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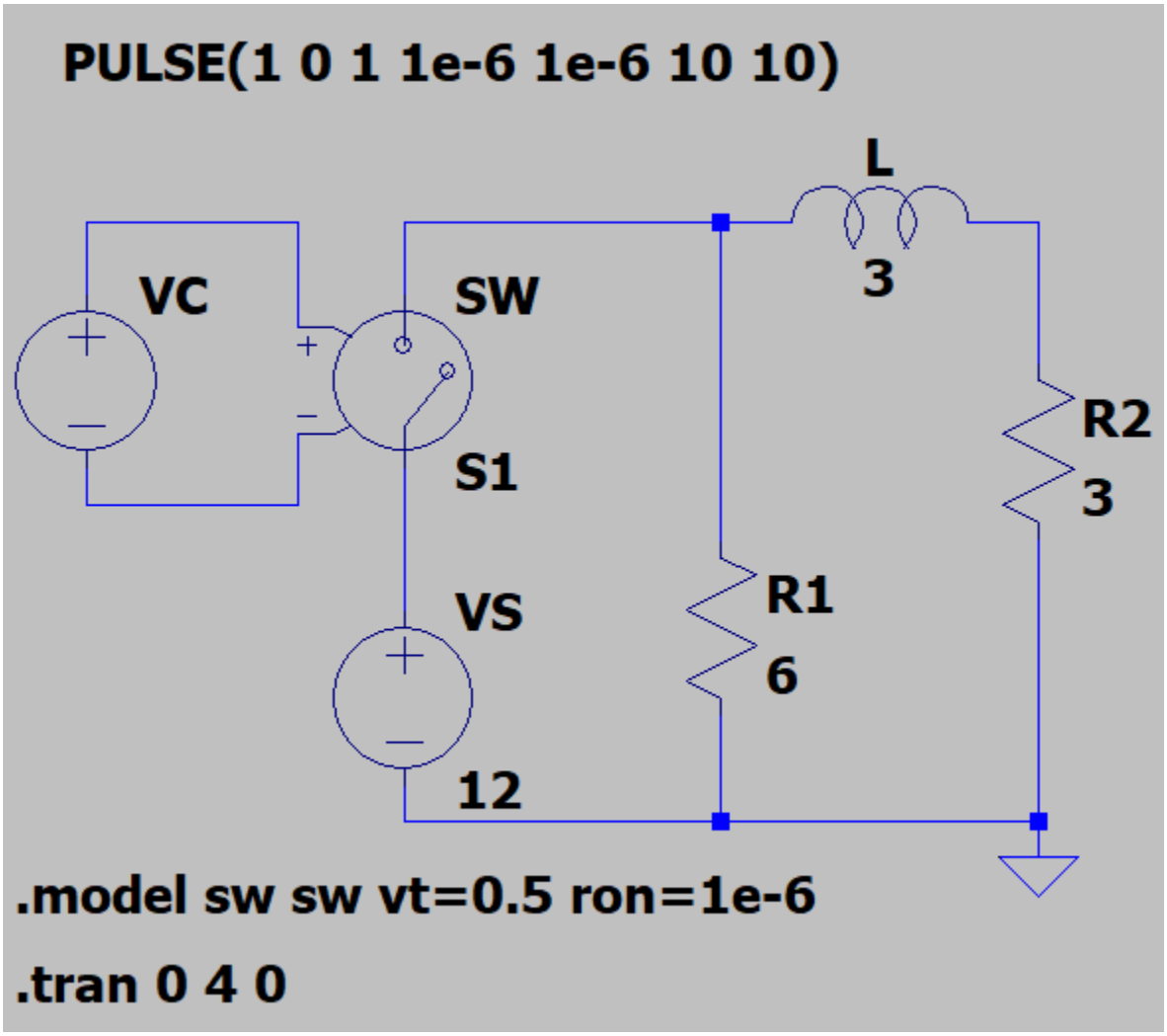
Assignment 4: Laplace Transform in Circuit Analysis

Exercise 1: Transient 1st Degree Circuit

Schematic:



Netlist:

```
* C:\Users\gurle\Documents\LTspiceXVII\eleceng 2cf3 assignements\assignment 4\assig4_q1.asc
R2 N003 0 3
VC N001 N004 PULSE(1 0 1 1e-6 1e-6 10 10)
S1 N005 N002 N001 N004 SW
R1 N002 0 6
```

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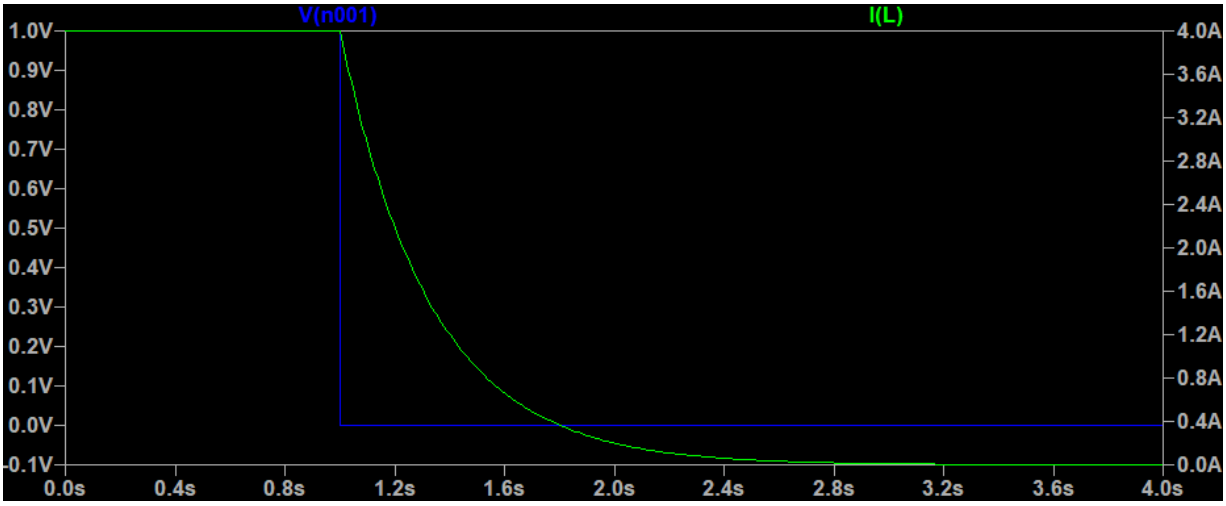
```
VS N005 0 12
L N002 N003 3
.model sw sw vt=0.5 ron=1e-6
.tran 0 4 0
.backanno
.end
```

Plot:



Analytical Solution:

$V = 12\,V$

$i(0^-) = \frac{V_{R_2}}{R_{R_2}} = \frac{12}{3} = 4A$

KVL:

$6i(t) + 3i(t) + 3\frac{di(t)}{dt} = 0$

$9i(t) + 3\frac{di}{dt} = 0$

Laplace Transform:

$9I(s) + 3[I(s) - I(0^-)] = 0$

$9I(s) + 3I(s) - 3I(0^-) = 0$

$I(s)(s + 3) = I(0^-)$

$I(s) = \frac{4}{s+3}$

$i(t) = 4e^{-3}u(t)$

Matlab Source Code and Plot:

