Question 15.7:

For an amplitude modulated wave, the maximum amplitude is found to be 10 V while the minimum amplitude is found to be 2 V. Determine the modulation index μ. What would be the value of μ if the minimum amplitude is zero volt?

Answer

Maximum amplitude, A_{max} = 10 V

Minimum amplitude, A_{min} = 2 V

Modulation index μ, is given by the relation:

$$\mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$$

$$= \frac{10-2}{10+2} = \frac{8}{12} = 0.67$$

If $A_{min} = 0$,

$$\text{Then } \mu' = \frac{A_{max}}{A_{max}} = \frac{10}{10} = 1$$

Question 15.8:

Due to economic reasons, only the upper sideband of an AM wave is transmitted, but at the receiving station, there is a facility for generating the carrier. Show that if a device is available which can multiply two signals, then it is possible to recover the modulating signal at the receiver station.

Answer

Let ω_c and ω_s be the respective frequencies of the carrier and signal waves.

Signal received at the receiving station, $V = V_1 \cos(\omega_c + \omega_s)t$

Instantaneous voltage of the carrier wave, $V_{in} = V_c \cos \omega_c t$

$$\therefore V V_{in} = V_1 \cos(\omega_c + \omega_s)t.(V_c \cos \omega_c t)$$

$$= V_1 V_c \left[\cos(\omega_c + \omega_s)t.\cos \omega_c t\right]$$

$$= \frac{V_1 V_c}{2}\left[2\cos(\omega_c + \omega_s)t.\cos \omega_c t\right]$$

$$= \frac{V_1 V_c}{2}\left[\cos\{(\omega_c + \omega_s)t + \omega_c t\} + \cos\{(\omega_c + \omega_s)t - \omega_c t\}\right]$$

$$= \frac{V_1 V_c}{2}\left[\cos\{(2\omega_c + \omega_s)t + \cos \omega_s t\}\right]$$

At the receiving station, the low-pass filter allows only high frequency signals to pass through it. It obstructs the low frequency signal ω_s. Thus, at the receiving station, one can record the modulating signal $\frac{V_1 V_c}{2}\cos \omega_s t$, which is the signal frequency.

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