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Drives, Controls and Modelling Laboratory Manual (MTE 3161)

Fifth Semester B.Tech (Mechatronics Engineering)

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Experiment I:

Date : 24 /8 /23

Introduction to Matlab

Aim:

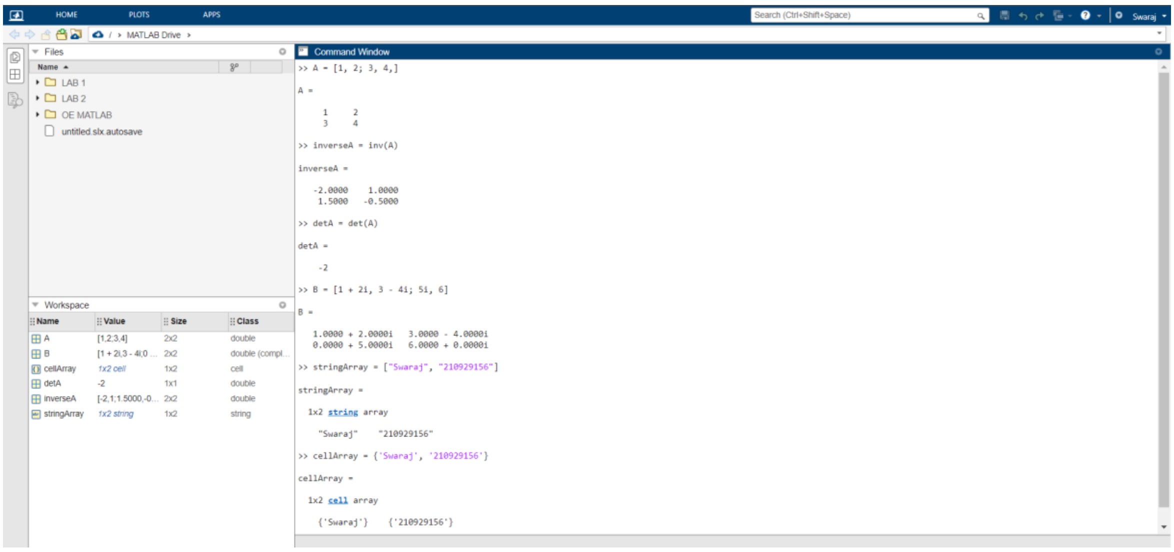
i. To understand various simulation environments in Matlab.
ii. To develop the models for DC excited first order RL Circuit in various simulation environments.
iii. To develop RLC network in circuit approach in Matalab/Simulink

Matlab:

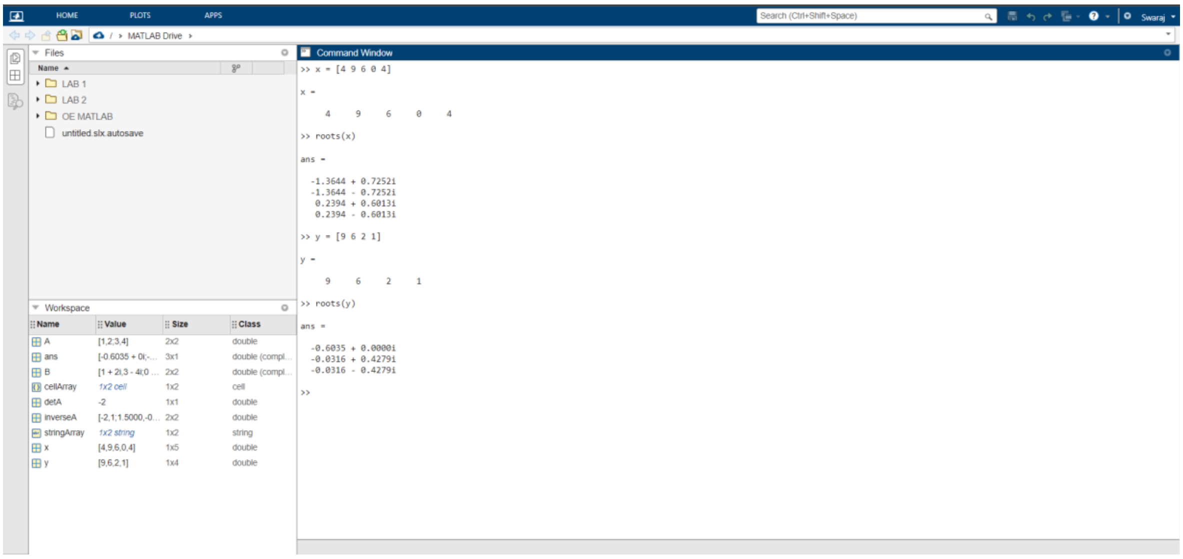
- **MATLAB stands for MATrix LABoratory.**
- **It is a software package for high-performance numerical computation and visualization.**
- **It provides an interactive environment with hundreds of built-in functions for technical computation, graphical and animation.**

Problem1:

