

A.

A filter is a circuit capable of passing (or amplifying) certain frequencies while attenuating other frequencies. Thus, a filter can extract important frequencies from signals that also contain undesirable or irrelevant frequencies.

In the field of electronics, there are many practical applications for filters.

Examples include:

- *Radio communications*: Filters enable radio receivers to only "see" the desired signal while rejecting all other signals (assuming that the other signals have different frequency content).
- *DC power supplies*: Filters are used to eliminate undesired high frequencies (i.e., noise) that are present on AC input lines. Additionally, filters are used on a power supply's output to reduce ripple.
- *Audio electronics*: A crossover network is a network of filters used to channel low-frequency audio to woofers, mid-range frequencies to midrange speakers, and high-frequency sounds to tweeters.
- *Analog-to-digital conversion*: Filters are placed in front of an ADC input to minimize aliasing.

B. Designing a Low-Pass Filter with 0.005Ω resistor and $0.01F$ capacitor

A 100V Amplitude was selected with a frequency of 1Hz for the Sine Wave Source.

C. Determining the Cut-off frequency

The cut-off frequency is calculated by $F = \frac{1}{2\pi RC}$

When $R = 0.005\Omega$ and $C = 0.01F$

$F = \frac{1}{2\pi \cdot 0.005 \cdot 0.01} = 3189.099 \text{ Hz}$

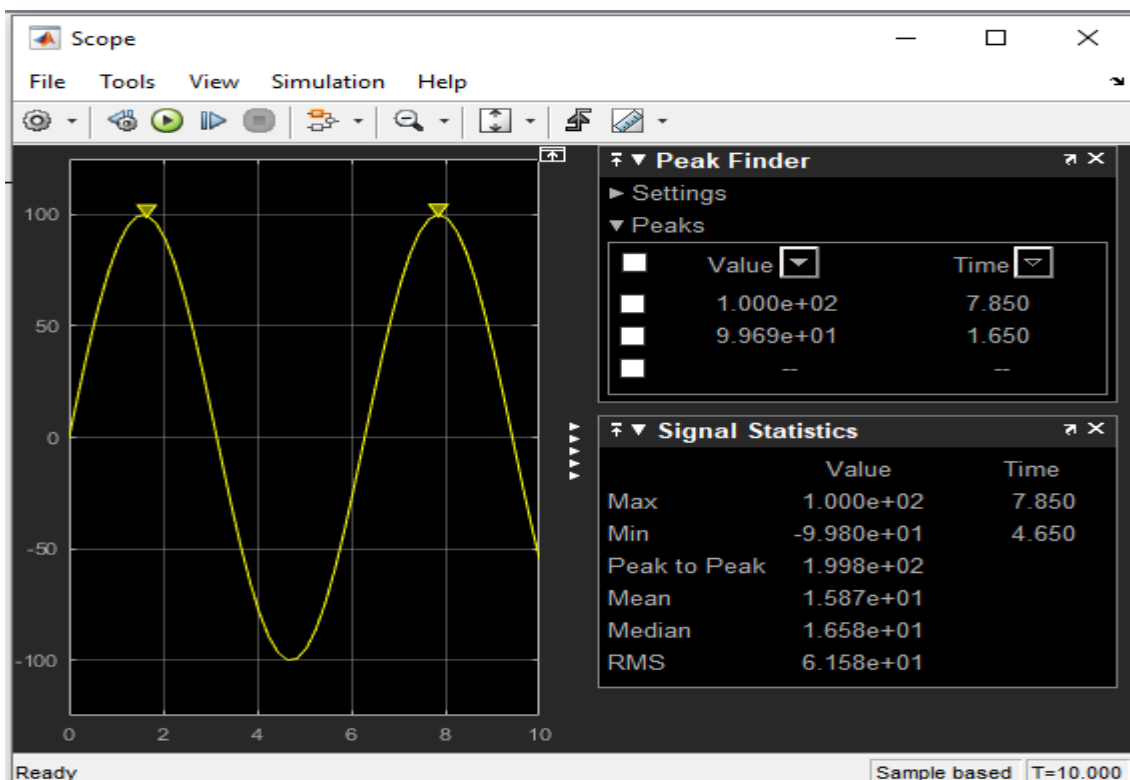
D. Design Output

The transfer function equation for the circuit is given as

$$\frac{1/RC}{S + 1/RC}$$

When $R = 0.005\Omega$ and $C = 0.01F$

$$\text{Transfer Fcn} = \frac{1/0.005 \cdot 0.01}{S + (0.005 \cdot 0.01)} = \frac{20000}{s + 20000}$$



