RIS Lab II

TASK 1.1-1.3

Harshit Mutha

TASK 1.1

Task 1.1. Explain why Fig. 1.4 represents the model of a capacitor by writing down the equation it implements.

A capacitor can be implemented with the following equations:

$$I(t) = C\frac{dv}{dt} \qquad\qquad V(t) = \frac{\int_0^t i\,dt}{C}$$

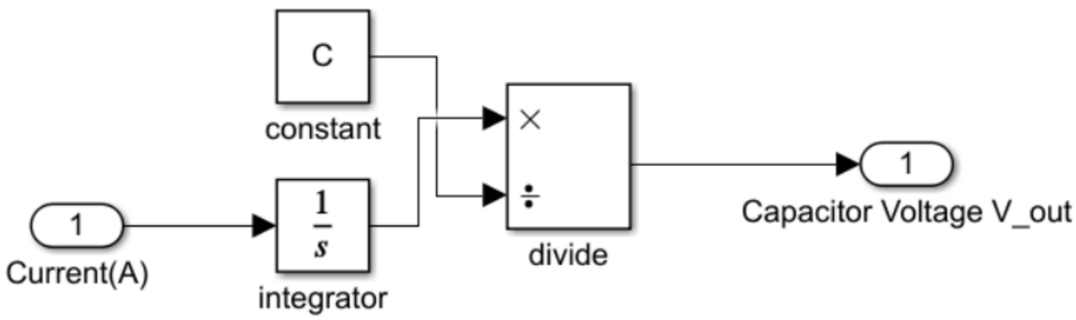
Here,

- I is the Current.
- C is the Capacitance.
- V is the Voltage.
- t is the Time.

The model in fig. 1.4 shows the voltage(output) equal to integration of current divided by the capacitance of a capacitor as shown in this equation:

$$V(t) = \frac{\int_0^t i\,dt}{C}$$

Task: Group together all these blocks to a capacitor subsystem.