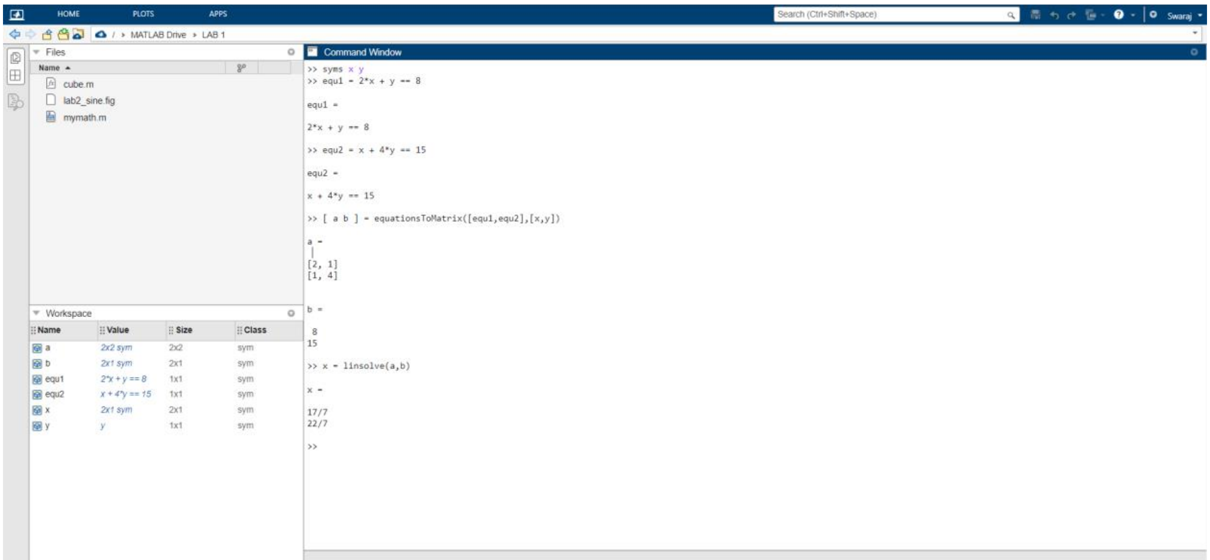
Matlab Matrix operations: creation of matrix, inv, det, complex matrix, string matrices, etc.

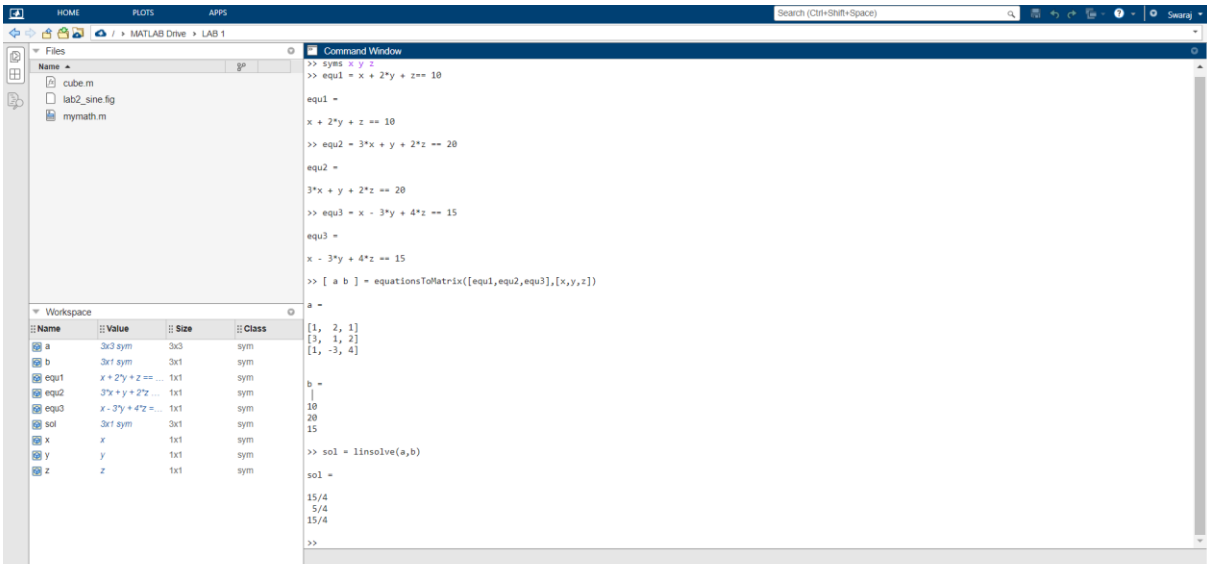


Mathematical operations: Solving general expressions and mathematical functions.

