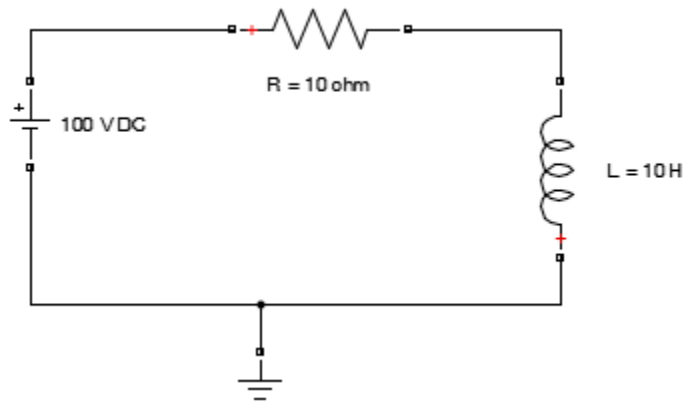## Lab # 03

Simulation of RL Circuit in MATLAB using Modeling Method

In this lab we will learn about the simulation as well as mathematical modeling of RL circuit.

A circuit with a dc battery source of 100 volt, with a resistor of 10 ohm and an inductor of 10 Henry is shown below.

As we know voltage across the resistor will be

$$V = IR$$

and current across the resistor will be

$$I = V/R$$

Similarly if we find voltage across inductor it will be

$$V = Ldi/dt$$

And for current we have

$$I = 1/L(\int V dt)$$

If we apply the KVL across the loop we get equation i.e.

$$V = IR + Ldi/dt$$

And for current

$$I = \int S \left(\frac{V - IR}{L} \right) dt$$

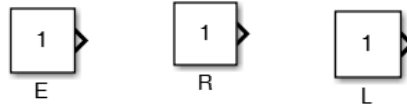   As S is multiplied here for the switching purpose i.e. S = 0 (Off State) and S = 1 (On State)
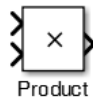
And for Power we have

$$P = VI$$

Now let us simulate this circuit with the set of these equations. The following components will be used.

Components Used:

- Three Constants Blocks one block for each i.e. for Dc voltage source, Resistor and for Inductor

- Product Block

- Add Block

- Divide Block

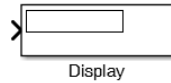

- Derivative Block

- Integrator Block

- Unit Step Block for Switching Purpose set the step time to 0.5

- Scope

Scope

- Display

Display

Now first of all enter the values of V (as here in Matlab Voltage is denoted by E), R and L in the Matlab Command window.

```
>> E = 100

E =

    100

>> R = 10

R =

    10

>> L = 10

L =

    10
```
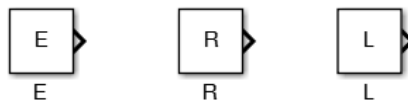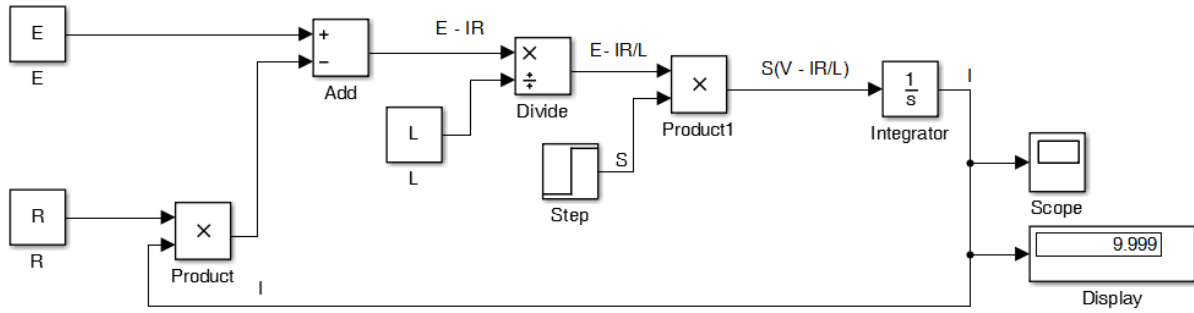
Now give the values to the constant blocks by double clicking on the constant blocks and give it simple E, R and L in the constant value block respectively.
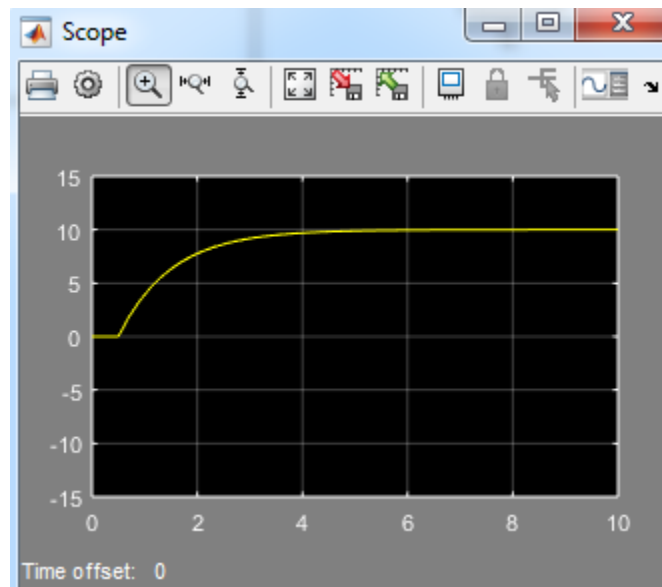

Now to find current across the RL circuit we have the following mathematical model from the current equation.