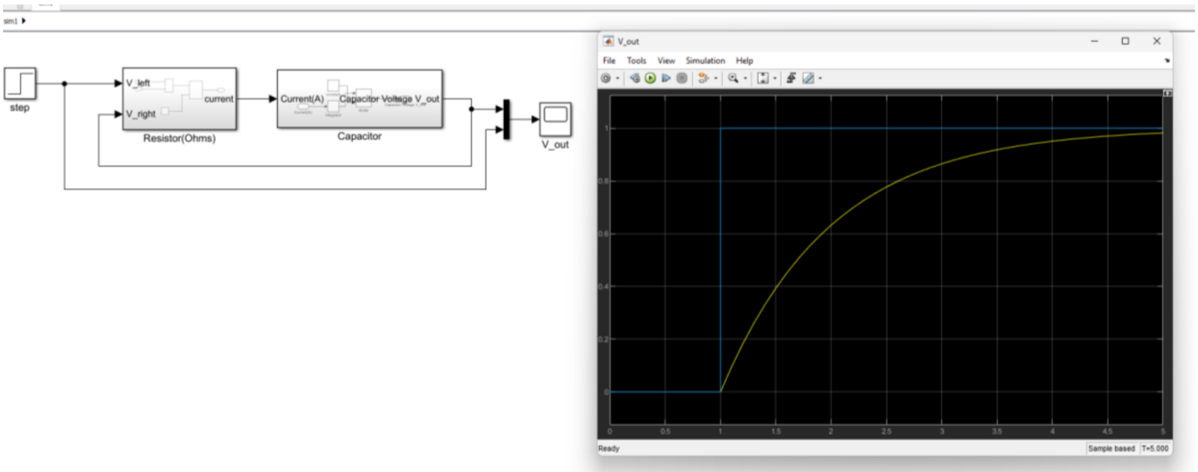


TASK 1.2

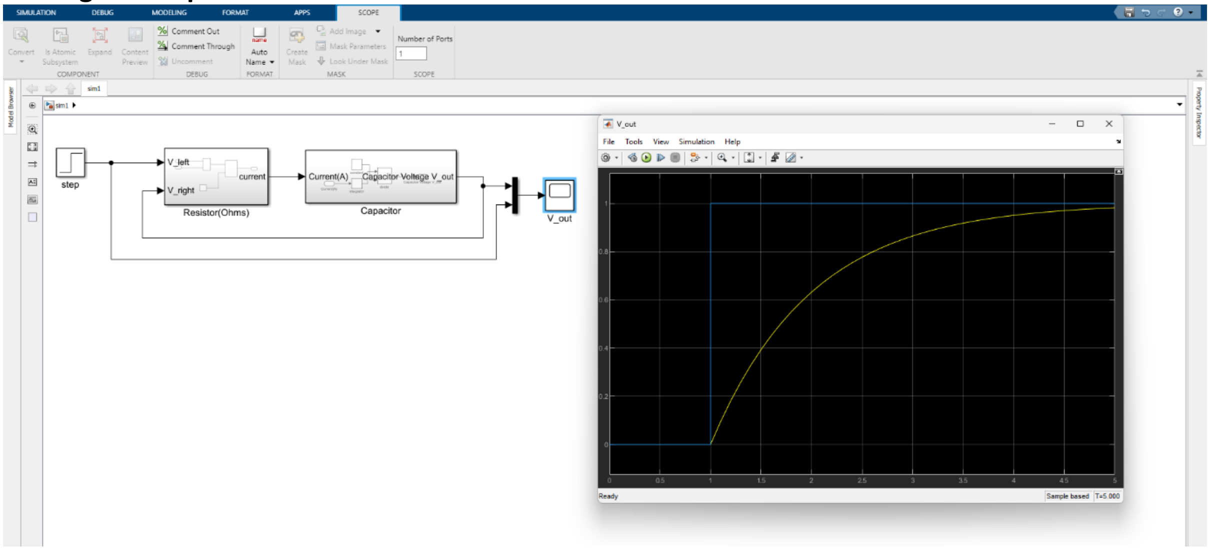
– What is the time-constant of this system? How can you see it in the plot? Change the simulation-time (in input field in the tool-ribbon) from the default 10.0 seconds to 5 times this time-constant.

Time constant here: $\tau = 1$ s

The time constant t of a circuit is the time required for the response to decay to a factor of 63.2 % of its final value, and can be seen clearly in the snapshot below (Is the point from where the yellow line shoots):



– **Run the system by pressing Ctrl+T or by clicking the run-button. Look at the output by double-clicking the scope.**



– Now change the variables R and C in the workspace and re-run the simulation. Does the scope display change as expected?

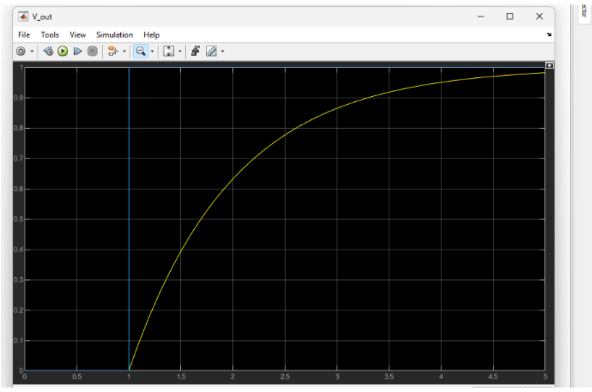
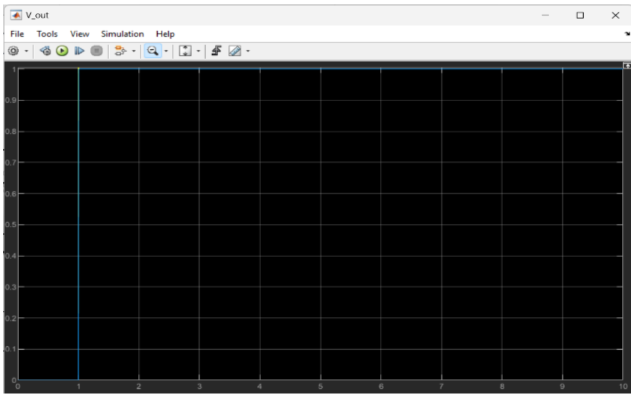


