator instead of switch.

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<u>Important note</u> : Students required to choose and ready with appropriate software (MATLAB, PSPICE, Multism or equivalent). Students must be able to use the software for this experiment.

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. Derived 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.

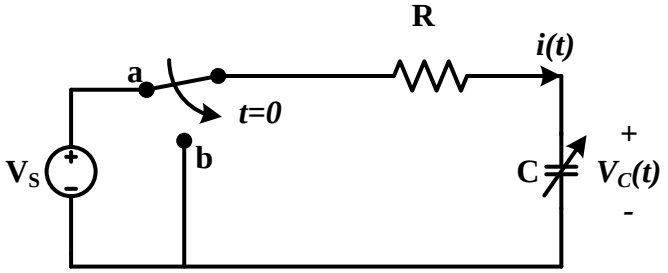

Figure 3

iii. The switch in **Figure 4** has been in position 'b' for a long time. At $t = 0$, the switch moves to 'a'.
   a. Derived 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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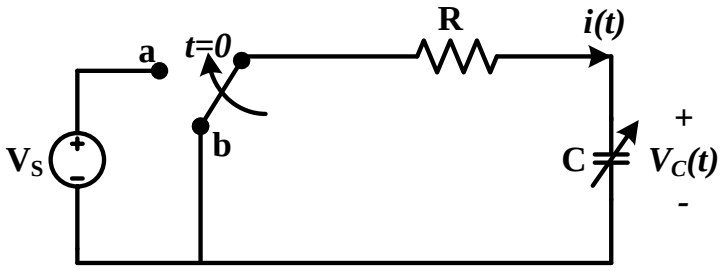

Figure 4

iv. Suggest experimental procedures (with appropriate software) to prove the result obtained from the exercise using square wave signal generator instead of switch.

<u>Important note</u> : Students required to choose and ready with appropriate software (MATLAB, PSPICE, Multism or equivalent). Students must be able to use the software for this experiment.

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II. EXPERIMENT

'*R-L* and *R-C* Series Transient Circuits'

IMPORTANT: Student 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. Instructions:

i. Part 1: RL Circuit

Based on item (iv) 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. Perform the experiment using any simulation tools (PSPICE, MATLAB, Multisim, etc.) to validate your results (use a 500 Hz square wave signal for V_s).

ii. Part 2: RC Circuit

Based on item (iv) 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. Perform the experiment using any simulation tools (PSPICE, MATLAB, Multisim, etc.) to validate your results (use a 500 Hz square wave signal for V_s).