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EC 42 COMMUNICATION THEORY
2 MARKS QUESTIONS & ANSWERS

UNIT-I AMPLITUDE MODULATION SYSTEMS

1. What is communication?

Communication is the process of conveying or transferring messages from one

Point to another.

2. Define modulation?

Modulation is a process by which some characteristics of high frequency carrier signal is varied in accordance with the instantaneous value of another signal called modulating signal.

3. What are the types of modulation?

Amplitude modulation, Frequency modulation, Phase modulation.

4. Define depth of modulation(or)modulation index.

It is defined as the ratio between message amplitude to that of carrier amplitude.

$m_a = V_m/V_c$

5. What are the degrees of modulation?

Under modulation. $m<1$

Critical modulation $m=1$

Over modulation $m>1$

6. If a 10KW amplitude modulated transmitter is modulated

Sinusoidally by 50%, what is the total RF power delivered?

$m_a = 50/100 = 0.5; P_c = 10$ kw

$$Pt=Pc(1+m^2/2)$$

$$=11.25kw$$

7. Define demodulation.

Demodulation or detection is the process by which modulating voltage is recovered from the modulated signal. It is the reverse process of modulation.

8. Define Amplitude modulation?

Amplitude modulation is the process by which amplitude of the carrier signal is varied in accordance with the instantaneous value of the modulating signal but frequency and phase of carrier wave is remains constant.

9. Define Frequency modulation?

Frequency modulation is the process by which frequency of the carrier signal is varied in accordance with the instantaneous value of the modulating signal.

10. Define phase modulation?

Phase modulation is the process by which Phase angle of the carrier signal is varied in accordance with the instantaneous value of the modulating signal.

11. As related to AM what is over modulation, under modulation and

100% modulation?

(OR)

When does a carrier is said to be over, under modulated in Amplitude modulation?

In the case of Under modulation, modulation index $m_a<1$(i.e.)$V_m<V_c$ .Here the envelope of Amplitude modulated signal does not reach the Zero amplitude axis. Hence the Message signal is fully preserved in the envelope of the AM Wave. In the case of Over modulation, modulation index $m_a>1$(i.e.)$V_m>V_c$. Here the envelope of Amplitude modulated signal crosses the zero axis.

In the case critical modulation modulation index $m_a=1$(i.e.)$V_m=V_c$ .Here the envelope of the modulated signal just reaches the zero amplitude axis. The message signal remains preserved.

12. What is the power saving in DSB-SC-AM and SSB-SC AM?

Power saving in DSB-SC-AM is 66.7%.

Power saving in SSB-SC-AM is 83.3%.

13. What are the advantages of VSB-AM?

It has bandwidth greater than SSB but less than DSB system. Power transmission greater than DSB but less than SSB system. No low frequency component lost. Hence it avoids phase distortion.

14. How will you generating DSB-SC-AM?

(OR)

Give the two methods of generating DSB-SC-AM.

There are two ways of generating DSBSC-AM such as

1. balanced modulator 2.ring modulators

15. Compare linear and non-linear modulators.

Sl.no	Linear modulators	Non-Linear modulators
1	Heavy filtering is not required.	Heavy filtering is required
2	These modulators are used in high level modulation.	These modulators are used in low level Modulation.
3	The carrier voltage is very much greater than modulating signal voltage.	The modulating signal voltage is very much greater than the carrier signal voltage.

16. What are advantages of ring modulator?

1. Its output is stable.
2. It requires no external power source to activate the diodes.
3. Virtually no maintenance.
4. Long life.

17. What are the advantages of DSB-SC and SSB-SC.

DSB-SC:

Suppression of carrier results in economy of power. It is commonly used in carrier current telephony system, in which one sideband is filtered out to reduce the width of the channel required for transmission.< strong> It offers secrecy. It increases the efficiency because the carrier is suppressed. SSB-SC Bandwidth of SSB is half that of DSB-SC AM. Thus twice the number of channels can be accommodated at a given frequency spectrum No carrier is transmitted, hence possibility of interference with other channels are avoided. It eliminates the possibility of fading. Fading occurs due to multipath propagation of electro-magnetic waves.

18. Give the methods of generating SSB-SC-AM. And mention Some applications of SSB-SC

The two methods of generating the SSB-SC waves are Frequency discrimination or Filter method.