A. If two signals of 5 K Ω and 2 K Ω are pass through the filter at different intervals. Discuss your observation

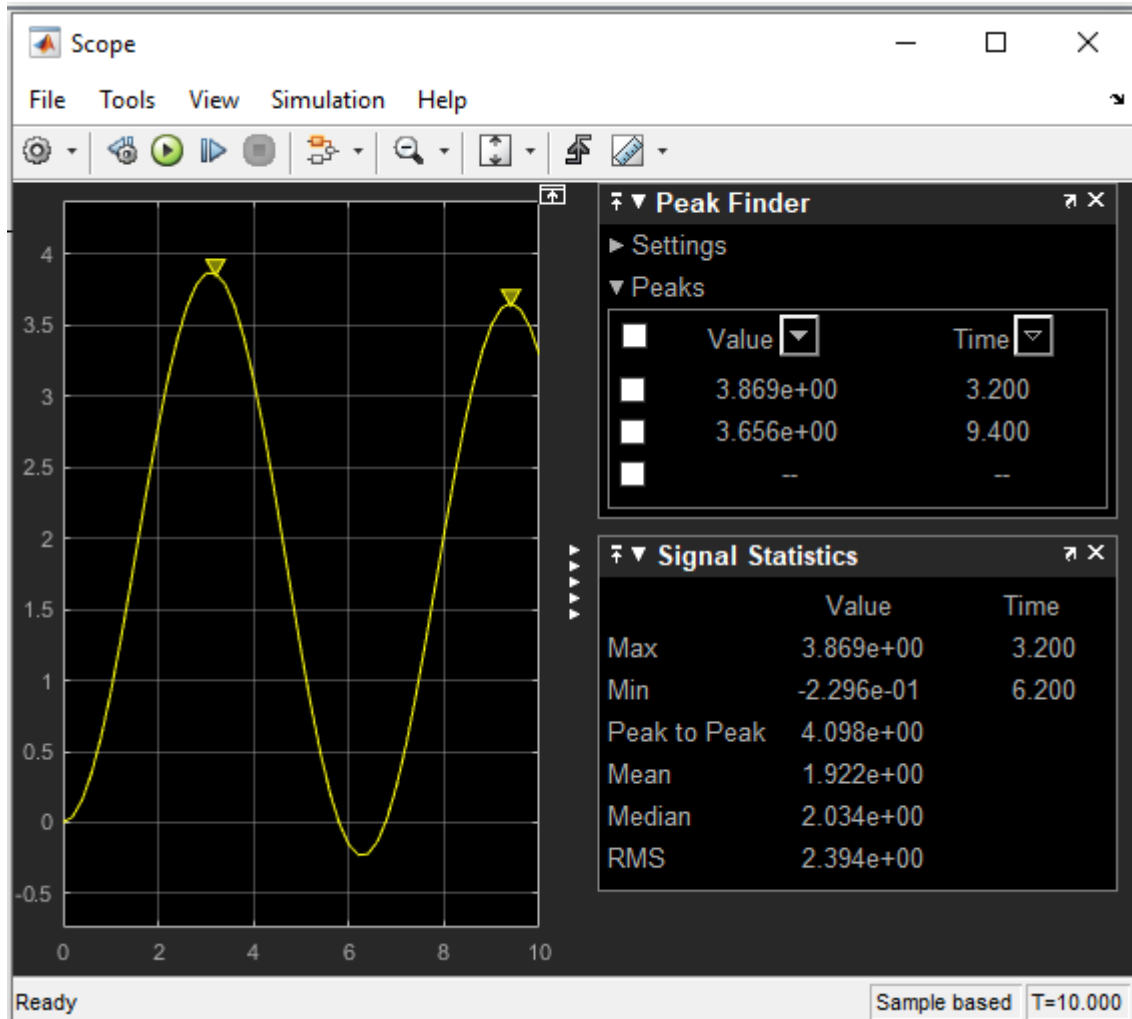
When the signal of 5 KΩ is passed through the filter, the following result is obtained:

The transfer function equation for the circuit is given as

$$(1/RC)/(S + 1/RC)$$

When $R= 5000\Omega$ and $C= 0.01F$

$$\text{Transfer Fcn}=(1/5000*0.01)/(S + (5000*0.01))= (0.02)/(s+ 0.02)$$



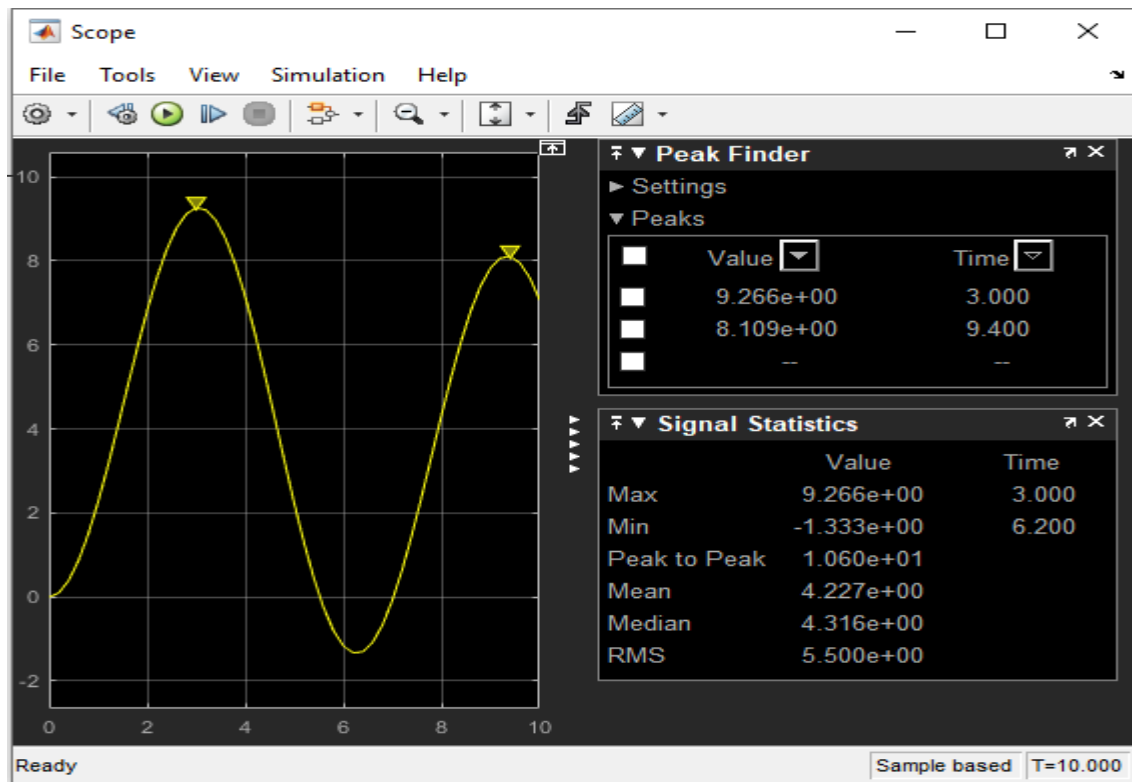
Observations: The signal is attenuated to 3.869 ohms

When the signal of 2K ohms is passed through the filter the following results are obtained: The transfer function equation for the circuit is given as

$$(1/RC)/(S + 1/RC)$$

When $R= 2000\Omega$ and $C= 0.01F$

$$\text{Transfer Fcn}=(1/2000*0.01)/(S + (2000*0.01))= (0.05)/(s+ 0.05)$$



Observations: The signal is attenuated to 9.266 ohms