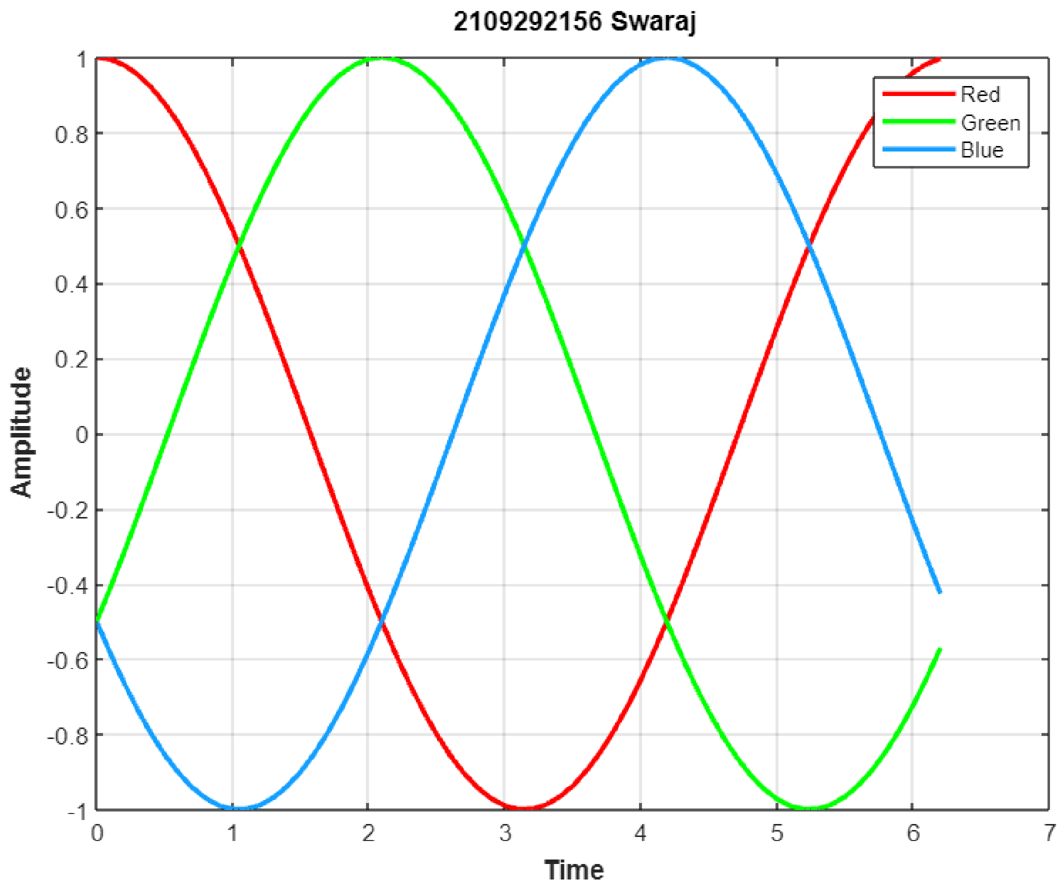



```
>> a=[1+2i 3+4i;5+1i 6+2i]

a =

   1.0000 + 2.0000i   3.0000 + 4.0000i
   5.0000 + 1.0000i   6.0000 + 2.0000i

>> b=[2+2i 6+2i; 7+3i 2+6i]

b =

   2.0000 + 2.0000i   6.0000 + 2.0000i
   7.0000 + 3.0000i   2.0000 + 6.0000i

>> c= a * b

c =

   7.0000 +43.0000i -16.0000 +40.0000i
  44.0000 +44.0000i  28.0000 +56.0000i
```

