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Matric number: 17/ENG04/031

Department: Electrical/Electronics

Course: Software Development and Application ENG 342

A. Classification of Filters

Filter is mainly classified into two types:

- Active Filter
- Passive Filter

➢ Active Filters

Filter Circuit which consists of active components like Transistors and Op-amps in addition to Resistors and Capacitors is called as **Active Filter**.

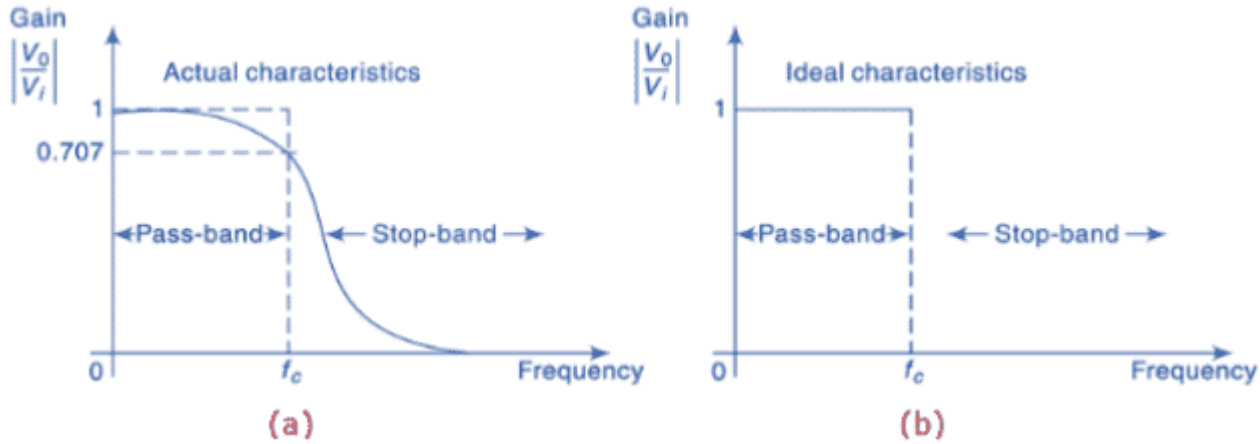
➢ Passive Filters

Filter circuit which consists of passive components such as Resistors, Capacitors and Inductors is called as Passive Filter. The operating frequency range of the filter banks on the components used to build the circuit. Hence the filter can be further categorized based on the operating frequency of a particular circuit. They are:

- Low Pass Filter
- High Pass Filter
- Band Pass Filter
- Band Stop Filter
- All Pass Filter

● Low Pass Filters

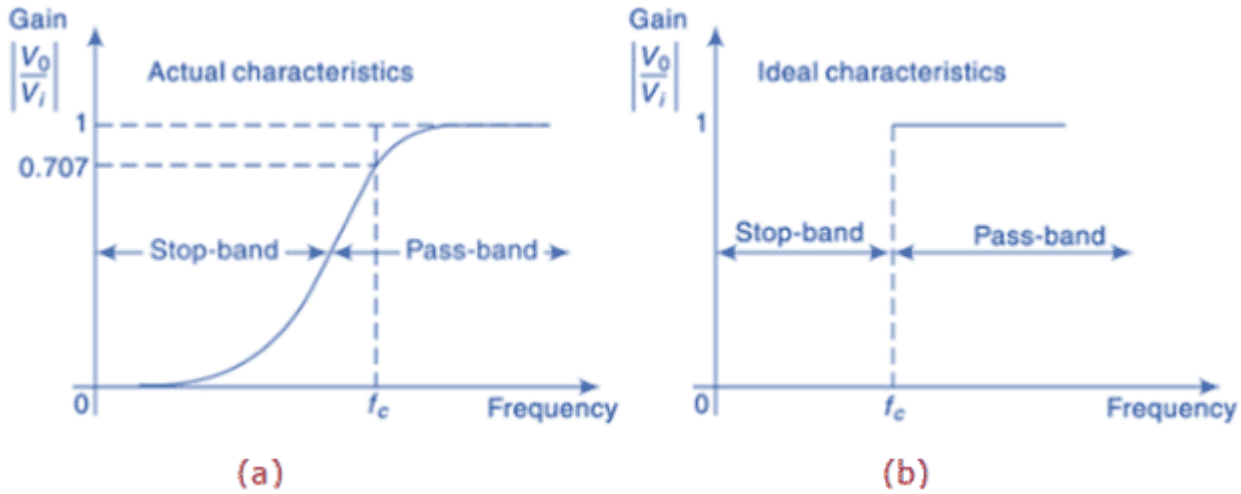
It is a type of Filter which attenuates all the frequencies above the cut-off frequencies. It provides a constant output (gain) from zero to cut-off frequency.