Phase discrimination method.

Applications:

Police Wireless communication.

SSB telegraph system

Point to point radio telephone communication VHF and UHF communication systems.

19. What are the types of AM modulators?

There are two types of AM modulators. They are

Linear modulators

Non-linear modulators

Linear modulators are classified as follows

Transistor modulator

There are three types of transistor modulator.

Collector modulator

Emitter modulator

Base modulator

Switching modulators

Non-linear modulators are classified as follows

Square law modulator

Product modulator

Balanced modulator

20. What is single tone and multi tone modulation?

If modulation is performed for a message signal with more than one frequency component then the modulation is called multi tone modulation. If modulation is performed for a message signal with one frequency component then the modulation is called single tone modulation.

21. What is the need for modulation?

Needs for modulation:

Ease of transmission

Multiplexing

Reduced noise

Narrow bandwidth

Frequency assignment

Reduce the equipments limitations

22. Compare AM with DSB-SC and SSB-SC.

AM signal	DSB-SC	SSB-SC
Bandwidth=2f m	Bandwidth=2f m	Bandwidth=f m
Contains USB, LSB, carrier	Contains USB,LSB	Contains LSB or USB
More power is required for transmission	Power required is less than that of AM.	

Power required is less than AM

&DSB-SC

23. What are the types of AM detectors?

1. Nonlinear detectors

2. Linear detectors

24. What are the types of linear detectors?

1. Synchronous or coherent detector.

2 .Envelope or non coherent detector.

25. A transmitter supplies 8 Kw to the antenna when modulated.

Determine the total power radiated when modulated to 30%.

$m_a = 30/100 = 0.3; P_c = 8$ kw

$P_t = P_c(1 + m_a^2/2)$

$= 8.36$ kw

26. The antenna current of an AM transmitter is 8A when only carrier is sent. It increases to 8.93A when the carrier is modulated by a single sine wave. Find the percentage modulation.

Solution:

Given: $I_c = 8A$ $I_t = 8.93A$ $m = 0.8$

Formula: $I_t = I_c (1 + m^2/2)^{1/2}$

$8.93 = 8(1 + m^2/2)^{1/2}$

$m = 0.701$

$I_t = 8 (1 + 0.8^2/2)^{1/2}$

$I_t = 9.1A$

27. A 1MHz carrier is amplitude modulated by 400Hz modulating signal to a depth of 50%.The modulated carrier power is 1KW.Calculate the power of the unmodulated signal.

Solution:-

$P_c = 1KW$, $m_a = 0.5 = 50\%$

The increase in power is given by 1.125-1=0.125KW is contained in two side bands.

28. What do you mean by Hibert transform and inverse Hilbert

Transform? And write few applications of Hilbert transform?

 It may be observed that the function x h (t) obtained by providing(-Π/2)phase shift to every frequency component present in x(t),actually represents the Hilbert transform of x(t).This means that x h (t) is the Hilbert transform of x(t) defined as

Also, the inverse Hilbert transform is defined as

 Few applications of Hilbert transform.

 For generation of SSB signals,

 For designing of minimum phase type filters,

 For representation of band pass signals.

29. Define multiplexing.

Multiplexing is defined as the process of transmitting several message signals simultaneously over a single channel.

30.Define sensitivity,Selectivity,Stability.

 Sensitivity is defined as a measure of its ability to receive weak signals. Selectivity of a receiver is defined as its ability to select the desired signals among the various signals. and Stability is the ability of the receiver to deliver a constant amount of output for a given a given period of time.

31. What are the drawbacks of emitter modulator?

1. The amplifier is operated in class A mode, thus the efficiency is low.

2. The output power is very small. Thus it is not suitable for generating high level modulation.

32. Define super heterodyne principle.

It can be defined as the process of operation of modulated waves to obtain similarly modulated waves of different frequency. This process uses a locally generated carrier wave, which determines the change of frequency.

And also we can define that a device performs the frequency translation of a modulated signal is known as a frequency mixer. the operation is often called frequency mixing, frequency conversion, or heterodyning.