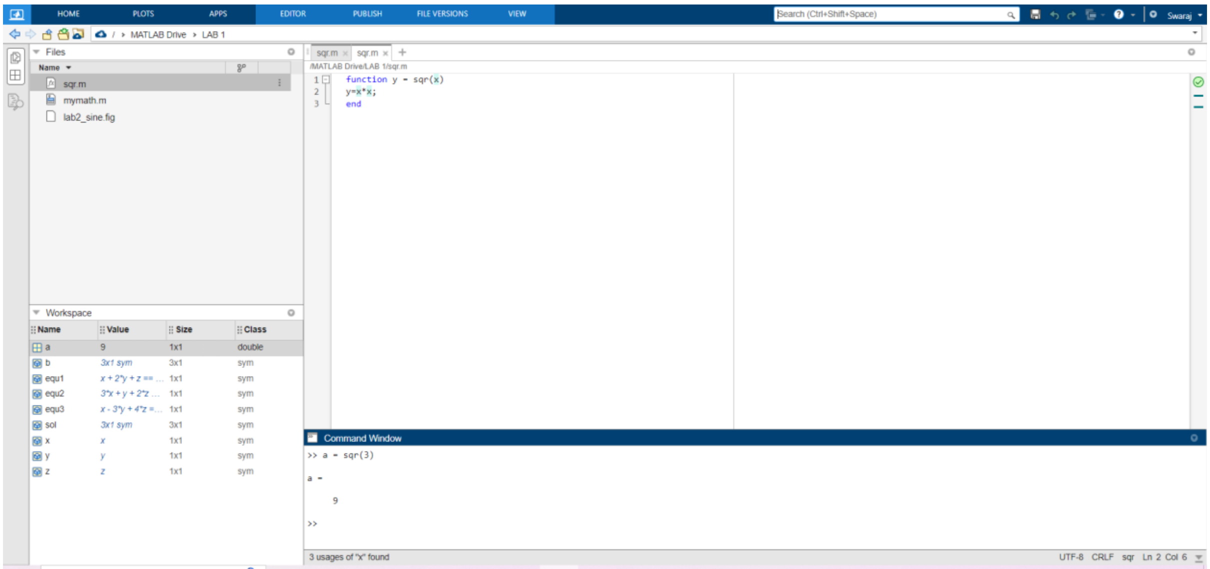




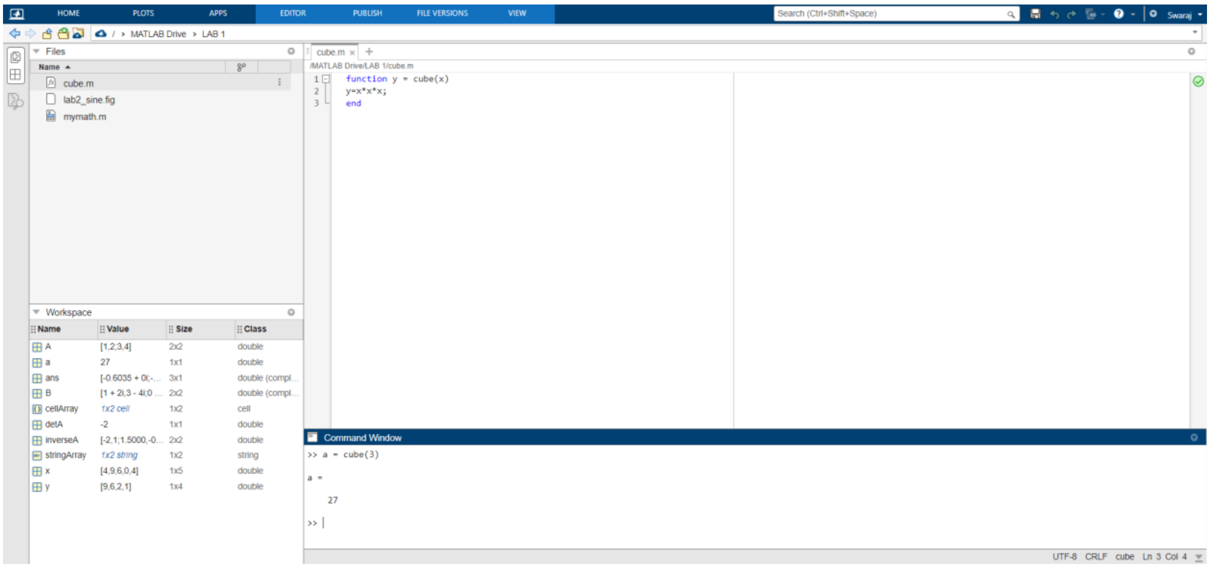
Graphics: plot instructions



Matlab Script: m file and editor.



Functions: creation and operation of functions.



Laplace transform operations: create transfer functions, step function etc

Simulink: various general Simulink block sets, **simscape**

Problem2:

Model the DC excited series RL circuit in following domains.

i. Using direct expression for current in script.

ii. Using transfer function approach in script.

iii. Using Simulink block diagram approach mathematical & transfer function.

iv. Using Simulink simscape.

i. **Analytical Expression in matlab script**

Analytical Solution - Expression

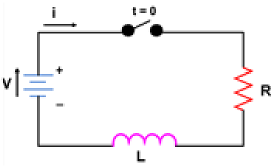
$i = \left(\frac{V}{R}\right)\left(1 - e^{-\left(\frac{R}{L}\right)*t}\right) \qquad V = 10, R = 1, L = 1$

$i = (10)\left(1 - e^{-t}\right)$

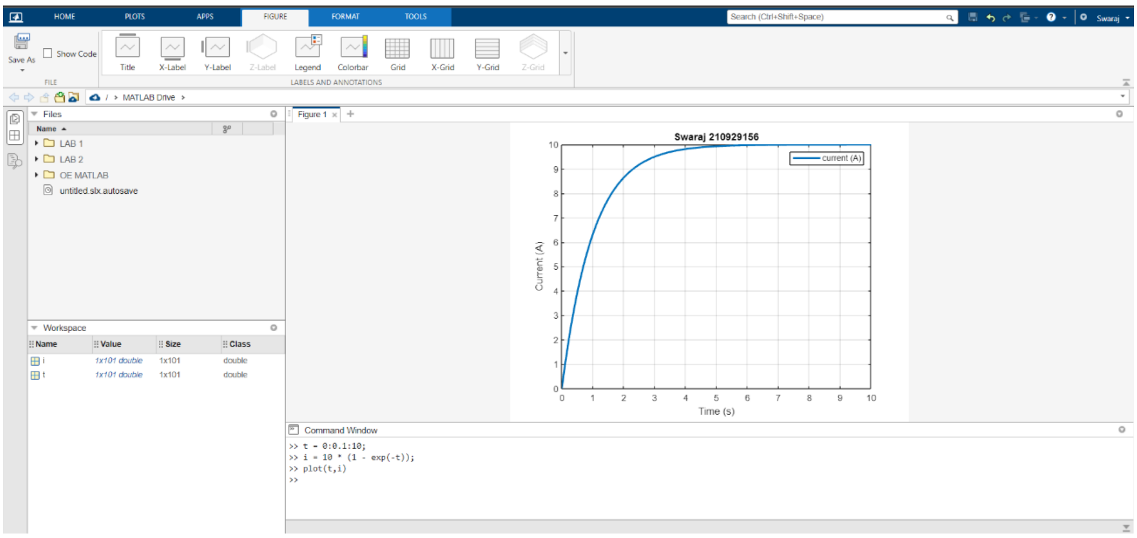
$\gg t = 0{:}0.1{:}10;$

$\gg i = 10 * (1 - exp(-t));$

$\gg plot(t, i)$



0:



ii.**10*Using transfer function approach in script.**

Using Laplace domain transfer function

$V = R * i + L\,\frac{di}{dt}$ *taking Laplace transform for this equation*

$V(s) = R * I(s) + sL * I(s)$

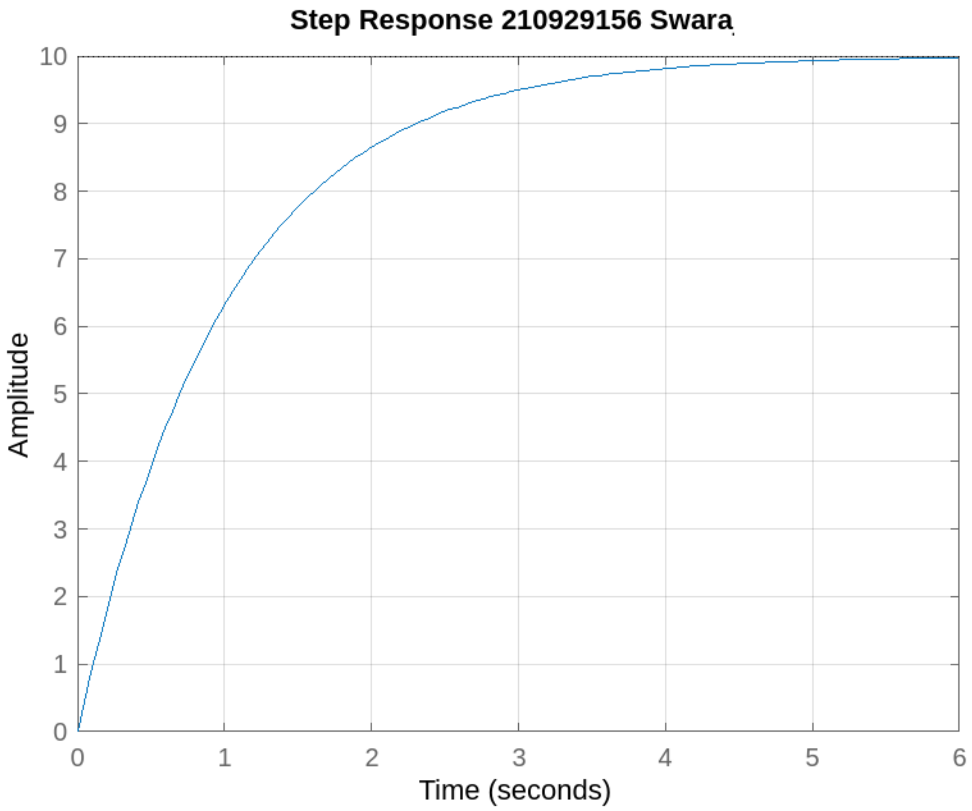
$I(s) = \frac{V(s)}{R + sL} \longrightarrow$ *transfer function* $\frac{I(s)}{V(s)} = \frac{1}{R + sL} = 1/(1+s)$

For given $V = 10, R = 1, L = 1,$ ***the step response for the transfer function***