Low Pass Filter Characteristics (a) Actual (b) Ideal

- **High Pass Filters**

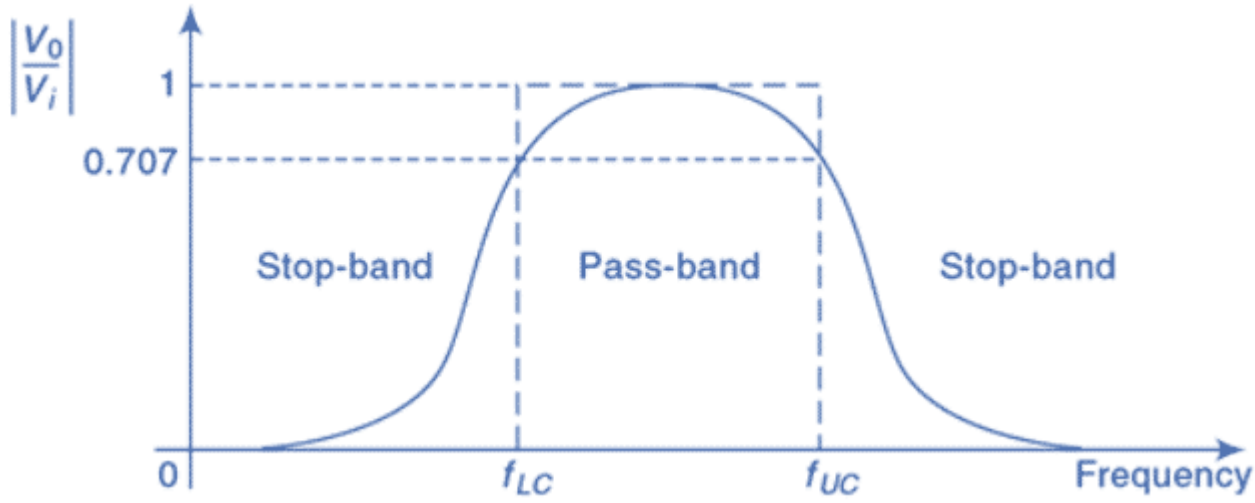
It is a type of Filter which attenuates all the frequencies below the cut-off frequencies. It provides a constant output (gain) above the cut-off frequency.



High Pass Filter Characteristics (a) Actual (b) Ideal

- **Band Pass Filters**

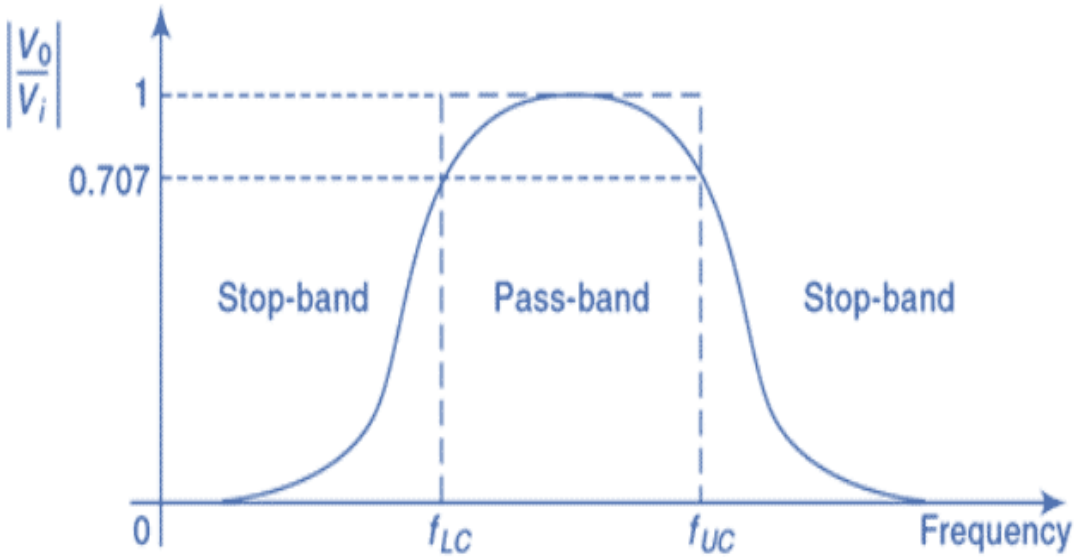
It is a type of filter which allows specific Band of frequencies to pass through and all other frequencies outside the band are attenuated.