UNIT-II ANGLE MODULATION SYSTEMS

1. Define frequency modulation.

Frequency modulation is defined as the process by which the frequency of the carrier wave is varied in accordance with the instantaneous amplitude of the modulating or message signal.

2. Define modulation index of frequency modulation.

It is defined as the ratio of maximum frequency deviation to the modulating frequency. $m_f = \Delta\omega_m = KV_m / \omega_m = d$

3. Define frequency Deviation in FM?

The instantaneous frequency of FM signal varies with time around the carrier frequencyω_c.This means that the instantaneous frequency of FM signal varies according to the modulating signal. The maximum change in instantaneous frequency form the average frequency ω_c is called frequency deviation.

4. What do you meant by multitone modulation, Percent modulation?

Modulation done for the message signal with more than one frequency component is called multitone modulation.

The term percent modulation as it is used in reference to FM refers to the ratio of actual frequency deviation to the maximum allowable frequency deviation.

5. Define phase modulation.

Phase modulation is defined as the process of changing the phase of the carrier signal in accordance with the instantaneous amplitude of the message signal.

6. What do you mean by angle modulation? And write their types?

Angle modulation may be defined as the process in which the total phase angle of a carrier wave is varied in accordance with the instantaneous value of the modulating or message signal while keeping the amplitude of the carrier constant. Phase modulation (PM) and Frequency modulation (FM) are the types of angle modulation.

7. Write the expression for the spectrum of a single tone FM Signal.

V FM (t) =V c cos(ω c t+m f sim ω m t)

8. How FM wave can be converted to PM wave?

The PM wave can be obtained from FM by differentiating the modulating signal before applying it to the frequency modulator circuit.

9. How PM wave can be converted to FM wave?

The FM wave can be obtained from PM by integrating the modulating signal before applying it to the phase modulator circuit.

10. Define phase deviation.

The maximum phase deviation of the total angle from the carrier angle is called phase deviation.

11. What are the types of Frequency Modulation?

(OR)

What do you mean by Narrow Band and Wide band?

Based on the modulation index FM can be divided into types. They are Narrow band FM and Wide band FM. If the modulation index is greater than one then it is wide band FM and if the modulation index is less than one then it is Narrow band FM

12. Compare FM to PM

The FM system having greater Modulation index results in larger band width.

PM system generally uses a smaller bandwidth because of smaller modulation index. In FM, the modulation index is increased when the modulating frequency is increased & vice versa. In PM, when the modulating frequency is changed, the modulation index in PM remains constant.

13. Compare AM to FM

In AM system there are three frequency

components and hence the bandwidth is

finite.

FM system has infinite number of sidebands in

addition to a single carrier. Hence its Bandwidth is

infinite.

The amplitude of modulated wave in AM is

dependent of modulation index.

The amplitude of frequency modulated wave in FM

is independent of modulation index.

In AM, most of the transmitted Power is

wasted

In FM, noise is very less.

14. What is the basic difference between an AM signal and a Narrowband FM signal?

In the case of sinusoidal modulation, the basic difference between an AM signal and a narrowband FM signal is that the algebraic sign of the lower side frequency in the narrow band FM is reversed.

15. Compare Wideband FM and Narrowband FM.

Parameter/Characteristics Wideband FM Narrowband FM

Modulation index Greater than 1 Less than or slightly greater than 1

Maximum Deviation 75KHz 5KHz

Range of Modulating

Frequency

30Hz to 15KHz 30 Hz to 3KHz

Maximum Modulation index 5 to 2500 Slightly greater than 1

Bandwidth

Large, about 15 times higher

than BW of narrowband FM

Small, approximately same as that

of AM

Applications Entertainment broadcasting

FM Mobile Communication like

Police wireless, ambulance etc.

16. What are the advantages of Angle Modulation?

Angle modulation has several inherent advantages over Amplitude modulation.

1 Noise immunity

2 Noise performance and signal-to-noise improvement.

3 Capture effect.

4 Power utilization and efficiency.

17. What is transmission bandwidth of FM?

For 'n'side bands the bandwidth of FM wave is given by

$B.W=2n\omega_m$ radians/sec

$B.W=2nf_m$ Hz

18. What are the two methods of producing an FM wave?

Basically there are two methods of producing an FM wave. They are,

i) Direct method

In this method the transmitter originates a wave whose frequency varies as function of the modulating source. It is used for the generation of NBFM

ii) Indirect method

In this method the transmitter originates a wave whose phase is a function of the modulation. Normally it is used for the generation of WBFM where WBFM is generated from NBFM

19. What are the disadvantages of FM system?

A much wider channel is required by FM.