$\gg s = tf('s');$ ***This is for transfer function variable 's'***

$\gg G = {}^{1}/_{(s+1)};$ ***The tranfer function***

$\gg step(10 * G)$ ***10 is for magnitude of Vdc applied***

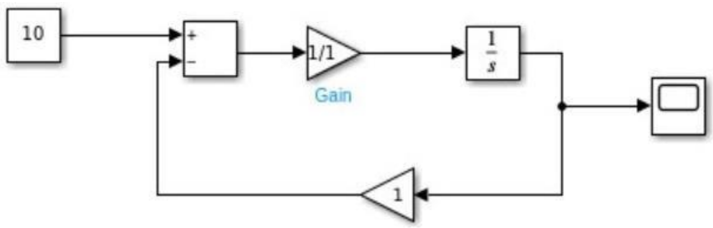


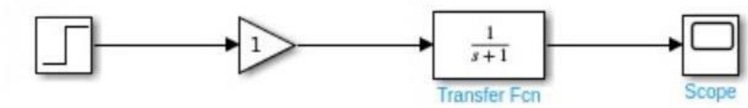
Using Simulink block diagram approach

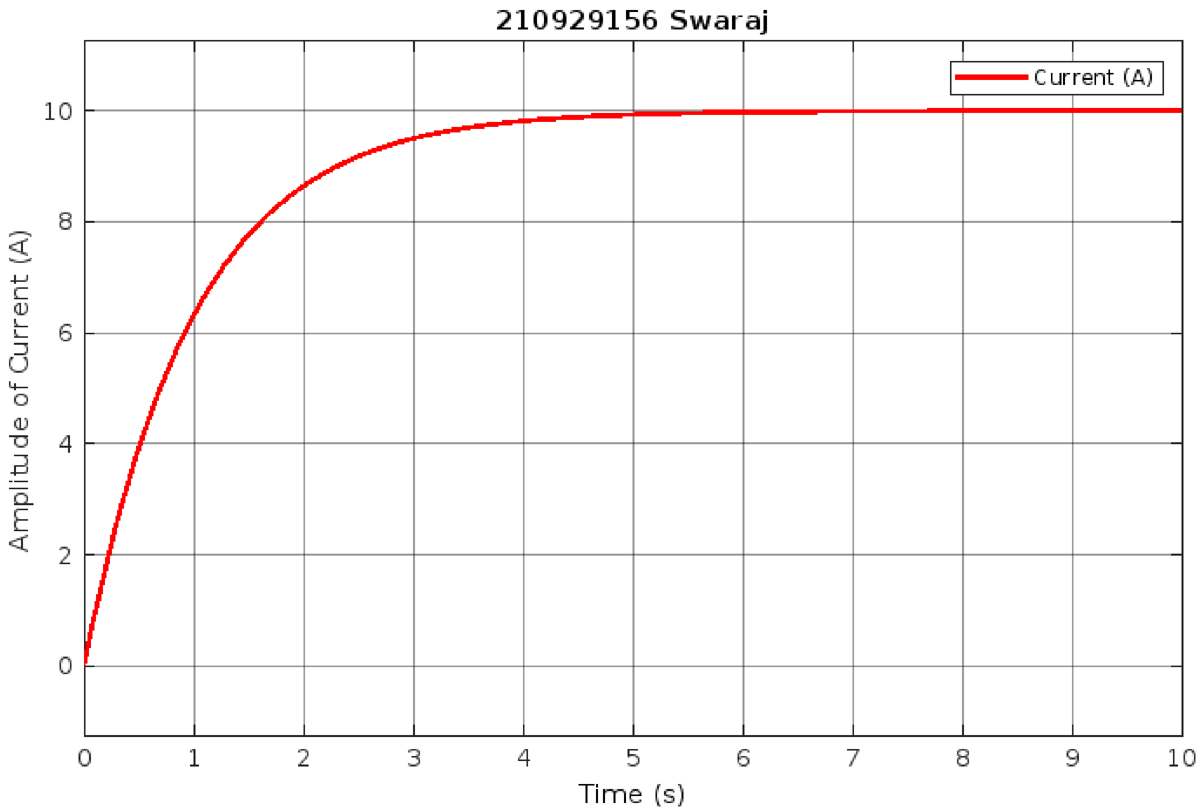
$V = R * i + L\,\frac{di}{dt}$ *rearranging this equation for di/dt*

$\frac{di}{dt} = \frac{V - R * i}{L}$ *Integrating on both sides*

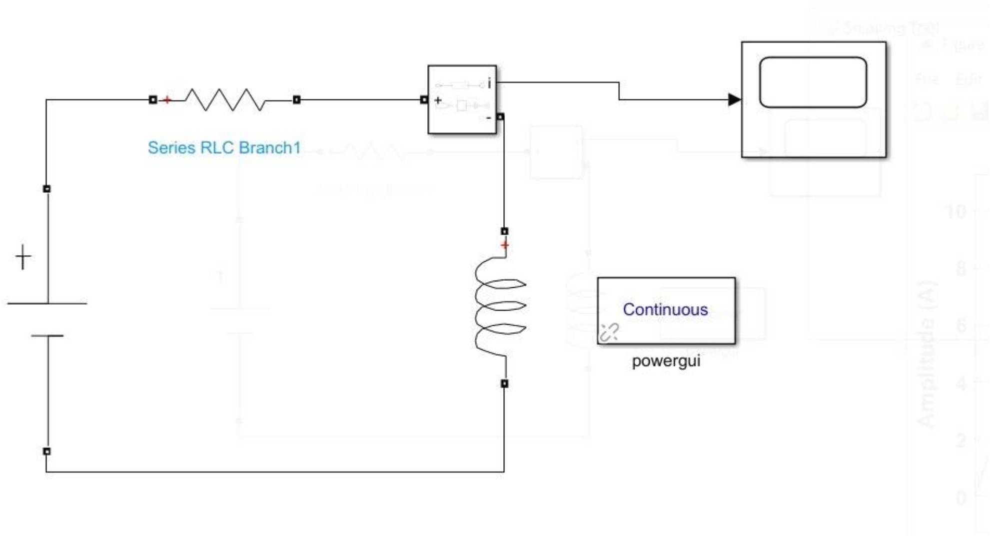
$\int \frac{di}{dt}\,dt = \int (V - R * i)/L\ dt = i \longrightarrow \boldsymbol{i * R}$

