Example 2.8:

An FM modulator is operating with a peak frequency deviation $\Delta f = 20$ kHz. The modulating signal frequency, f_m is 10kHz, and the 100 kHz carrier signal has an amplitude of 10 V. Determine :

a) The minimum bandwidth using Bessel Function table.

b) The minimum bandwidth using Carson's Rule.

Sketch the frequency spectrum for (a), with actual amplitudes.

Solution :

a) From equation (2.24), $BW_{FM} = 2 \times n \times f_m$

Modulation index , $m_f = \Delta f / f_m$

$= 20k / 10k$

$= \underline{2.0}$

So , from Bessel Function table, at $m_f = 2.0$, number of sideband, n is 4, giving,

$$BW_{FM} = 2 \times 4 \times 10k$$
$$= \underline{80 \text{ kHz}}$$

b) From equation (25), using Carson's rule,

$$BW_{FM} = 2[\ \Delta f + f_m\ ] \text{ Hz}$$
$$= \underline{60 \text{ kHz}}$$

The frequency spectrum,