K. Shiva sai
19BD1A0482

ADC Assignment-4

1 Difference between amplitude and angle modulation.

A Difference between amplitude and angle modulation:

→ main differences between amplitude modolation and Angle modulation are.

i) zero crossing spacing of angle modulation no longer has a perfect regularity as amplitude modulation does.

ii) Angle modulated signal has constant envelope; yet, the enevelope of amplitude modulated signal is dependent on the message signal

Advantages:-

i) Noise reduction

ii) improved system fidelity

iii) more efficient use of power

Disadvantages:-

i) Increased bandwidth

ii) use of more compler circuits.

Advantage over AM:-

→ freedom from interference: all natural and external noise consist of amplitude variation, thus receiver usually can't distinguish between amplitude of noice or desired signal Amis noisy than Fm.

→ operate in very high frequency band (VHF). 88MHz-108MHz

→ can transmit musical programs with higher degree of fidelity.

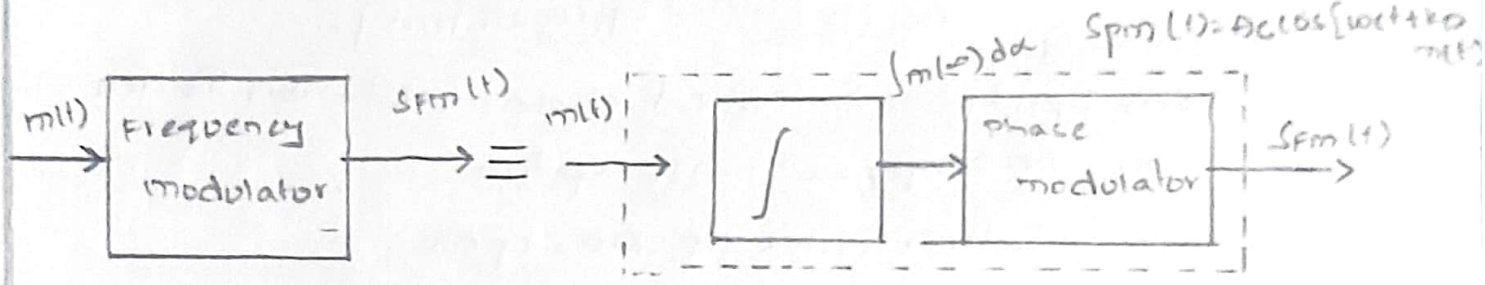
Frequency relationship between PM and FM

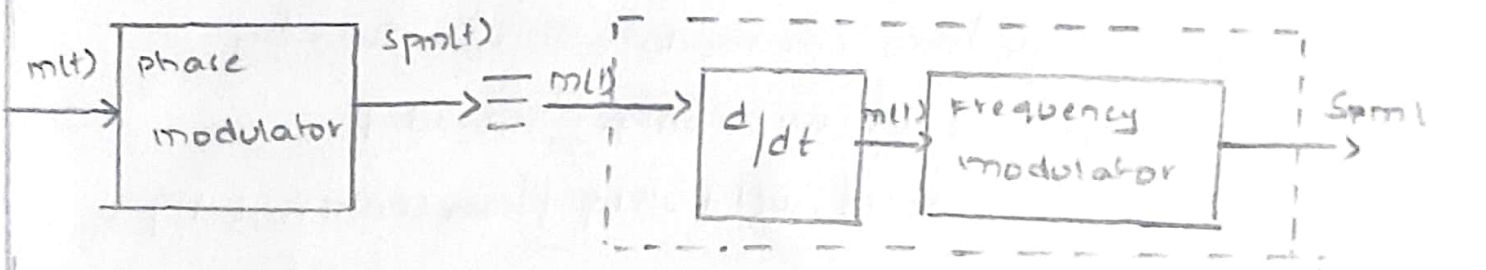
Relationship between PM and FM

-> Equations $S_{PM}(t)$ and $S_{FM}(t)$ show that in both PM and FM, the angle of a carrier is varied in proportion to some measure of m(t)

-> In PM: Directly proportional to m(t)

-> In FM: Directly proportional to integral of m(t).





$S_{FM}(t) = A_c \cos[\omega_c t + 2\pi k_f \int_{-\infty}^{t} m(\alpha)\,d\alpha]$

Frequency Relationship between PM and FM:

-> Expressions for PM wave is $s(t) = A\cos[\omega_c t + k_p x(t)]$

-> Expression for FM wave: $s(t) = A\cos[\omega_c t + k_f \int_0^t x(t)\,dt]$

-> In PM, the phase angle varies linearly with base band signal x(t)

-> In FM phase angle varies linearly with the integral of baseband signal x(t)

-> Thus, PM can be obtained from FM and the converse is also true.