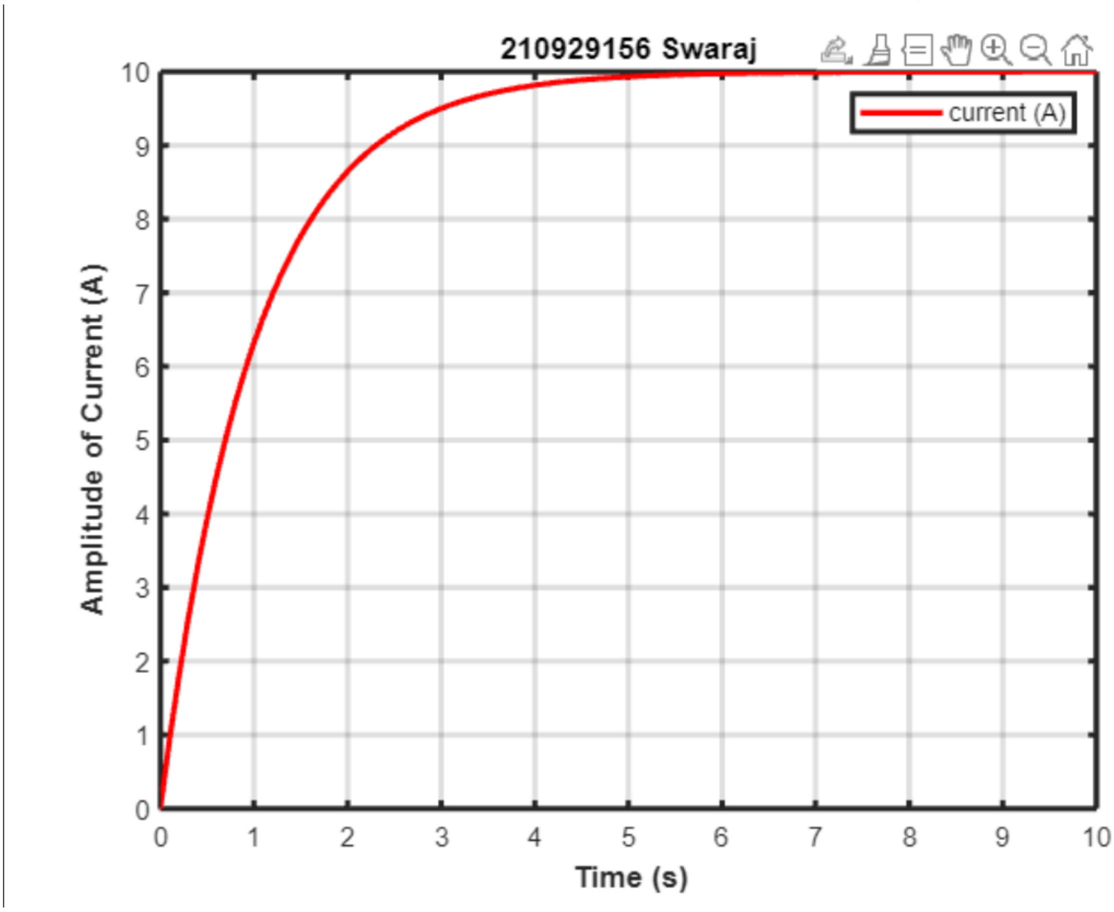






iv.**Using Simulink simscape**


Series RLC Branch1
Continuous
powergui

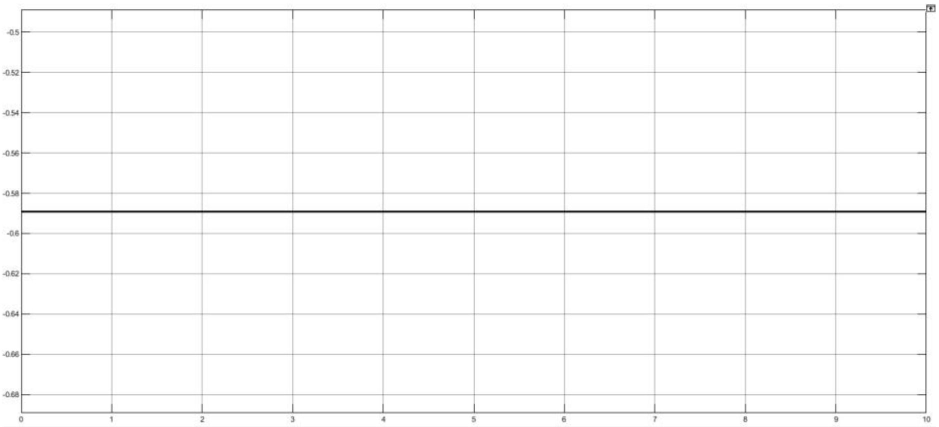

210929156 Swaraj
current (A)
Amplitude of Current (A)
Time (s)

Open-Ended Lab Exercises - 1: (5M)

- Find the roots of equation   x^4 + 2*x^3+2*x+1=0.

```
>> a=[ 1 2 0 2 1];
>> r=roots(a)

r =

  -2.2966 + 0.0000i
   0.3660 + 0.9306i
   0.3660 - 0.9306i
  -0.4354 + 0.0000i
```

-



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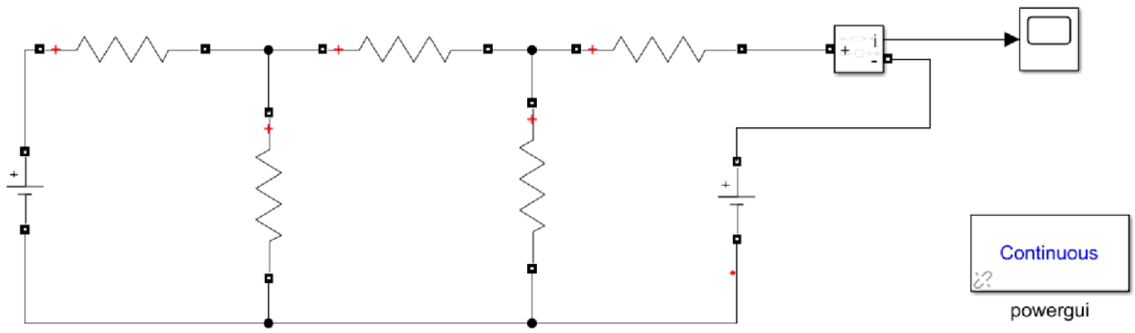

