ElecEng 2CF4
Assignment 4 Report 1

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EXERCISE #1: TRANSIENT 1ST DEGREE CIRCUIT

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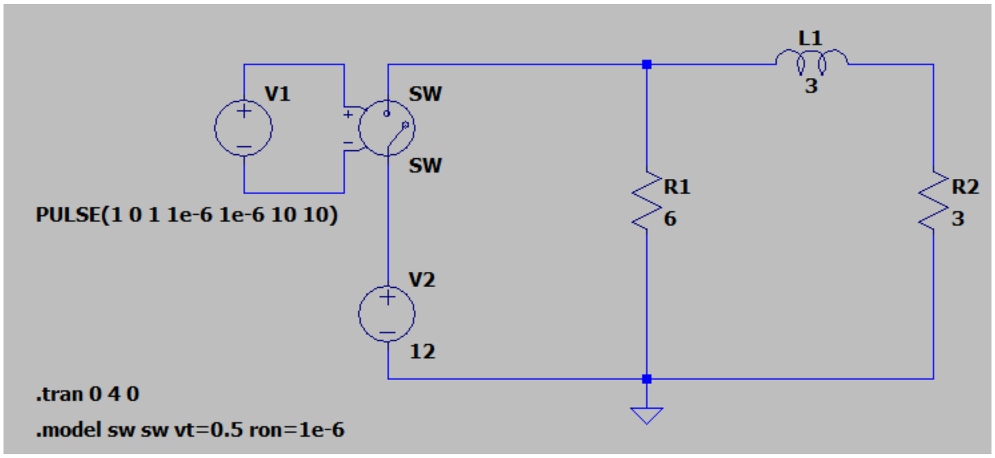
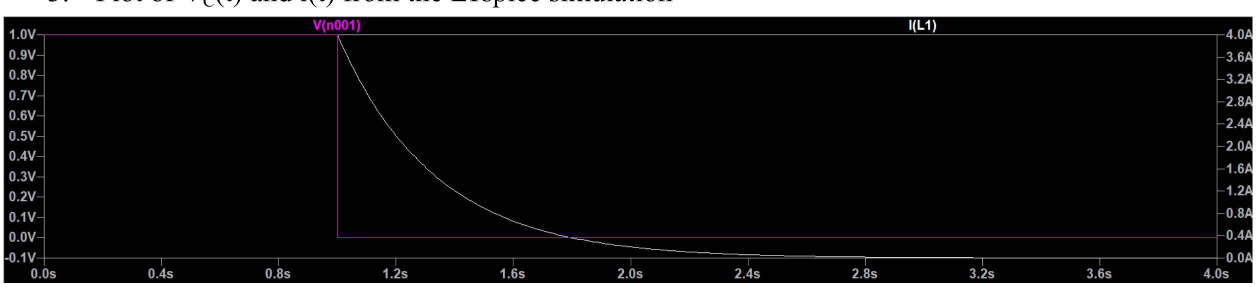
1. Circuit Schematic



2. Spice Netlist

```
* C:\Users\Josh\Documents\COMPENG\Y2S2\2EI\DP2\Draft5.asc
V1 N001 N004 PULSE(1 0 1 1e-6 1e-6 10 10)
V2 N005 N006 12
R1 N002 N006 6
L1 N002 N003 3
R2 N003 N006 3
SW N005 N002 N001 N004 SW
.tran 0 4 0
.model sw sw vt=0.5 ron=1e-6
.backanno
.end
```

3. Plot of $V_C(t)$ and i(t) from the LTspice simulation



4. Analytical solution for i(t) based on the Laplace transform.

$$i(0^-) = \frac{R_6}{R_3 + R_6}(I_T)$$
$$i(0^-) = \frac{6}{3+6}\left(\frac{12}{\left(\frac{1}{6}+\frac{1}{3}\right)^{-1}}\right) = 4A$$

By KVL:

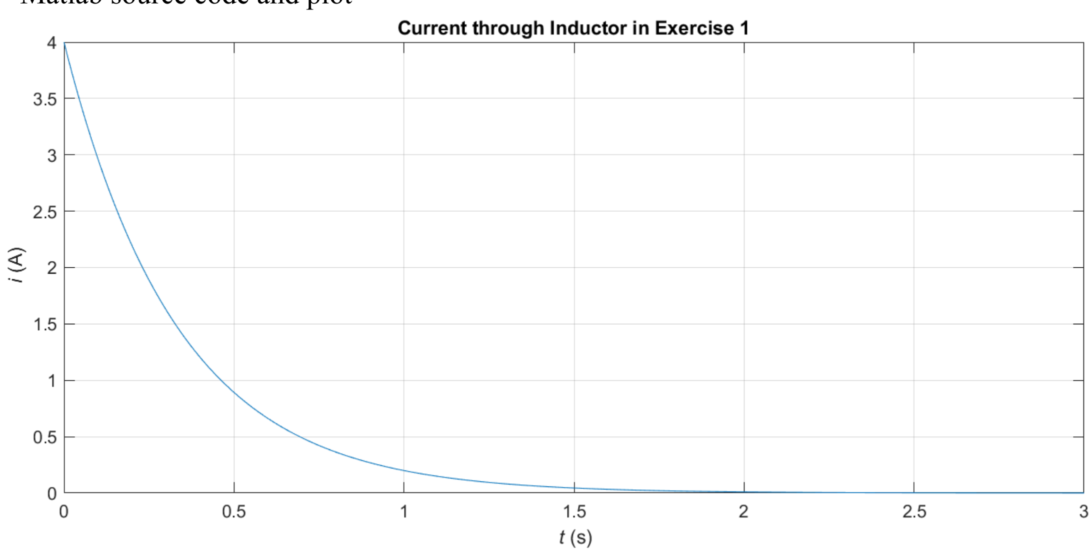
$$L\frac{di(t)}{dt} + Ri(t) = 0$$

$$\frac{di(t)}{dt} + 3i(t) = 0$$

Taking the Laplace Transform:

$$\mathcal{L}\left\{\frac{di(t)}{dt} + 3i(t)\right\} = 0$$
$$sI(s) - i(0^-) + 3I(s) = 0$$
$$I(s) = \frac{4}{s+3}$$
$$i(t) = \mathcal{L}^{-1}\left(\frac{4}{s+3}\right)$$
$$i(t) = 4e^{-3t}$$

5. Matlab source code and plot



```
clear all; close all; % clean up memory and close all open plot windows
t = linspace(0, 3, 1001); % vector of 1001 time samples from 0 to 3 s
i = 4*exp((-3)*t); % change this to the function i(t) you found from Laplace analysis
figure;
plot(t, i);
grid on;
title('Current through Inductor in Exercise 1');
xlabel('{\it t} (s)');
ylabel('{\it i} (A)');
```

6. Does the LTspice simulation result agree with the MATLAB plot of the theoretical result? Justify your answer.

The LTspice simulation and MATLAB solution of i(t) exhibit the expected exponential decay behavior of a first-order RL circuit. Key features include:

- Time constant consistency: Both plots show the same decay rate, confirming correct system dynamics
- Initial condition match: the simulated i(0) = 4A aligns with theoretical expectations
- Steady-state verification: Both approaches predict i(t) → 0 as t → infinity, confirming accuracy