FM transmitting and receiving equipments tend to be more complex and hence it is expensive

20. How will you generate message from frequency-modulated signals?

First the frequency-modulated signals are converted into corresponding amplitude-modulated signal using frequency dependent circuits. Then the original signal is recovered from this AM signal.

21. List the properties of the Bessel function.

The properties of the Bessel function is given by,

i) $J_n(b) = (-1)^n J_{-n}(b)$ for all n, both positive and negative.

ii) For small values of the modulation index b ,we have

$J_0(b) = 1$

$J_1(b) = b/2$

$J_n(b) = 0, n > 2.$

iii) $\sum_{n=-\infty}^{\infty} J_n(b) = 1$

22. What are the types of FM detectors?

Slope detector and phase discriminator.

23. What are the types of phase discriminator?

Foster seely discriminator and ratio detector.

24. What are the disadvantages of balanced slope detector?

1. Amplitude limiting cannot be provided
2. Linearity is not sufficient
3. It is difficult to align because of three different frequency to which various tuned

circuits to be tuned.

4. The tuned circuit is not purely band limited.

25. Define capture effect.

With FM and PM, a phenomenon known as the capture effect allows a receiver to differentiate between two signals received with the same frequency, providing one signal atleast twice as high in amplitude as the other; the receiver will capture the stronger signal and eliminate the weaker signal.

26. What is FM thresholding?

With the use of limiters, FM and PM demodulators can actually reduce the noise level and improve the signal to noise ratio during the demodulation process. This is called FM thresholding.

27. Define Pre-emphasis and de-emphasis.

Noise at the higher-modulating signal frequencies is inherently greater in amplitude than noise at the lower frequencies. i.e the higher - modulating-signal frequencies have a lower signal-to-noise ration than the lower frequencies. To compensate for this, the high-frequency modulating signals are emphasized or boosted in amplitude in the transmitter. To compensate for this boost, the high-frequency signals are attenuated or deemphasized in the receiver after demodulation has been performed.

28. State the Carson's rule.

Carson's rule provides a thumb formula to calculate the bandwidth of a single tone wide band FM.According to this rule the FM bandwidth is given as twice the sum of the frequency deviation and the highest modulating frequency. bhowever, it must be remembered that this rule is just an approximation.

Mathematically B.W=$2(\Delta\omega+\omega_m)$

29. What are the disadvantages of FM?

A much wider channel typically 200 KHz is required in FM as against only 10 KHz in AM broad cast. This forms serious limitation of FM. FM transmitting and receiving equipments particularly used for modulation and demodulation tend to be more complex and hence more costly.

30. What is the use of crystal controlled oscillator?

The crystal-controlled oscillator always produces a constant carrier frequency there by enhancing frequency stability.

31. In a FM wave the frequency deviation is 25 KHz. What is the Modulation index when the modulating signal frequency is 100Hz &10 KHz?

Soln:

$\Delta f = 25$ KHz ; m f

=

=

when $f_m = 100$ Hz

radians

when $f_m = 10{,}000$ Hz

= 2.5radians

32.A carrier is frequency modulated with a sinusoidal signal of 2 KHz resulting in a maximum frequency deviation of 5 KHz. Find (i) Modulation index (ii) Bandwidth of the modulated signal.

Solution:

Given data : Modulating frequency $f_m = 2$ K Hz

Maximum frequency deviation $= \Delta f = 5$ KHz

i. Modulation index = m f =

=

ii. Bandwidth of the modulated signal is given by,

BW = $2(\Delta f + f_m)$

= $2(5 \times 10^3 + 2 \times 10^3)$

= 14 KHz.

33. A 2 KHz audio signal modulates a 50MHz carrier causing a frequency deviation of 2.5KHz.Determine the bandwidth of FM signal..

f m = 2 K Hz

f c = 50MHz

Δf = 2.5 KHz

Modulation index = m f =

B.W=2 f m =2x2x10 3 =4KHz.