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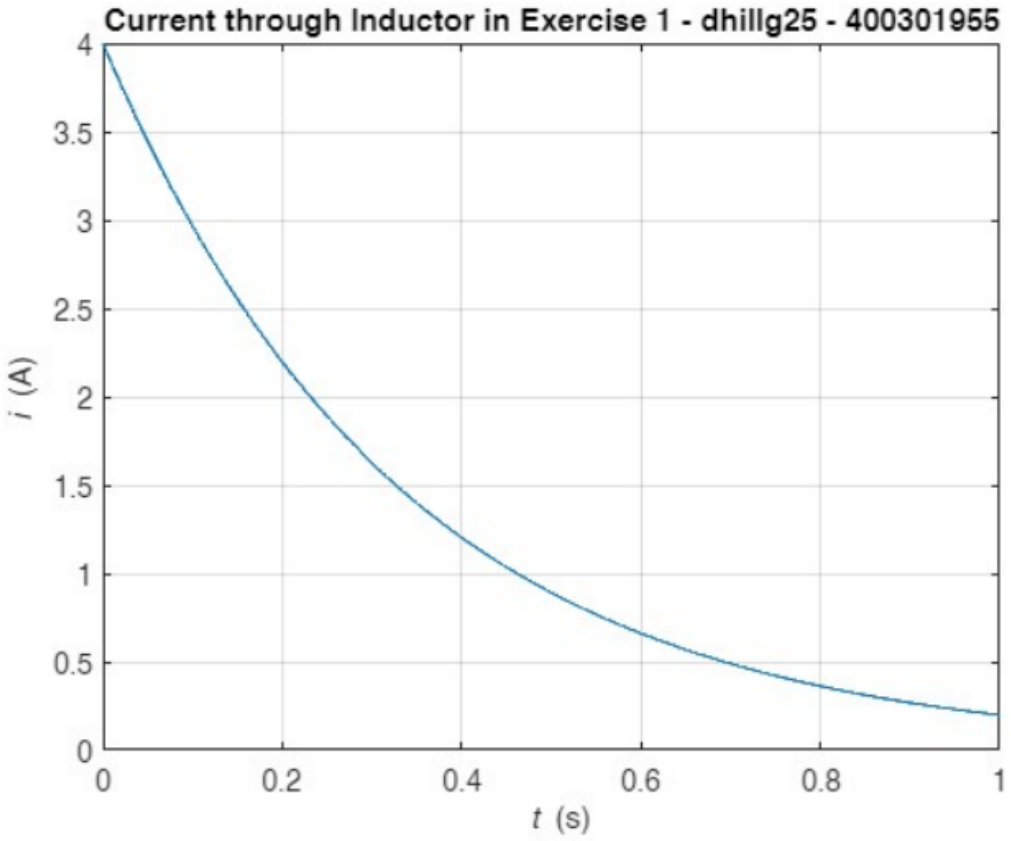
```
clear all; close all; % clean up memory and close all open plot windows
t = linspace(0, 1, 1001); % vector of time samples where function is calculated
i = 4*exp(-3*t); % change this to the function i(t) you found from Laplace analysis
figure;
plot(t, i);
grid on;
title('Current through Inductor in Exercise 1 - dhillg25 - 400301955');
xlabel('{\it t} (s)');
ylabel('{\it i} (A)');
```



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

The LTspice simulation results agree with the MATLAB plot. This can be seen as the MATLAB graph matches up with the I(L) from LTspice.

Exercise 2: Transient 2nd Degree Circuit

Schematic:

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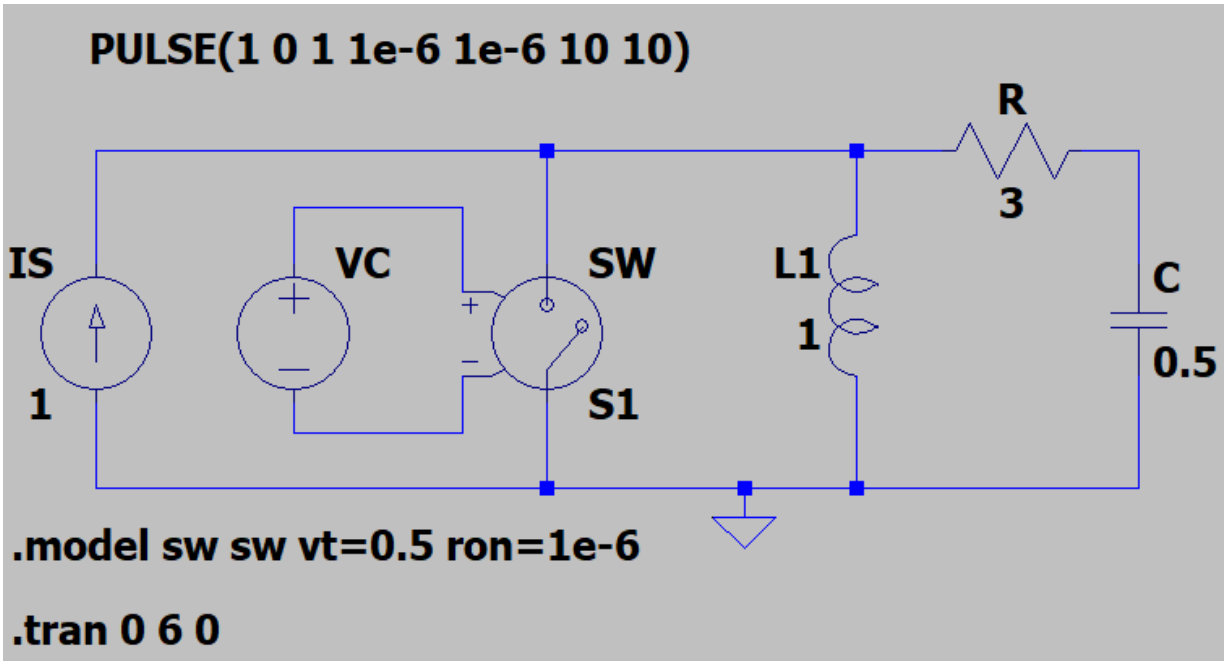

