

UNIT II

ANGLE MODULATION SCHEMES

1. Define Angle Modulation.

The other type of modulation in continuous-wave modulation is **Angle Modulation**. Angle Modulation is the process in which the frequency or the phase of the carrier signal varies according to the message signal.

2. Define Frequency Modulation.

In amplitude modulation, the amplitude of the carrier signal varies. Whereas, in **Frequency Modulation (FM)**, the frequency of the carrier signal varies in accordance with the instantaneous amplitude of the modulating signal. Hence, in frequency modulation, the amplitude and the phase of the carrier signal remains constant

3. What are the features of Narrow Band FM?

Following are the features of Narrowband FM.

- This frequency modulation has a small bandwidth when compared to wideband FM.
- The modulation index β , β is small, i.e., less than 1.
- Its spectrum consists of the carrier, the upper sideband and the lower sideband.
- This is used in mobile communications such as police wireless, ambulances, taxicabs, etc.

4. What are the features of Wide Band FM?

Following are the features of Wideband FM.

- This frequency modulation has infinite bandwidth.
- The modulation index β is large, i.e., higher than 1.
- Its spectrum consists of a carrier and infinite number of sidebands, which are located around it.
- This is used in entertainment, broadcasting applications such as FM radio, TV, etc.

5. Define Phase Modulation.

In frequency modulation, the frequency of the carrier varies. Whereas, in **Phase Modulation (PM)**, the phase of the carrier signal varies in accordance with the instantaneous amplitude of the modulating signal. So, in phase modulation, the amplitude and the frequency of the carrier signal remains constant.

6. Write Formula to calculate modulation index of FM wave.

$$\beta = \text{modulation index} = \Delta f / f_m = k_f A_m / f_m$$

7. Write Formula to calculate bandwidth of an FM wave.

$$\text{Band Width} = 2(\beta + 1) f_m$$

8. What is Principle in Direct method of FM generation?

This method is called as the Direct Method because we are generating a wide band FM wave directly. In this method, Voltage Controlled Oscillator (VCO) is used to generate WBFM. VCO produces an output signal, whose frequency is proportional to the input signal voltage. This is similar to the definition of FM wave.

9. What is Principle in Indirect method of FM generation?

This method is called as Indirect Method because we are generating a wide band FM wave indirectly. This means, first we will generate NBFM wave and then with the help of frequency multipliers we will get WBFM wave.

10. What are the different methods of FM detectors?

1. Balanced Discriminator
2. Foster-Seeley discriminator
3. Ratio Detector
4. Slope Detector

11. What are the advantages and Disadvantages of Ratio Detector?

Advantages:

Simple to construct using discrete components

Offers good level of performance and reasonable linearity

Disadvantages:

- High cost of transformer
- Typically lends itself to use in only circuits using discrete components and not integrated within an IC.

12. Write standard equation for an FM wave?

$$s(t) = A_c \cos\left(2\pi f_c t + 2\pi k_f \int m(t) dt\right)$$

This is the **equation of FM wave**.

If the modulating signal is $m(t) = A_m \cos(2\pi f_m t)$, then the equation of FM wave will be

$$s(t) = A_c \cos(2\pi f_c t + \beta \sin(2\pi f_m t))$$

13. Write standard equation for a PM wave?

$$s(t) = A_c \cos(2\pi f_c t + k_p m(t))$$

This is the **equation of PM wave**.

If the modulating signal, $m(t) = A_m \cos(2\pi f_m t)$, then the equation of PM wave will be

$$s(t) = A_c \cos(2\pi f_c t + \beta \cos(2\pi f_m t))$$

Where,

- $\beta = \text{modulation index} = \Delta\phi = k_p A_m$
- $\Delta\phi$ is phase deviation

14. What are the advantages and Disadvantages of Slope Detector?

Advantages:

- Simple - can be used to provide FM demodulation when only an AM detector is present.
- Enables Fm to be Detected without any additional circuitry

Disadvantages:

- Not linear as the output is dependent upon the curve of a filter
- Not particularly effective as it relies on centering the signal part of the way down the filter curve where signal strengths are less
- Both frequency and amplitude variations are accepted and therefore much higher levels of noise and interference are experienced

15. Define Pre-Emphasis?

Signals with higher modulation frequencies have lower SNR, In order to compensate this, the high frequency signals are emphasized or boosted in amplitude at the transmitter section of a communication system prior to the modulation process. That is, the pre emphasis network allows the high frequency modulating signal to modulate the carrier at higher level, this causes more frequency deviation

16. Define De-Emphasis?

De emphasis is the inverse process of preemphasis, used to attenuate the high frequency signal that is boosted at the transmitter section. The de-emphasis network at the receiver section restores the original amplitude Vs frequency characteristics of the information signal, after the demodulation process. The preemphasis and deemphasis produces a more uniform SNR throughout the modulating signal frequency spectrum.

17. Define Capture Effect.

In **telecommunications**, the **capture effect**, or **FM capture effect**, is a phenomenon associated with **FM** reception in which only the stronger of two signals at, or near, the same **frequency** or channel will be **demodulated**. The capture effect is defined as the complete suppression of the weaker signal at the **receiver limiter** (if it has one) where the weaker signal is not **amplified**, but **attenuated**. When both signals are nearly equal in strength, or are **fading** independently, the receiver may **switch** from one to the other and exhibit **picket fencing**. The capture effect can occur at the signal limiter, or in the **demodulation** stage, for circuits that do not require a signal limiter. Some types of **radio receiver circuits** have a stronger capture effect than others.

18. Define Deviation Ratio.

Accordingly the FM deviation ratio can be defined as: the ratio of the maximum carrier frequency deviation to the highest audio modulating frequency.

$$m = \text{Max frequency deviation} / \text{Max modulation frequency}$$

19. Write Advantages and Disadvantages of Foster-Seeley FM discriminator.

Advantages:

- Offers good level of performance and reasonable linearity.
- Simple to construct using discrete components.
- Provides higher output than the ratio detector
- Provides a more linear output, i.e. lower distortion than the ratio detector

Disadvantages:

- Does not easily lend itself to being incorporated within an integrated circuit.
- High cost of transformer.
- Narrower bandwidth than the ratio detector

20. What are the Eigen values of modulation index where carrier component will disappear in FM.

Eigen values of modulation index are 2.4, 5.5, 8.6, 11.8, and so on.