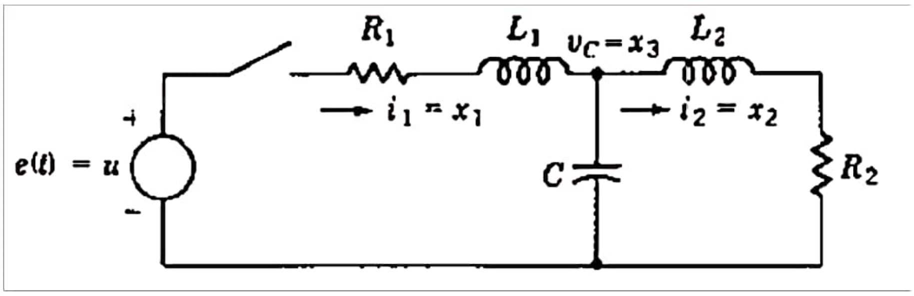
Lab Session 04

Exercise:

Question 1:

Obtain the state space representation for the system shown below. Solve the resulting state equations using MATLAB *ode45* function (write complete script). Plot the inductor current i_1 and i_2 and the capacitor voltage v_c as marked in the figure with respect to time for $t = 0$ to 500 sec considering the following values of R, L and C and write in your words about what you observed by looking at plots.
[*Hint: Refer lecture 3 for the possible observations about this question.*]
[*Use separate A4 sheets for plots and attach it with this document*]



System Parameters:
$R_1 = R_2 = 10$
$L_1 = L_2 = 1$
$C = 5$
$e = 50$

Write your answers below this line

For Mesh 1:-

$$R_1 i_1 + L_1 D i_1 + \frac{1}{CD}(i_1 - i_2) = e \quad \text{— (A)}$$

For Mesh 2:-

$$\frac{1}{CD}(i_1 - i_2) = L_2 D i_2 + R_2 i_2 \quad \text{— (B)}$$

State Variables:-

$$x_1 = i_1 \quad , \quad x_2 = i_2 \quad , \quad x_3 = V_C$$

Now,

$$x_1' = \frac{e}{L_1} - \frac{R_1}{L_1} x_1 - \frac{1}{L_1} x_3 \quad \text{——— (1)}$$