34. Determine the bandwidth of a wideband FM; given that carrier Signal of 100MHz frequency modulates a signal of 5 KHz with the 50 KHz as frequency deviation.

B.W for WBFM=2Δf m

Modulation index = m f =

Δf m =50 KHz

f m = 5K Hz

f c = 100KHz

B.W=2x50KHz=100KHz

UNIT-III NOISE THEORY

1. Define noise.

Noise is defined as any unwanted form of energy, which tends to interfere with proper reception and reproduction of wanted signal.

2. Give the classification of noise.

Noise is broadly classified into two types. They are External noise and internal noise. External noise may be defined as that type of noise which is generated external to the communication system. And it can be classified into

1. Atmospheric noise
2. Extraterrestrial noises
3. Man –made noises or industrial noises

Internal noise may be defined as that type of system which is generated internally or within the communication system or receiver. it can be classified into

1. Thermal noise
2. Shot noise
3. Transit time noise
4. Miscellaneous internal noise

3. What are the types of extraterrestrial noise and write their origin?

 The two type of extraterrestrial noise are solar noise and cosmic noise Solar noise is the electrical noise eminating from the sun. Cosmic noise is the noise received from the center part of our galaxy, other Distant galaxies and other virtual point sources.

4. Define Atmospheric noise and industrial noise?

Atmospheric noise, which is also called static, is produced by lightning discharges in thunderstorms and other natural electrical disturbances which occur in the atmosphere. The industrial noise or man-made noise is that type of noise which is produced by such sources as automobiles and aircraft ignition, electrical motors, switch gears and leakage from high voltage transmission lines and several other heavy electrical equipments.

5. Define shot noise?

Shot noises arises in active devices due to random behaviour of charge carriers. In electron tubes, shot noise is generated due to random emission of electrons from cathodes, whereas in semiconductor devices shot noise is generated due to random diffusion of minority carriers or simply random generation and recombination of electron-hole pairs.

6. Define partition noise?

Partition noise is generated in a circuit when a current has to divide between two or more paths. This means that partition noise results from the random fluctuations in the division. 7. Define flicker noise (or) Low frequency noise. Flicker noise is the one appearing in transistors operating at low audio frequencies. Flicker noise is produced at low frequencies (below few KHz).This noise is also called as flicker noise (1/f noise).

8. Define transit time of a transistor.

Transit time is defined as the time taken by the electron to travel from emitter to the collector.

9. Define Transit-Time noise or high frequency noise.

It is generally observed in semiconductor devices, when transit-time of charge carriers crossing a junction is comparable with time period of the signal. Some charge carriers diffuse back to the source, this process gives rise to the input admittance and it affects the conductance with increase in frequency. This conductance produces transit time noise.

10. Define Avalanche noise?

The reverse bias characteristic of a diode shows a region where the reverse current increases rapidly with a slight increase in magnitude of the reverse bias voltage. That is voltage increase current also increases. This is because the holes and electrons in the depletion region gain sufficient energy from reverse bias to ionize atoms by collision. This collision provides spikes in current in avalanche region. This noise is called as avalanche noise.

11. Define Thermal noise?

The thermal noise or white noise or Johnson noise is the random noise which is generated in a resistor or the resistive component of complex impedance due to rapid and random motion of the molecules, atoms and electrons.

12. Write an expression for thermal noise generated in a resistor.

The expression for maximum noise power output of a resistor may be given as

Where K-Boltzmann's constant=1.38x10 -23 Joule/deg.K

T-absolute temperature.

B-bandwidth of interest in Hz.

13. Explain White Noise.

Many types of noise sources are Gaussian and have flat spectral density over a wide frequency range. Such spectrum has all frequency components in equal portion, and is therefore called

white noise. The power spectral density of white noise is independent of the operating frequency. And it is also defined as noise in idealized form is known as white noise. This means that in a communication system, the noise analysis is based on an idealized form of noise, is white noise.

14. Give the expression for noise voltage in a resistor.

The mean –square value of thermal noise voltage is given by

$V_n^2 = 4 K T B R$

K – Boltz man constant

R – Resistance

T – Absolute temperature

B - Bandwidth

15. Define equivalent noise bandwidth of an ideal band pass system.

Equivalent noise band width may be defined as the bandwidth of an ideal band pass system which produces the same noise power as the actual system does.

