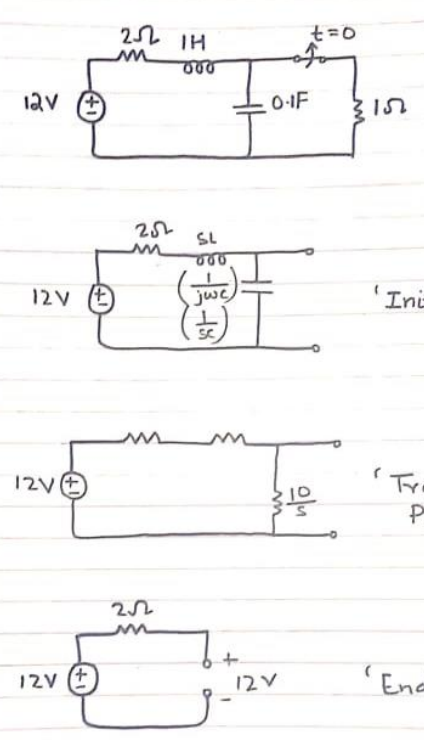


# Lab 12

## Task 1:

Solution of Circuit:

LAB TASK 1



The diagrams illustrate the circuit's behavior at different stages:

- Initial State ( $t=0$ ):** A 12V DC source is in series with a  $2\Omega$  resistor. This is followed by a parallel combination of an inductor ( $1H$ ) and a capacitor ( $0.1F$ ). A switch is shown opening at  $t=0$ , after which a  $1\Omega$  resistor is connected in parallel with the capacitor.
- 'Initially':** The equivalent circuit for the initial state, showing the inductor as an open circuit and the capacitor as a short circuit with impedance  $\frac{1}{j\omega C}$ .
- 'Transition Phase':** The equivalent circuit during the transition phase, where the inductor is represented by its Laplace transform impedance  $sL$  and the capacitor by  $\frac{1}{sC}$ .
- 'End Result':** The final steady-state equivalent circuit, where the inductor is a short circuit and the capacitor is an open circuit. The output voltage across the  $1\Omega$  resistor is 12V.

As in the transition phase the equivalent circuit is a normal series circuit, the current through the circuit is given by:

$$I = \frac{V}{R} = \frac{12}{2 + s + \frac{10}{s}}$$

$$= \frac{12}{s\left(\frac{2}{s}\right) + \frac{s(s)}{s} + \frac{10}{s}}$$

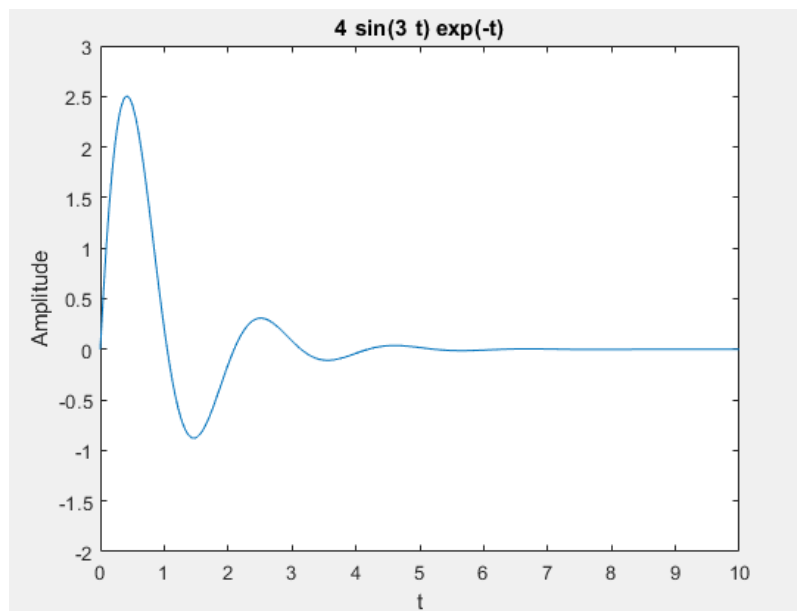
$$= \frac{12s}{s^2 + 2s + 10}$$

(b) As answer of energy is infinity hence the system is BIBO unstable.