Band Pass Filter Characteristics

- **Band Stop Filters**

Specific Band of frequencies gets rejected and allows passing of frequencies outside the Band.



Band Stop Filter Characteristics

- **All Pass Filters**

It is a type of filter which passes all frequencies equally. It is also known as Phase-Shift filter, time-delay filter as the output voltage shifts in phase with respect to input voltage but they are equal in magnitude.

Fig. 7 – All Pass Filter Characteristics

Applications of Filters

The applications include:

- Filter Circuits are used to eliminate background Noise
- They are used in Radio tuning to a specific frequency
- Used in Pre-amplification, Equalization, Tone Control in Audio Systems
- They are also used in Signal Processing Circuits and Data Conversion
- Filter Circuits are extensively used in Medical Electronic Systems

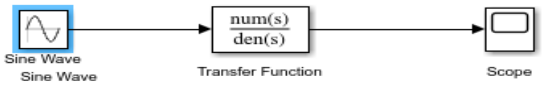
Advantages of Filters

The advantages are:

- They are economical or cost-effective
- Unlike passive filter circuits, Active Filter Circuits require power supply

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

I used a 100V amplitude with a frequency of 1Hz for the Sine Wave Source.



C. Determining the Cut-off frequency

The cut-off frequency is F= ½*(pi*R*C)

When R= 0.005Ω and C= 0.01F

F= 0.5*pi*0.005*0.01=3189.099 Hz

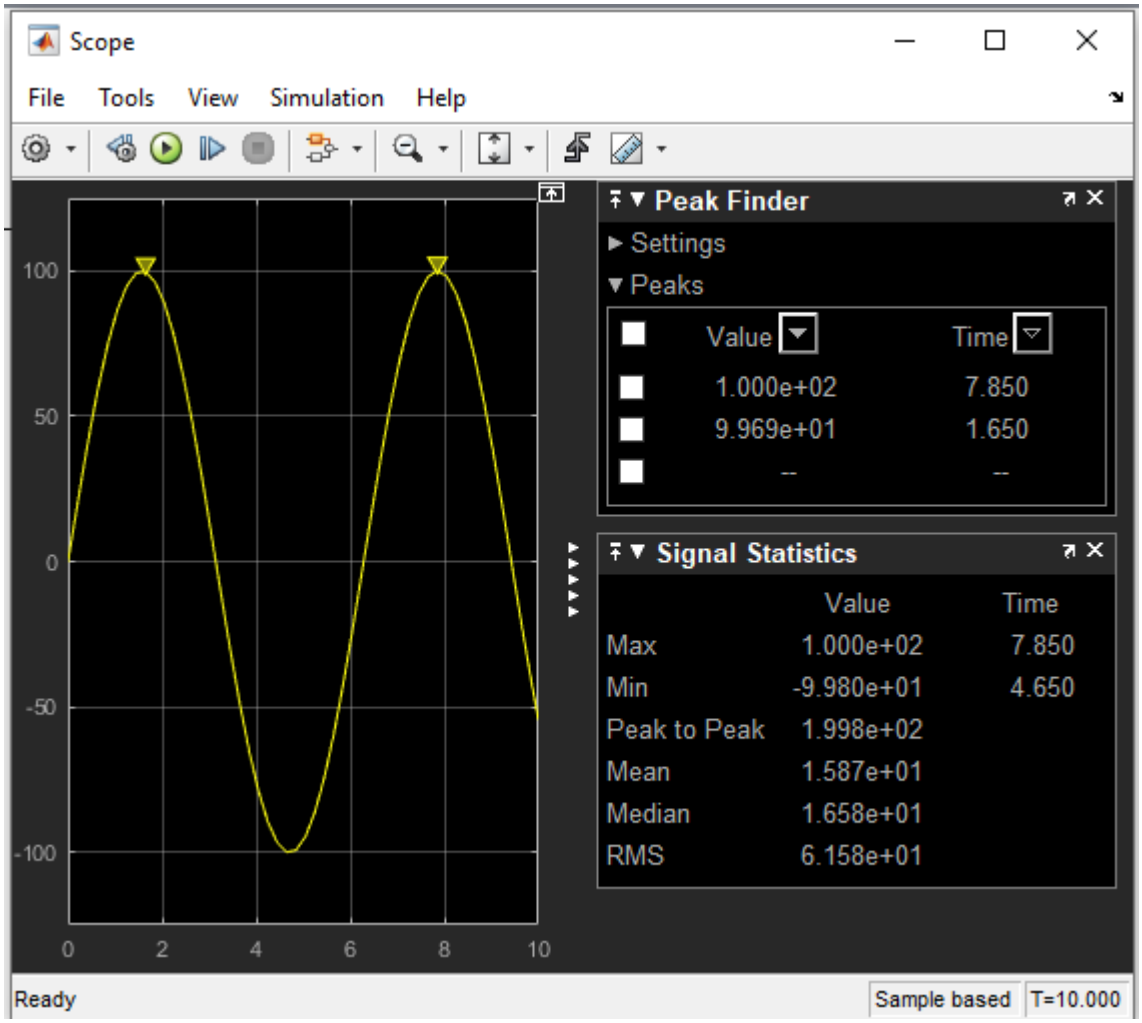
D. Design Output

The transfer function is:

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

When R= 0.005Ω and C= 0.01F

Transfer Fcn =(1/0.005*0.01)/(S + (0.005*0.01))= (20000)/(s+ 20000)



E. <u>If two signals of 5 KΩ and 2 KΩ are pass through the filter at different intervals. Discuss your observation</u>

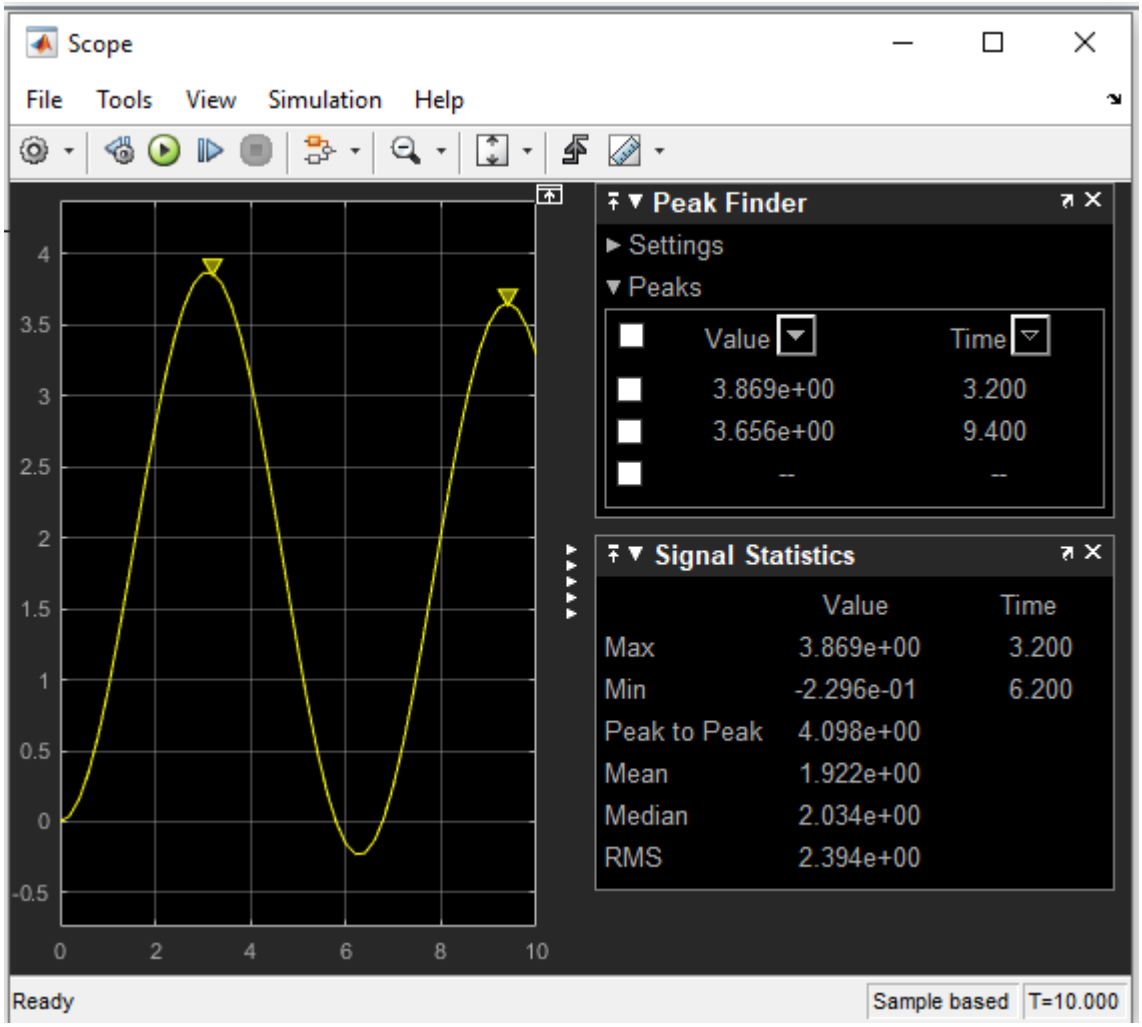
When the signal of 5 KΩ is passed through the filter, I arrived at;

