Notch filters: A Notch filter is a special form Band reject filters. Instead of removing the entire range of frequencies, it only removes selective foraquency components.

It is used to remove periodic noise and ringing effects. and also removes the electrical interference caused by electrical disturbance.

Figure (1)

(ii) **Notch Filter:** A notch filter is one of the most widely used selective filters.

The coordinates of notch filters should be symmetric about the origin. [i.e., a notch with center (u_0, v_0) must have a symmetric (Mirror image) notch with center $(-u_0, -v_0)$].

The expression for notch reject filter is given as,

$$H_{NR}(u, v) = \prod_{K=1}^{Q} H_K(u, v)\, H_{-K}(u, v)$$

Where,

$H_K(u, v)$ – High pass filter with centre (u_k, v_k)

$H_{-K}(u, v)$ – High pass filter with centre $(-u_k, -v_k)$

In general terms, notch reject filter is given as the product of high pass filter with notch centre (u_k, v_k) and translated notch centre $(-u_k, -v_k)$.

So, the distance from the point (u, v) is the frequency domain to the centre $(M/2, N/2)$ is given as,

$$D_K(u, v) = [(u - M/2 - u_k)^2 + (u - N/2 - v_k)^2]^{1/2}$$

$$D_{-K}(u, v) = [(u - M/2 + u_k)^2 + (v - N/2 + v_k)^2]^{1/2}$$

If three notch pairs are connected together, then expression for butterworth notch reject filter is given as,

$$H_{NR}(u, v) = \prod_{k=1}^{3}\left[\frac{1}{1 + \left[\frac{D_{0k}}{D_k(u, v)}\right]^{2n}}\right]\left[\frac{1}{1 + \left[\frac{D_{0k}}{D_{-k}(u, v)^{2n}}\right]}\right]$$

Where,

D_{0k} – Constant.

The value of D_{0k} is same for same pair of notches and different for different pair of notches. Notch pass filter can be obtained by the notch reject filter using the expression given below:

$$H_{NP}(u, v) = 1 - H_{NR}(u, v)$$

Where,

$H_{NP}(u, v)$ - Notch pass filter

$H_{NR}(u, v)$ - Notch reject filter.

The notch filters are used to provide high attenuation and to eliminated the bursts occurring in an image.

The notch filters are majorly used in Raman spectroscopy, to suppress the laser beams in the experiments.