Figure 1: R = 1e10 and C = 1e-10



1 R = 1e2 and C = 1e-6

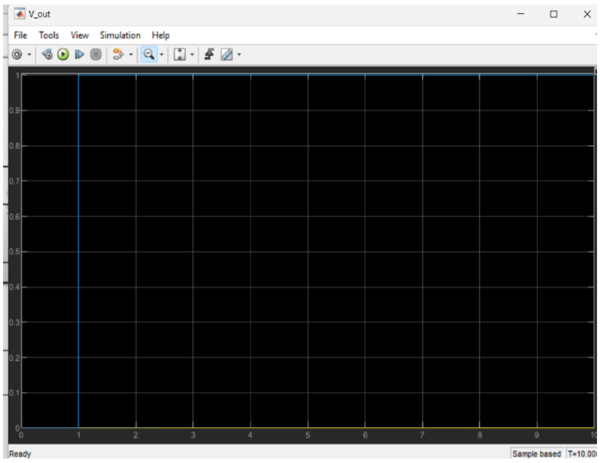


Figure 3: *R = 1e6 and C = 1e-2*

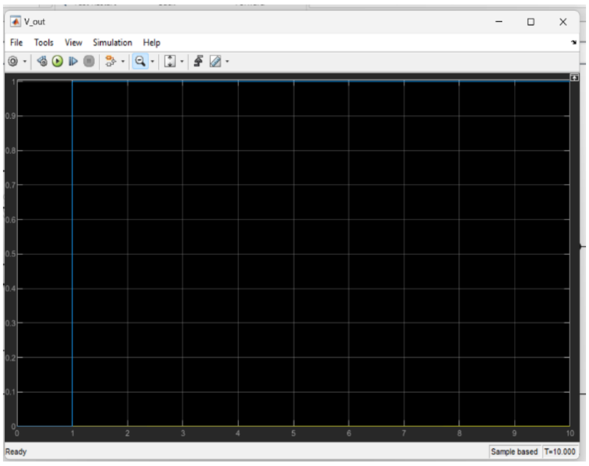
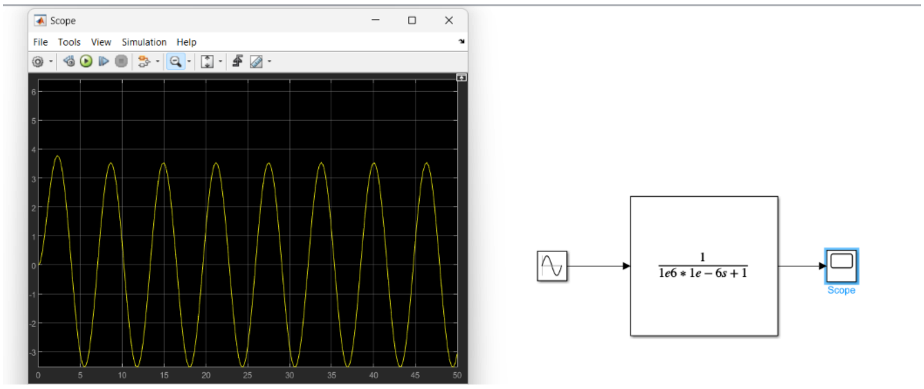


Figure 4: R = 1e2 and C = 1e-2

The change in the plot is as expected. If we look at the pattern, it can be seen that the time constant and delay are inversely proportional to each other.

TASK 1.3

1. **How many seconds does it take for the initial transient to die off in the output response?**



It takes 2.986s for the initial transient response to die off in the output response.

2. **What is the expected gain-ratio (ratio of output to input amplitudes) from theory? You can find this by replacing s by jω in the transfer-function and evaluating |H(jω)|.**

As the used frequency is 1hz, that equals to 2*3.142 = 6.28 rad/s so we substitute jw = 6.28j into the transfer function as follows:

$$\left| \frac{1}{R \cdot C \cdot (s+1)} \right| = \left| \frac{1}{R \cdot C \cdot (jw+1)} \right| = \left| \frac{1}{1e^{6} \cdot 1e^{-6} \cdot 6.28j + 1} \right|$$

$$= -0.1573$$

3. **Zoom in the scope to find the amplitude ratio of the output wave to the input wave. Is it as expected?**

The mean can be calculated as follows:

$$Amplitude = \left(\frac{9.197 \cdot 10^{-1} - \left(-8.167 \cdot 10^{-1}\right)}{2} \right) = 0.862$$

The amplitude of used input wave is 5 so we calculate the Amplitude Ratio as follows:

$$Amplitude\ Ratio = \frac{0.8682}{5} = 0.1736$$

Hence, it can be concluded that the amplitude ratio value is as expected.