BAND ELIMINATION FILTER

As mentioned earlier, this filter is also called band stop filter or band reject filter. The action of this filter is exactly opposite to the band pass filter. This filter has two pass bands and one stop band. A band of frequencies is attenuated by this filter, hence the name band elimination filter.

also classified as :

i) Wide band reject filter and

ii) Narrow band reject filter.

The figure of merit (Q) for narrow band filter is greater than 10. In its frequency response, it shows a notch and hence, also called as notch filter. The bandwidth of the notch filter is very small as compared to wide band reject filter.

1. Wide Band Reject Filter

Similar to the wide band pass filter, this filter also consists of a high pass and low pass filter sections. Additionally, it consists of a summing amplifier. The Fig. 3.11.1 shows the circuit diagram of wide band reject filter.

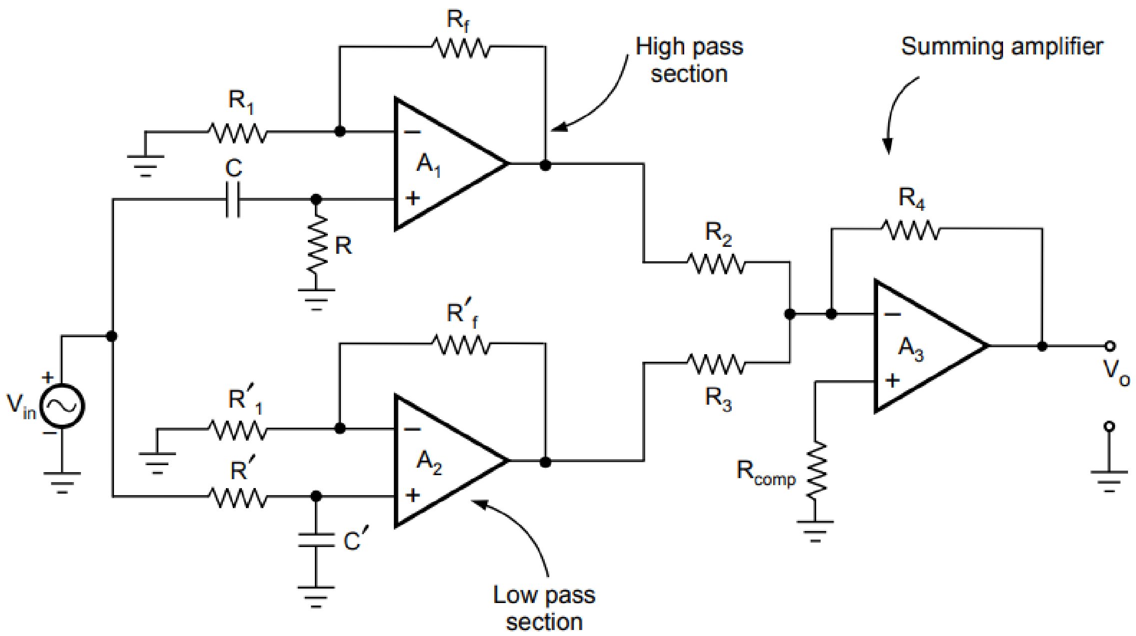

Fig. 3.11.1 Wide band reject filter

To have the satisfactory operation of this filter, it has to satisfy following two conditions :

i) The low cut-off frequency, f_L of high pass filter must be greater than the high cut-off frequency, f_H of low pass filter.

ii) The pass band gain of both high pass and low pass sections must be equal. The design of the overall filter is based on the individual design of the various sections.

The gain of the summing amplifier can be set to 1 for simplicity and thus,

$R_2 = R_3 = R_4 = R$ …. (3.11.1)

Hence, $R_{comp} = R_2 \parallel R_3 \parallel R_4 = R / 3$ …. (3.11.2)

Both high pass and low pass sections provide attenuation in the stop band between f_H and f_L. For $f < f_H$ the transmission is due to low pass section while for $f > f_L$, the transmission is due to high pass section. The frequency response for this type of filter is shown in Fig. 3.11.2.