$$I = \int S\left(\frac{V - IR}{L}\right) dt$$

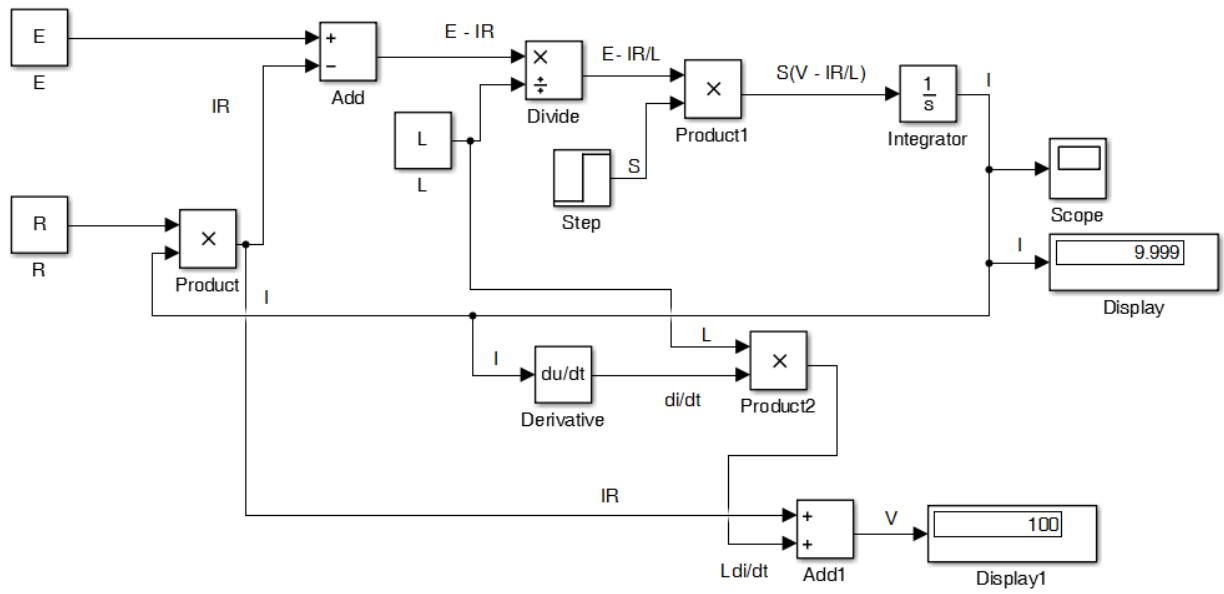To check the output current characteristics through RL circuit click on scope you will get the following result.

This output shows two regions/states the Transient state and the Steady state. These states are dependent on the value of inductor used in the circuit.

Now to find the voltage across the circuit we have the following mathematical model from the voltage equation.
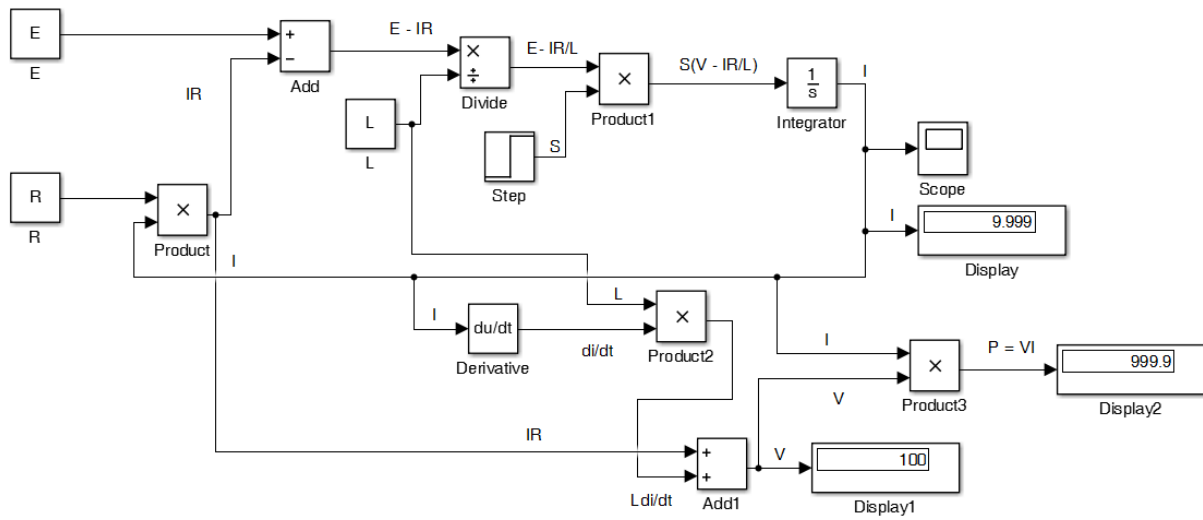
$$V = IR + Ldi/dt$$

E

E

E - IR

+ −
Add

× ÷
Divide

E- IR/L

L

L

S

Step

×
Product1

S(V - IR/L)

1
s
Integrator

I

Scope

I

9.999

Display

R

R

×
Product

I

I

du/dt
Derivative

di/dt

L

×
Product2

IR

+ +
Add1

V

100

Ldi/dt

Display1

Now for Power we have

$$P = VI$$

The circuit arrangement will be shown below as:-

E

E

E - IR

+ −
Add

IR

× ÷
Divide

E- IR/L

L

L

S

Step

×
Product1

S(V - IR/L)

1
s
Integrator

I

Scope

I

9.999

Display

R

R

×
Product

I

I

du/dt
Derivative

di/dt

L

×
Product2

IR

I

V

×
Product3

P = VI

999.9

Display2

+ +
Add1

V

100

Ldi/dt

Display1

Lab Task:

Simulate RL circuit by modeling method. Find the parameters (voltage, current and power) across each component. Give your Id number as the values for the constant blocks.