Code:

```
1 - syms t s
2 - Vi=12;
3 - V=laplace(Vi,s);
4 - I=V/(2+s+10./s);
5 - Io=ilaplace(I,t);
6 - ezplot(Io,[0 10]); %plots the expression over the default domain
7 - ylim([-2 3])
8 - xlabel('t')
9 - ylabel('Amplitude')
10
11 - E=int(abs(Vi).^2,t,0,inf);
12
13 |
```

Graph:

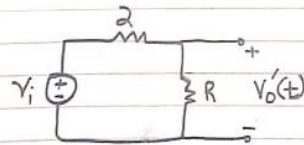
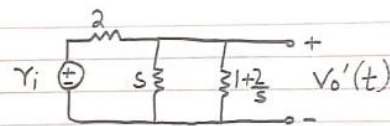
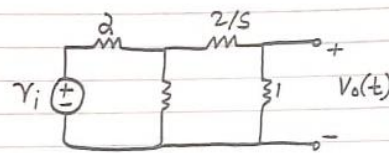
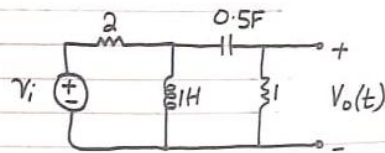


System is BIBO Unstable.

## Task 2:

Solution of Circuit:

### LAB TASK 2



$$\frac{1}{R} = \frac{1}{s} + \frac{1}{1 + \frac{2}{s}}$$

$$= \left[ \frac{1}{s} + \frac{s}{s+2} \right]$$

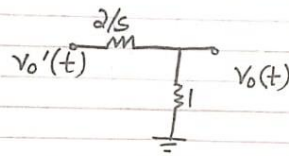
$$= \left[ \frac{(s+2) + (s)(s)}{s(s+2)} \right]^{-1}$$

$$= \left[ \frac{s+2+s^2}{s^2+2s} \right]^{-1}$$

$$= \left[ \frac{s(s+2)}{s^2+s+2} \right]$$

Now, solving this series circuit to get the output voltage;

$$\begin{aligned} V_o'(t) &= V_i \left[ \frac{s(s+2)}{s^2+s+2} \times \frac{1}{2} \right] \\ &= V_i \left[ \frac{s(s+2)}{2s^2+2s+4} \right] \end{aligned}$$



So now for  $V_o(t)$ ;

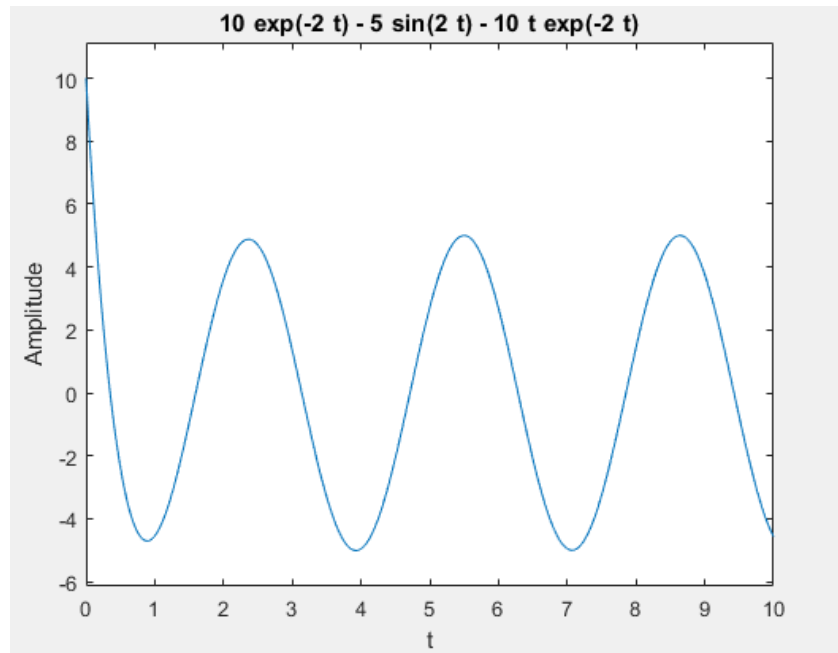
$$\begin{aligned} V_o(t) &= V_o'(t) \times \frac{1}{1+2/s} \\ &= V_o'(t) \times \frac{s}{s+2} \\ &= V_i \left[ \frac{s(s+2)}{2s^2+2s+4} \right] \times \frac{s}{s+2} \\ &= V_i \frac{s^2}{2s^2+2s+4} \end{aligned}$$

(b) As answer of energy is infinity, the system is BIBO unstable.

Code:

```
1 - syms t s
2 - input=10.*cos(2.*t).*heaviside(t);
3 - lapin=laplace(input,s);
4 - output=lapin.*((s.^2)./(s+2).^2);
5 - vout=ilaplace(output,t);
6 - ezplot(vout,[0 10]) %plots the expression over the default domain
7 - xlabel('t')
8 - ylabel('Amplitude')
9
10 - E = sum(int(abs(vout).^2,t,-inf,inf));
11 -
```

**Graph:**



**System is BIBO Unstable.**

**Critical Analysis:**

In this lab I learnt:

- How to use Laplace command to solve circuit on MATLAB.
- Furthermore, we learnt to determine stability of the system.

---

**THE END**