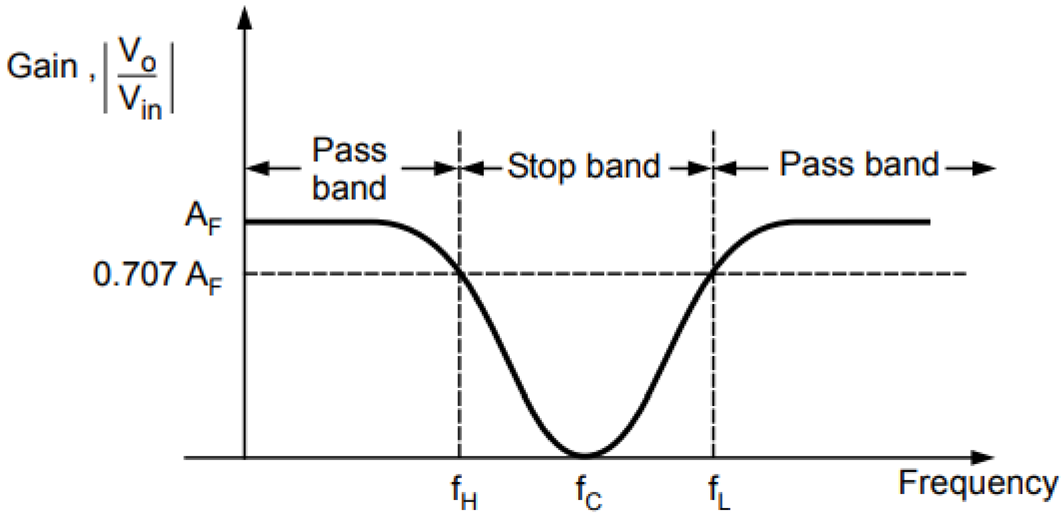

Fig. 3.11.2 Frequency response

The centre frequency, f_C is given by,

$f_C = \sqrt{f_H f_L}$

2. Narrow Band Reject Filter (Notch Filter)

The name of the filter i.e. Notch filter is due to the characteristics shape of its frequency response curve. The stop band of this filter is very narrow. The typical application of the notch filter is the rejection of a single frequency, such as 50 Hz power line frequency hum. It is also used in the biomedical instrumentation and also blanking of control tones for telephone lines. Thus, particular unwanted frequency can be eliminated using this filter.

The passive circuit used to obtain the notch filter is the twin T network as shown in Fig. 3.11.3.

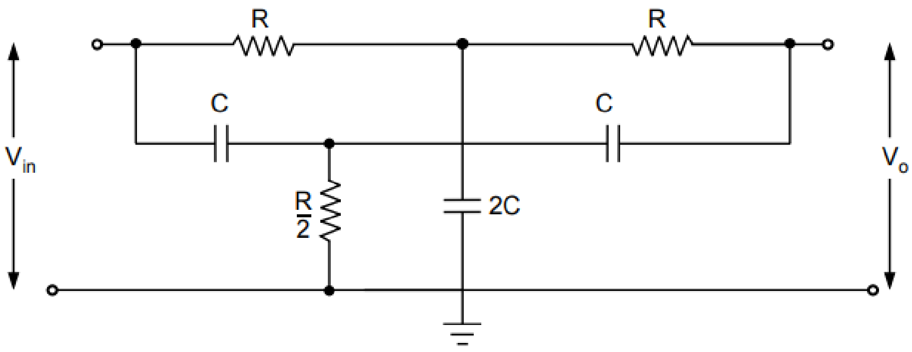

Fig. 3.11.3 Twin T network

It consists of two T networks. One consists of two resistors and a capacitor while other consists of two capacitors and one resistor.

The notch out frequency is the frequency at which the maximum attenuation occurs. This is given by

$f_N = 1 / 2\pi RC$ … (3.11.3)

The value of Q i.e. figure of merit for the passive network is very low, hence an active notch filter which uses twin T network is preferred in practice. This is shown in Fig. 3.11.4.

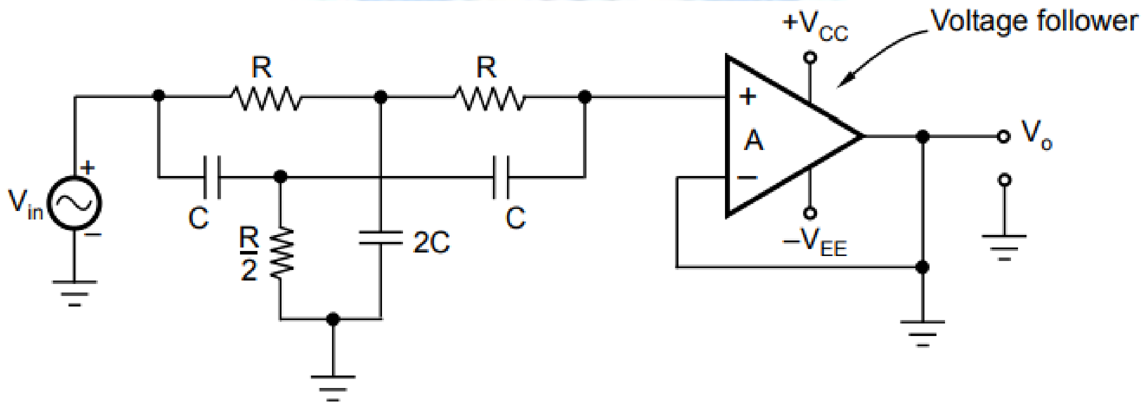

Fig. 3.11.4 Active notch filter

To design a notch filter, to eliminate the specific notch frequency, f_N choose the capacitor C less than or equal to μF. Then, calculate the value of R using equation (3.11.3). To obtain best performance of the circuit, the components designed should have precise values which are close to their designed values. The frequency response of the notch filter is shown in the Fig. 3.11.5. Fig.

3.11.5 (a) shows the ideal response while the Fig. 3.11.5 (b) shows the practical response.

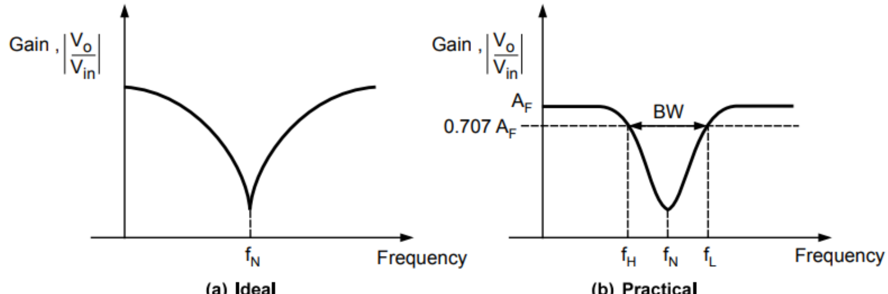

Fig. 3.11.5 Frequency response