Communication Systems

Lecture - 7

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Amplitude Modulation (AM) :

When a modulating wave is superimposed on a high frequency wave as such the frequency and phase of the carrier wave remains constant but the amplitude of the carrier wave changes in accordance with the modulating wave that is called amplitude modulation.

Let the instantaneous carrier voltage ec and modulating voltage em be represented by

$$e_c = E_c \cos \omega_c t \quad (1)$$

$$e_m = E_m \cos \omega_m t \quad (2)$$

The amplitude modulated wave is given by

$$e_{mod} = (E_c + k e_m) \cos \omega_c t \quad (3)$$

where k is a constant of proportionality

$$e_{mod} = E_c \ (1+ \ k E_m / E_c \ \cos \omega_m t \ ) \cos \omega_c t \qquad (4)$$

In amplitude modulation proportionality constant constant is considered to be unity

$$e_{mod} = E_c \ (1+ \ m \cos \omega_m t \ ) \cos \omega_c t$$

$$e_{mod} = E_c \cos \omega_c t \ + m E_C \cos \omega_m t \cos \omega_c t$$

In amplitude modulation proportionality constant constant is considered to be unity

$$e_{mod} = E_c \ (1+ \ m \ Cos\omega_m \ t \ )Cos \ \omega_c \ t$$

$$e_{mod} = E_c \cos \omega_c \ t \ + m \ E_C \ Cos\omega_m \ t \cos \ \omega_c \ t$$

$$e_{mod} = E_c \cos \omega_c \ t \ + m \ E_C /2 \ [Cos \ (\omega_c \ + \omega_m \ )t/2 + Cos \ (\omega_c \ - \omega_m \ )t/2 \ ]$$

(5)

where $m = E_m / E_c$ is called depth of modulation or modulation index or modulation factor .

$$E_m = (E_{max} - E_{min}) / 2 \qquad (6)$$

and $E_c = E_{max} - Em$

$$= E_{max} - (E_{max} - E_{min}) / 2$$

$$E_c = (E_{max} + E_{min}) / 2 \qquad (7)$$

Modulation Index or Depth of modulation or modulation factor

It is defined as the ratio between amplitude of modulating signal to the amplitude of carrier wave i.e,

$$m = E_m / E_c = (E_{max} - E_{min}) / (E_{max} + E_{min}) \qquad (8)$$

Depth of modulation determines the quality of the transmitted signal . When modulation index is small , variation in carrier amplitude will be small . Therefore , audio signal being transmitted will be weak . As the modulation index increases , the audio signal on reception becomes clear.