16. Explain why thermal noise is also called as Johnson noise?

Thermal noise is also called as Johnson noise after the scientist J.B.Johnson who presented a detailed investigation of it.

17. Define signal to noise ratio.

Signal to noise ratio is the ratio of signal power to the noise power at the same point in a system.

18. Define noise figure.

$$\text{Nose figure } F = \frac{S/N \text{ at the input}}{S/N \text{ at the output}}$$

S/N = Signal power / Noise Power

19. What is narrowband noise?

The receiver of a communication system usually includes some provision for preprocessing the received signal. The preprocessing may take the form of a narrowband filter whose bandwidth is large enough to pass modulated component of the received signal essentially undistorted but not so large as to admit excessive noise through the receiver. The noise process appearing at the output of such filter is called narrow band noise.

UNIT-IV NOISE IN CW MODULATION SYSTEMS

1. Define figure of merit?

The figure of merit'γ'may be defined as the ratio of o/p signal to noise ration to input signal to noise ration of a receiver.

2. What is the figure of merit of DSB-SC system?

The figure of merit of a DSB-SC system is 2.

3. What is the figure of merit of SSB-SC system?

The figure of merit of an SSB-SC system is 1.

4. An amplifies operating over the frequency range from 18 to 20 MHz has a 10Kh input resistor. Calculate the RMS voltage at the input to this amplifier if the ambient temperature is 27ºC.

Given data:-

R = 10 KΩ, K = 1.38X10 -23 J/K(Boltzman constant)

B.w – B = (18 – 20) that is (20 – 18) MHZ = 2MHz

T = 27ºC + 273 = 300ºK

The RMS voltage is given by the expression,

$\sqrt{4RKTB} = \sqrt{4X10X10\ 3\ X1.38X10\ -23\ X2X10\ 6\ X300}$

$= \sqrt{4X1.38X3X2X10\ -11} = 1.82X10\ -5\ V = 1.82\mu V.$

5. Two resistors of 20kΩ and 50k are at room temperature of 15ºc or 288k. For a given B.w of 100KHz determine the thermal noise voltage generated by i).Each resistor, ii).The two resistors in series, iii). The two resistors are in parallel.

1. thermal noise in First resistor

V n1 = √4KTBR 1 = √4X1.38X10 -23 X288X100X10 3 X20X10 3.

V n1 = 5.6μV

And in 2 nd resistor

V n2 = √4KTBR 2 = √4X1.38X10 -23 X288X100X10 3 X50X10 3

V n2 = 8.91μV.

ii. when two resistors in series

V nr = √4KTB (R 1 +R 2)

= √4X1.38X10 -23 X288X100X10 3 X (20+50) X10 3 .

= 10.55μV

iii. when two resistors are in parallel

V nr = √4KTB R par 1/R eq = 1/R 1 + 1/R 2 = (14 – 3) X 10 3

= √4X1.38X10 -23 X288X100X10 3 X14.3X10 3 = 4.7μV.

6. Write the advantages of Super heterodyne receiver over TRF

Receivers?

The super heterodyne receiver has the following advantages over TRF receivers.

1. Improved selectivity in terms of adjacent channels.
2. More uniform selectivity in terms of adjacent channels.
3. Improved receiver stability.
4. Higher gain per stage because IF amplifiers are operated at a lower frequency.
5. Uniform band width because of fixed intermediate frequency.

7. Compare the noise performance of an AM and FM system?

The figure of merit of AM system is 1/3 when the modulation is 100 percent and that of

FM is (3/2) mf 2 .The use of FM offers improved noise performance over AM when (3/2)mf 2 >

1/3.mf –modulation index in FM.

8. What is threshold effect in AM receivers?

The loss of the message signal x (t) in an envelope detector due to the presence of the large noise is known as the Threshold effect. The threshold effect is also defined as when a noise is large compared to the signal at the input of the envelope detector, the detected output has a message signal completely mingled with noise. it means that if the i/p signal to noise ratio(S i /N i) is below a certain level called threshold level.

9. Define Noise-Quieting effect?

Noise power of FM detector varies inversely with carrier power. The decrease in noise power with an increase in carrier power is called noise-quieting effect.