The transfer function equation for the circuit is;

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

When R= 5000Ω and C= 0.01F

Transfer Fcn=(1/5000*0.01)/(S + (5000*0.01))= (0.02)/(s+ 0.02)



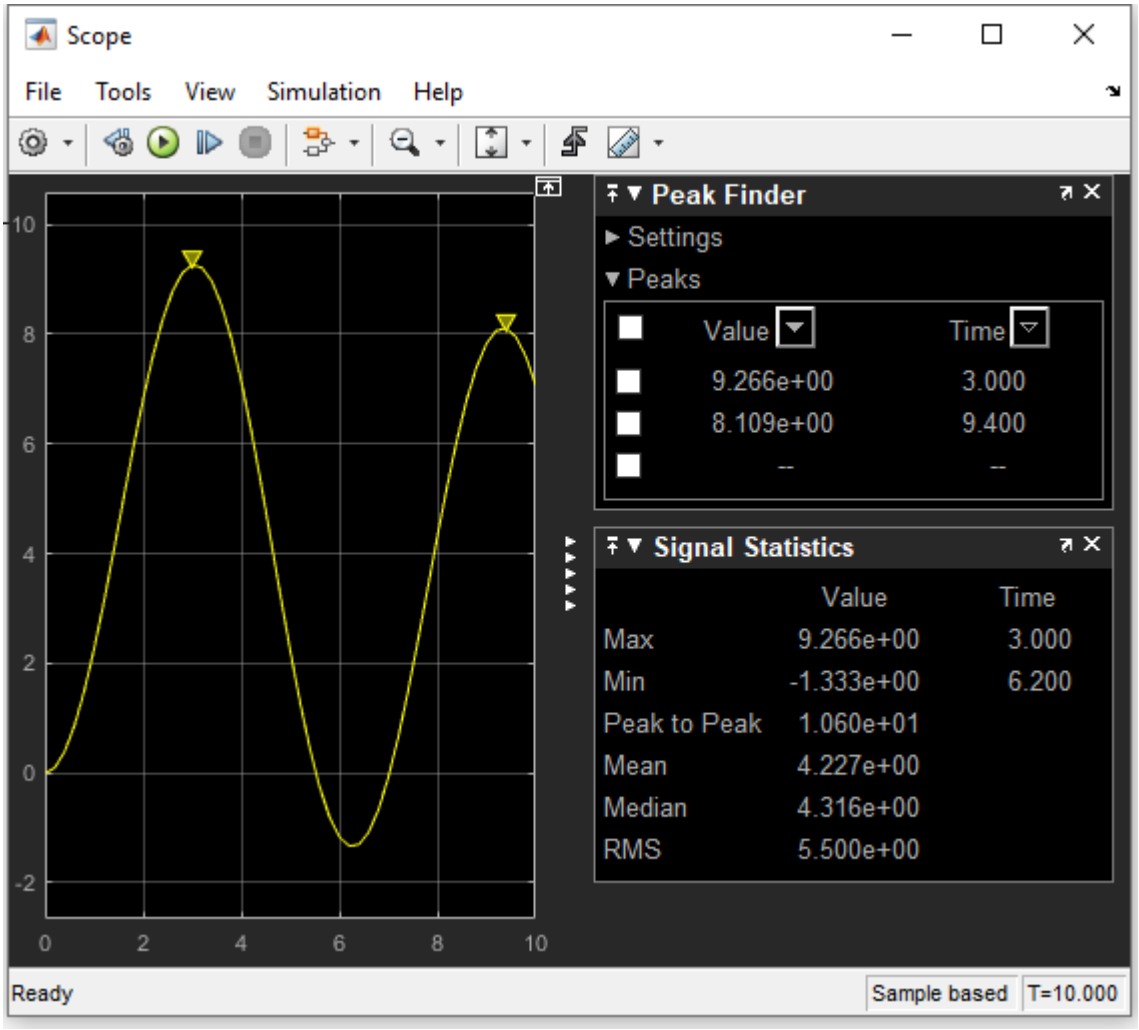
✓ **Observations:** The signal is reduced to 3.869 ohms

Eii. <u>When the signal of 2K ohms is passed through the filter the following results are obtained</u>: The transfer function equation for the circuit is;

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

When R= 2000Ω and C= 0.01F

Transfer Fcn=(1/2000*0.01)/(S + (2000*0.01))= (0.05)/(s+ 0.05)



✓ **Observations:** The signal is reduced by approximately 9.266 ohms