3) Single tone angle modulation (PM and FM) derivation

A (a) Single tone angle modulation:-

Let a message signal $m(t) = A_m \cos 2\pi f_m t$

the phase modulated signal is represented by $S_{PM}(t) =$

$S_{pm}(t) = A_c \cos[\omega_c t + k_{pm} m(t)]$

For a single tone modulating signal, the pm wave is represented by

$$S_{pm}(t) = A_c \cos[\omega_c t + k_{pm} \cos 2\pi f_m t]$$
$$= A_c \cos[\omega_c t + \beta_p \cos 2\pi f_m t]$$

Where $\beta_p = k_p A_m$ is called phase modulation index phase deviation $\Delta\theta = k_{pmax}\{m(t)\} = k_p A_m$

Phase deviation index $\beta_p = \Delta\theta = k_p A_m$

b) Single tone angle modulation (FM):

for a single tone FM modulation is given by

$$S_{FM}(t) = A_c \cos[\omega_c t + 2\pi k_f \int_{-\infty}^{t} m(\alpha) d\alpha]$$
$$= A_c \cos[\omega_c t + 2\pi k_f \int_{-\infty}^{t} A_m \cos 2\pi f_m t \, dt]$$
$$= A_c \cos[\omega_c t + \frac{2\pi k_f A_m}{2\pi f_m} \sin 2\pi f_m t]$$
$$= A_c \cos[\omega_c t + \beta_f \sin 2\pi f_m t]$$

Where $\beta_f = \frac{k_f A_m}{f_m} = \frac{\Delta f}{f_m}$ is called frequency modulation index and where $\Delta f = k_f A_m$ is known as frequency deviation

Brief summary

Phase modulation: $PM = A_c \cos[\omega_c t + \beta_p \cos 2\pi f_m t]$

Phase modulation: index $\beta_p = k_p A_m$

Phase deviation $\Delta\theta = k_p A_m$.

Frequency modulation: $f_m = A_c \cos[\omega_c t + \beta_f \cos 2\pi f_m t]$

Frequency modulation index $\beta_f = \frac{k_f A_m}{f_m} = \frac{\Delta f}{f_m}$;

frequency deviation $\Delta f = k_f A_m$

4 Define:

i) modulation index ii) Deviation ratio iii) Percentage MI of FM
iv) Carsons rule v) pre-emphasis vi) De-emphasis.

A modulation index:- modulation index is defined as the ratio of frequency deviation (δ) to the modulating frequency (f_m)

$$m.I = \frac{\text{frequency deviation}}{\text{modulating frequency}}$$

$$m_f = \delta / f_m$$

ii Deviation Ratio:- the modulation index corresponding to maximum deviation and maximum frequency is called deviation ratio

$$\text{Deviation ratio} = \frac{\text{maximum deviation}}{\text{maximum modulating frequency}}$$

$$= \frac{\delta_{max}}{f_{max}}.$$

In FM broadcasting the maximum value of deviation is limited to 75kHz. the maximum modulating frequency is also limited to 15kHz.

iii Percentage m.i of FM:-

the percentage modulation is defined as the ratio of the actual frequency deviation produced by the modulating signal to the maximum allowable frequency deviation

$$\%\ M.I = \frac{\text{actual deviation}}{\text{maximum allowable deviation.}}$$

iv Carson's role:-

Carson's role state that, the bandwidth of FM wave is twice the sum of deviation and highest modulating frequency

$$BW = 2(f + f_{m\,max})$$

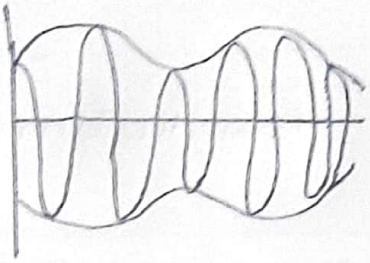
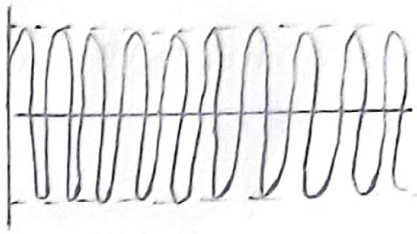
v Pre-emphasis:-

the artificial boosting of higher audio modulating frequencies in accordance with prearranged response curve is called pre-emphasis.

vi De-emphasis:-

- De-emphasis circuit is used at FM receiver
- the artificial in accordance boosting of higher modulating frequencies in the process of pre-emphasis is nullified at receiver by process called de-emphasis.

5 Compare AM and FM.

Parameter	AM	FM
1. Definition	Amplitude of carrier is varied in accordance with amplitude of modulating signal keeping frequency and phase constant	Frequency of carrier is varied in accordance with the amplitude of modulating signal keeping amplitude and phase constant.
2. Constant Parameter	Frequency and phase.	Amplitude and phase.
3. modulated signal		
4. modulation signal	$m = \frac{Em}{Ec}$	$m = \delta / fm$
5. No. of sidebands	only two	Infinite and depends on mf
6) Bandwidth	$BW = 2fm$	$BW = 2(\delta + fm(max))$
7) Application	MW, SW band broadcasting video transmission in TV	Broadcasting FM audio transmission in TV.

7

6 Compare NBFM and WBFM.

A:

	WBFM	NBFM
1.	modulating index is greater than 1 ($B>1$)	modulation index is less than 1 ($B<1$)
2.	Frequency deviation 75KHz	Frequency deviation = 5KHz.
3.	modulating frequency range from 30Hz - 15KHz	modulation frequency = 3KHz
4.	Bandwidth 15times NBFM	Bandwidth = $2f_m$.
5.	Noise is more suppressed use: entertainment and broadcasting	less suppressing of noise use: mobile communication.