10.Define capture effect in FM?

When the interference is stronger then it will suppress the desired FM input. When the interference signal and FM input are of equal strength, the receiver fluctuates back and forth between them .This phenomenon is known as the capture effect. We may also define as in low noise case; the distortion produced by the noise at the o/p of FM detector is negligible in comparison to the desired modulating signal. And noise almost suppressed by the signal. This phenomenon is called as capture effect.

11.Define FM threshold effect

As the input noise power is increased the carrier to noise ratio is decreased the receiver breaks and as the carrier to noise ratio is reduced further crackling sound is heard and the output SNR cannot be predicted by the equation. This phenomenon is known as threshold effect. It is also defined as when the SNR becomes even slightly less than unity, an impulse of noise is generated. This noise impulse appears at the output of the detector in the form of click sound. If the SNR ratio is further decreased so that the ratio is moderately less than unity, the impulses are generated rapidly and clicks merge in to spluttering sound. This phenomenon is known as "threshold effect".

12. How is threshold reduction achieved in FM systems?

Threshold reduction is achieved in FM system by using an FM demodulator with negative feedback or by using a phase locked loop demodulator. Such devices are referred to as extended-threshold demodulators.

13. What is Pre-emphasis?

The pre modulation filtering in the transistor, to raise the power spectral density of the base band signal in its upper-frequency range is called pre emphasis (or pre distortion) Pre emphasis is particularly effective in FM systems which are used for Transmission of audio signals.

14. Define de-emphasis.

A de-emphasis in the receiver used to restore relative magnitude of different improvement in AF signal and to suppress noise is called de-emphasis.

15. What is the figure of merit of a AM system with 100 percent Modulation?

The figure of merit of an AM system with 100 percent modulation is 1/3.This means that other factors being equal an AM system must transmit three times as much average power as a suppressed system in order to achieve the same quality of noise performance.

16. What is Nyquist rate?

The sampling rate of $2f_m$ samples per second for a signal bandwidth of f_m Hertz is called the Nyquist rate. Its reciprocal $1/f_m$ is called the Nyquist interval.

17. Compare AM to FM

In AM system there are three frequency components and hence the bandwidth is

finite. FM system has infinite number of sidebands in addition to a single carrier. Hence its Bandwidth is infinite. The amplitude of modulated wave in AM is dependent of modulation index. The amplitude of frequency modulated wave in FM is independent of modulation index. In AM, most of the transmitted Power is wasted In FM, noise is very less.

UNIT-V INFORMATION THEORY

1. What is the channel capacity of binary symmetric channel with error probability of 0.2?

W.K.T P=0.2, Hence 1-P=0.8

Channel capacity for binary symmetric channel

$C=1+P\log_2 P+ (1-P) \log_2 (1-P)$

$=1+ 0.2\log_2 0.2+ 0.8 \log_2 0.8$

=1-0.4644-0.2575

C=0.278 bits/message.

2. What is entropy?

The average information per source symbol in a particular interval is called entropy.

3. What is discrete memory less source?

The symbols emitted by the source during successive signaling intervals are statistically independent. That source is called discrete memory less source. Here memoryless, means that the symbol emitted any time is independent of previous choices.

4. What is amount of information?

The amount of information gained after observing the event S=S K , which occurs with probability P K , as the logarithmic function. Amount of information I(S K)=Log(1/P K) Unit of information is bit.

5. What is mean by one bit?

One bit is the amount of information that use we gain, when one of two possible and equally likely (equal-probability) events occurs.

6. What is information rate?

Information rate 'R'is represented as the average number of bits of information persecond.

R=r.H(x)information bits/second

Where "H(x)"is entropy

'r' is rate at which messages are generated.

7. What is meant by Source encoding?

The efficient representation of data generated by a discrete source. This process is called "Source coding". The device that performs the representation is called a source encoder.

8. Name the two source coding techniques.

Prefix coding or instantaneous coding Shannon fano coding Huffman coding.

9. What is meant by prefix code?

Prefix coding is variable length coding algorithm. It assigns binary digits to the messages as per their probabilities of occurance.Prefix of the codeword means any sequence which is initial part of the code word. A prefix code is defined as a code in which no code word is the prefix of any other code word.