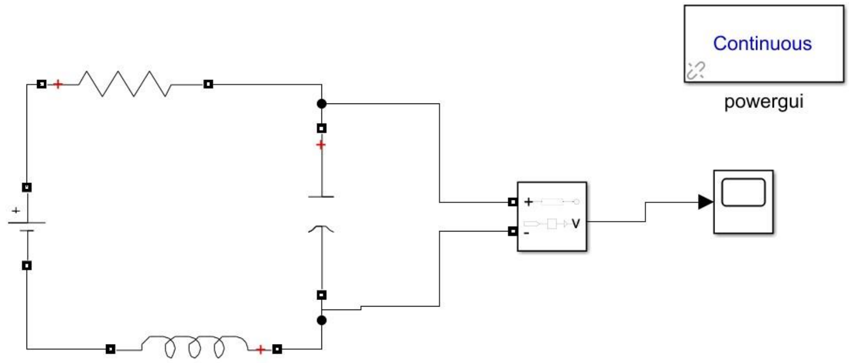

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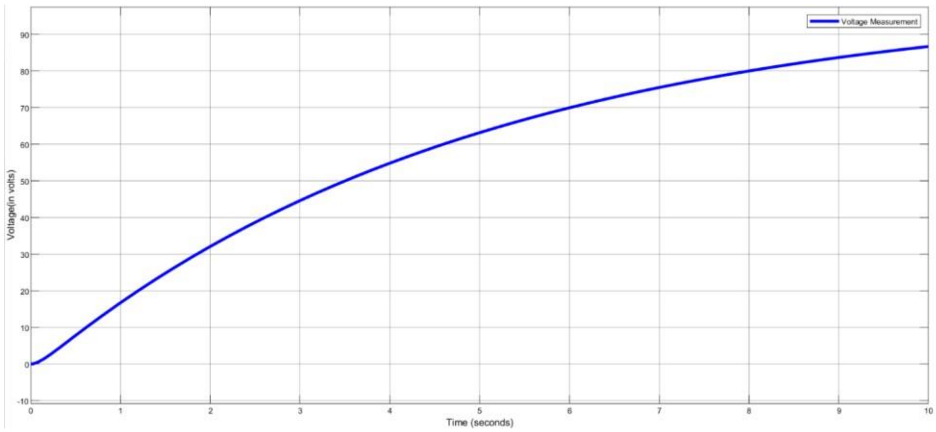
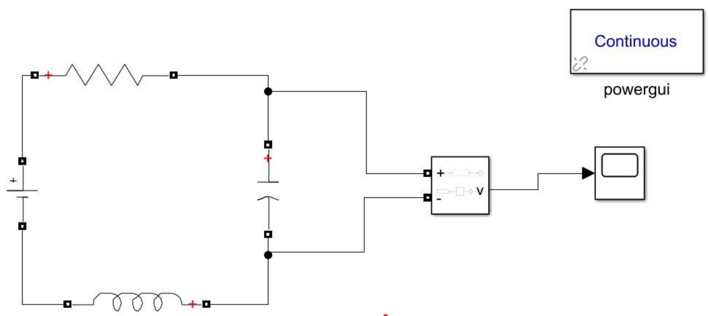


Voltage Measurement
Voltage(in volts)
Time (seconds)

-



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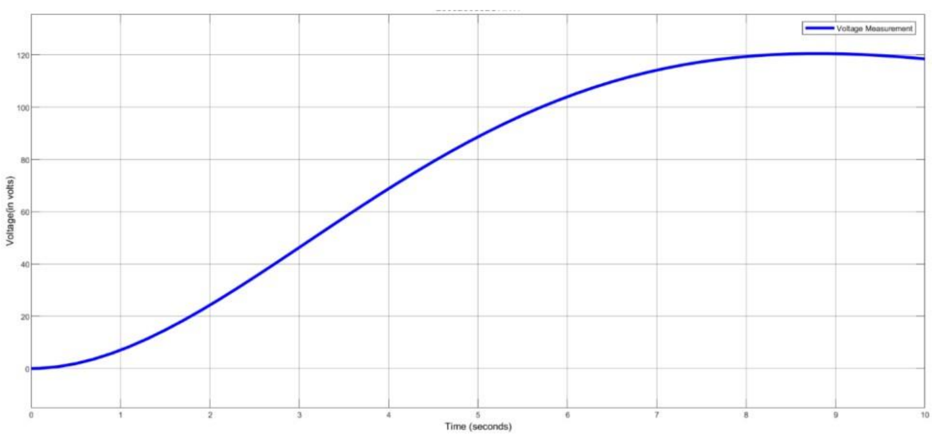
powergui



Voltage Measurement
Voltage(in volts)
Time (seconds)

5.

- Liquid level control in tanks can be modelled as first order systems.
- A linear spring-damper system.