Netlist:

```
* C:\Users\gurle\Documents\LTspiceXVII\eleceng 2cf3 assignements\assignment 4\assig4_q2.asc
R N002 N001 3
VC N003 N004 PULSE(1 0 1 1e-6 1e-6 10 10)
L1 0 N001 1
C N002 0 0.5
S1 0 N001 N003 N004 SW
IS 0 N001 1
.model sw sw vt=0.5 ron=1e-6
.tran 0 6 0
.backanno
.end
```

Plot:

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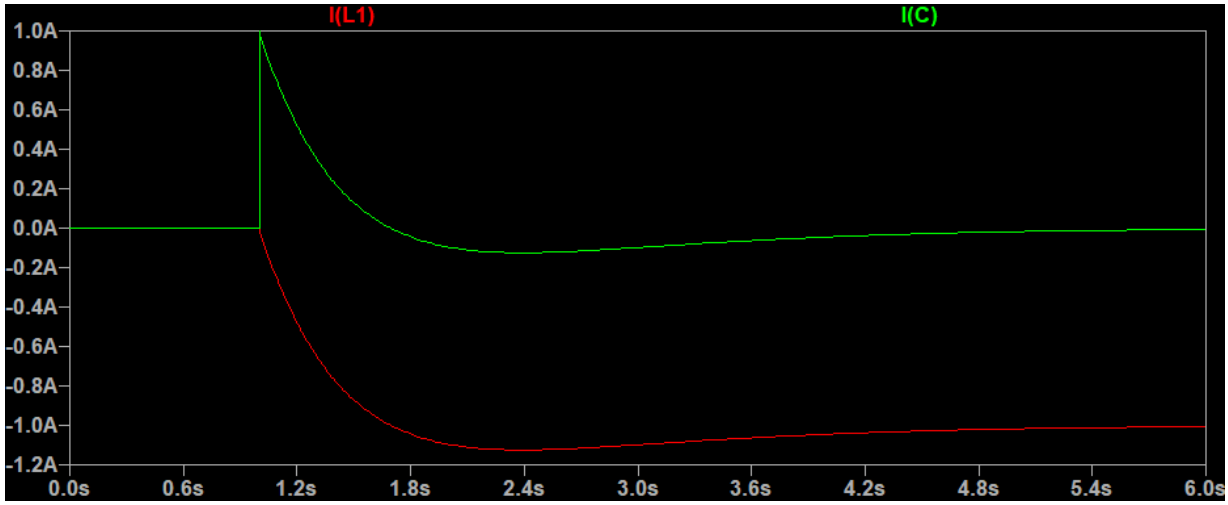

Matlab Source Code and Plot:

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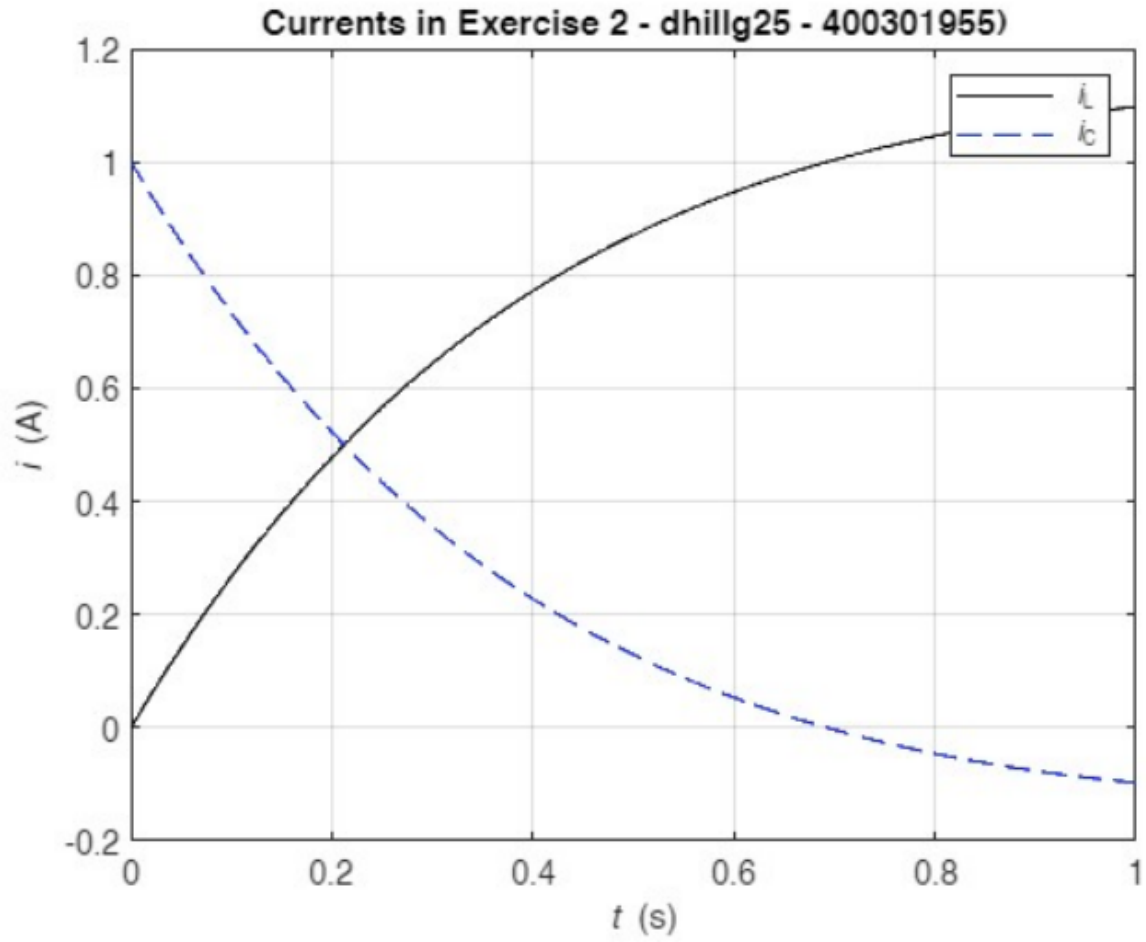
```
clear all; close all;
t = linspace(0, 1, 1001);
iC = -1*exp(-t) + 2*exp(-2*t); % change this to the function iC(t) you found from Laplace analysis
iL = 1 - iC; % change this to the function iL(t) you found from Laplace analysis
figure;
plot(t, iL,'-k') % plot curve in solid black line
hold on;
plot(t, iC,'--b') % plot curve in dash blue line
hold off;
grid on;
legend('{\it i}_L','{\it i}_C')
title('Currents in Exercise 2 - dhillg25 - 400301955)')
xlabel('{\it t} (s)');
ylabel('{\it i} (A)');
```



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

The LTspice simulation results agree with the MATLAB plot. This can be seen as the curve for iC approaches 0.