10. Write about data compaction?

For efficient signal transmission, the redundant information should be removed from the signal prior to transmission. This operation with no loss of information is ordinarily performed on a signal in digital form. This refers to “Data compaction” (or)”Lossless data”.

11. What is channel redundancy?

Redundancy is given as,

Redundancy (g) =1-Code efficiency

Redundancy (g) =1-h

The redundancy should be as low as possible.

12. What is mutual information?

The mutual information is defined as the amount of information transferred when X i is transmitted and Y J is received. It is represented by I(X i , Y J) and given as,

13. Write about channel capacity?

The channel capacity of the discrete memoryless channel is given as maximum average mutual information. The maximization is taken with respect to input probabilities P(x i)

$$C=\max_{\{P(x_i)\}} I(x; y)$$

14. Define lossless channel.

The channel described by a channel matrix with only one nonzero element in each column is called a lossless channel. In the lossless channel no sources information is lost in transmission.

15. Define Deterministic channel

A channel described by a channel matrix with only one nonzero element in each row is called a deterministic channel and this element must be unity.

16. Define noiseless channel.

A channel is called noiseless if it is both lossless and deterministic. The channel matrix has only one element in each row and in each column and this element is unity. The input and output alphabets are of the same size.

17. Explain Shannon-Fano coding.

An efficient code can be obtained by the following simple procedure, known as Shannon-Fano algorithm.

1. List the source symbols in order of decreasing probability.

2. Partition the set into two sets that are as close to equiprobable as possible, and sign

0 to the upper set and 1 to the lower set.

3. Continue this process, each time partitioning the sets with as nearly equal probabilities as possible until further partitioning is not possible.

18. State the properties of mutual information.

1. $I(X;Y)=I(Y;X)$

2. $I(X,Y)\geq 0$

3. $I(X;Y)=H(Y)-H(Y/X)$

4. $I(X; Y) =H(X) +H(Y)-H(X; Y)$.

19. Give the relation between the different entropies.

$H(X; Y) =H(X) +H(Y/X)$

$=H(Y) +H(X/Y)$

H(X) - entropy of the source(Y/X), H(X/Y)-conditional entropy

H(Y)-entropy of destination

H(X, Y) - Joint entropy of the source and destination.

20. What is source coding and entropy coding?

A conversion of the output of a DMS into a sequence of binary symbols is called source coding. The design of a variable length code such that its average code word length approaches the entropy of the DMS is often referred to as entropy coding.

21. What is information theory?

Information theory deals with the mathematical modeling and analysis of a communication system rather than with physical sources and physical channels.

22. What is the channel capacity of a BSC and BEC?

For BSC the channel capacity C=1+plog 2 p + (1-p) log 2 (1-p).

For BEC the channel capacity C= (1-p)

23. What happens when the number of coding alphabet increases?

When the number of coding alphabet increases the efficiency of the coding technique decreases.

24. What is channel diagram and channel matrix?

The transition probability diagram of the channel is called the channel diagram and its matrix representation is called the channel matrix.

25. Is the trans information of a continuous system non-negative? If So, why?

The mutual information is always positive.i.e,

$$I(X; Y) \geq 0$$

26. Define rate of information transmission across the channel.

Rate of information transmission across the channel is given as,

D t = [H(X)-H(X/Y)] r bits/sec

Here H(X) is the entropy of the source.

H(X/Y) is the conditional entropy.

27. State the channel coding theorem for a discrete memoryless

Channel.

Given a source of 'M'equally likely messages, with M>>1,which is generating

information at a rate R.Given channel with capacity C.Then if,

$$R \leq C$$

There exists a coding technique such that the output of the source may be transmitted over the channel with a probability of error in the received message which may be made arbitrarily small.

28. Prove that the following,

$I(X; Y) = H(X) + H(Y) - H(X, Y)$

We know the relation

$H(X, Y) = H(X/Y) + H(Y)$

There fore

$H(X/Y) = H(X, Y) - H(Y)$ --------- (1)

Mutual information is given by

$I(X; Y) = H(X) - H(X/ Y)$ --------- (2)

Substituting equation (1) in (2)

$I(X; Y) = H(X) + H(Y) - H(X/ Y)$

Thus the required relation is proved.