$$x_2' = \frac{1}{L_2} x_3 - \frac{R_2}{L_2} x_2 \quad \text{——— (2)}$$

$$x_3' = \frac{1}{C} x_1 - \frac{1}{C} x_2 \quad \text{——— (3)}$$

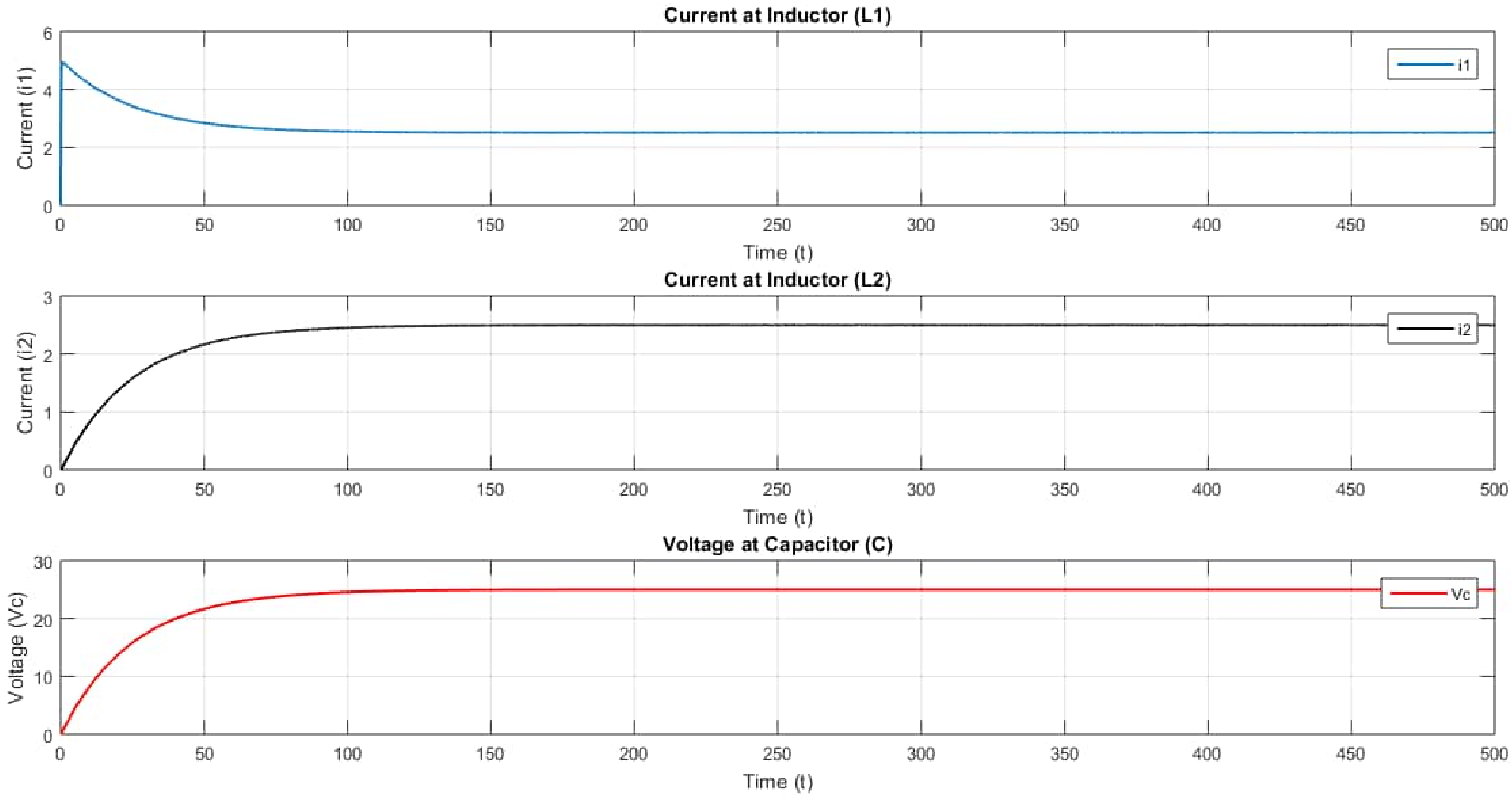
FUNCTION SCRIPT:-

RLC.m :-

```
function dxdt= RLC(t,x)
  R1 = 10 ;  R2= 10;
  L1 = 1 ;  L2 = 1;
  C = 5;   e= 50;
  dxdt(1,1) = e/L1 - R1*x(1)/L1 - x(3)/L1;
  dxdt (2,1) = x(3)/L2 - R2*x(2)/L2;
  dxdt (3,1) = x(1)/C - x(2)/C;
end
```

PROGRAM SCRIPT:-

```
clear, close, clc
[t,x] = ode45('RLC',[0 500],[0;0;0;0]);
figure
subplot(3,1,1);
plot(t,x(:,1),'LineWidth',1.5);
ylabel('Current (i1)'); xlabel('Time (t)');
title('Current at Inductor (L1)');
legend('i1'); grid;
subplot(3,1,2);
plot(t,x(:,2),'k','LineWidth',1.5);
ylabel('Current (i2)'); xlabel('Time (t)');
title('Current at Inductor (L2)');
legend('i2'); grid;
subplot(3,1,3);
plot(t,x(:,3),'r','LineWidth',1.5);
ylabel('Voltage (Vc)'); xlabel('Time (t)');
title('Voltage at Capacitor (C)');
legend('Vc'); grid;
```


Current at Inductor (L1)
Current (i1)
Time (t)
i1
Current at Inductor (L2)
Current (i2)
Time (t)
i2
Voltage at Capacitor (C)
Voltage (Vc)
Time (t)
Vc

OBSERVATIONS :-

At Inductor L_1 :-

Current (i_1) at inductor (L_1) starts with a constant value and decays exponentially, it acheives stability ~~linear~~ after some time and remains constant.

At Inductor L_2 :-

Current (i_2) at inductor (L_2) starts with zero and increases exponentially, it acheives stability after some time and remains constant.

At Capacitor C :-

Voltage (V_c) at capacitor (C) starts with zero and increases exponentially, it acheives stability after some time and remains constant