MAHAKAVI BHARATHIYAR COLLEGE OF ENGINEERING & TECHNOLOGY

VASUDEVANALLUR, 627758.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EC 2252 COMMUNICATION THEORY

TWO MARKS QUESTIONS WITH ANSWER

PREPARED BY

R.RAJATHI
ASSIATANT PROFESSOR
DEPT OF ECE
MBCET

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SUBJECT CODE: EC 2252 SUBJECT: COMMUNICATION THEORY

UNIT I AMPLITUDE MODULATION SYSTEMS

1. Define modulation?
Modulation is a process by which some characteristics of high frequency carrier signal is varied in accordance with the instantaneous value of the modulating signal.

2. What are the types of analog modulation?
Amplitude modulation.
Angle Modulation
1. Frequency modulation
2. Phase modulation.

3. Define depth of modulation.
It is defined as the ratio between message amplitude to that of carrier amplitude.
m=Em/Ec

4. What are the degrees of modulation?
Under modulation. m<1
Critical modulation m=1
Over modulation m>1

5. What is the need for modulation?
- Needs for modulation:
- Ease of transmission
- Multiplexing
- Reduced noise
- Narrow bandwidth
- Frequency assignment
- Reduce the equipments limitations

6. 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

7.Give the classification of modulation.
There are two types of modulation. They are
Analog modulation
Digital modulation
Analog modulation is classified as follows
Continuous wave modulation
Pulse modulation
Continuous wave modulation is classified as follows
Amplitude modulation
Double side band suppressed carrier
Single side band suppressed carrier
Vestigial side band suppressed carrier
Angle modulation
Frequency modulation
Phase modulation
Pulse modulation is classified as follows
Pulse amplitude modulation
Pulse position modulation
Pulse duration modulation
Pulse code modulation
Digital modulation is classified as follows
Amplitude shift keying
Phase shift keying
Frequency shift keying

8.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
.
9 .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: Ic =8A It=8.93A m=0.8
Formula: It=Ic $(1+m^2/2)$½
$8.93=8(1+m^2/2)$ ½
m=0.701
It=8 $(1+0.8^2/2)$½
It=9.1A

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

AM signal	DSB-SC	SSB-SC
Bandwidth=2fm	Bandwidth=2fm	Bandwidth=fm
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

11 What are the advantages of VSB-AM?

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

12 Compare linear and non-linear modulators.

Linear modulators	Non-linear modulators
Heavy filtering is not required.	Heavy filtering is required
These modulators are used in high level modulation.	These modulators are used in low level modulation.
The carrier voltage is very much greater than modulating signal voltage.	The modulating signal voltage is very much greater than the carrier signal voltage.

13. How will you generating DSBSC-AM ?

There are two ways of generating DSBSC-AM such as

1. balanced modulator 2.ring modulators

14. 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.

15. Define demodulation.

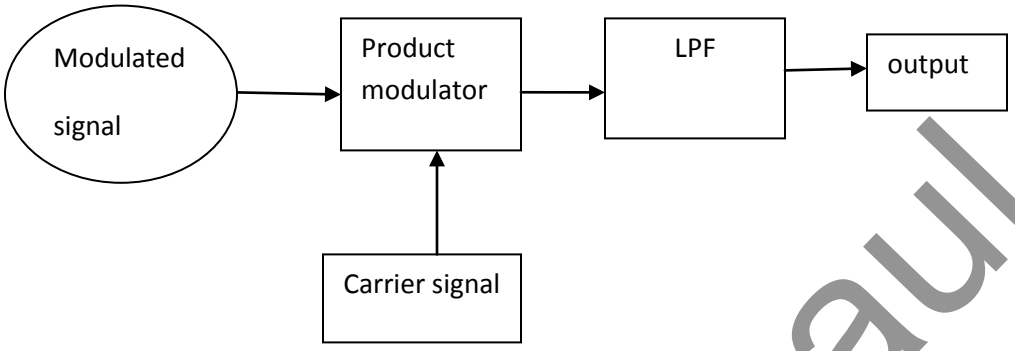
Demodulation or detection is the process by which modulating voltage is recovered from the modulated signal. It is the reverse process of modulation.

16. What are the types of AM detectors?

1. Nonlinear detectors
2. Linear detectors

17. What are the types of linear detectors?
1.Synchronous or coherent detector.
2 .Envelope or non coherent detector.

18.draw the block diagram of coherent detector.



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

20.Define sensitivity.
It is defined as a measure of its ability to receive weak signals.

UNIT 2- ANGLE MODULATION SYSTEMS

1. Define selectivity.
Selectivity of a receiver is defined as its ability to select the desired signals among the various signals.

2. Define stability.
It is the ability of the receiver to deliver a constant amount of output for a given a given period of time.

3. 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.

4. A transmitter supplies 8 Kw to the antenna when modulated. Determine the total power radiated when modulated to 30%.

m=0.3; Pc=8 kw

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

=8.36 kw

5. 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.

6. 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.

7. Define modulation index of frequency modulation.

It is defined as the ratio of maximum frequency deviation to the modulating frequency. b = df/fm

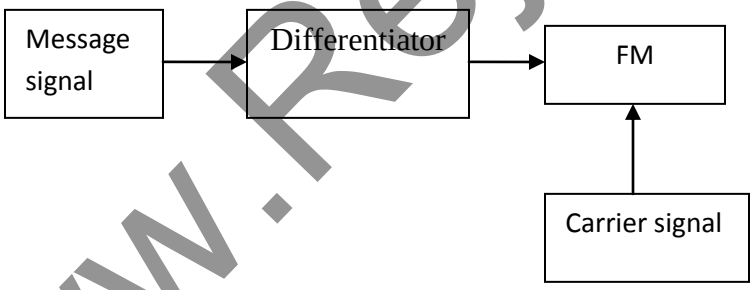
8. What do you meant by multitone modulation?

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

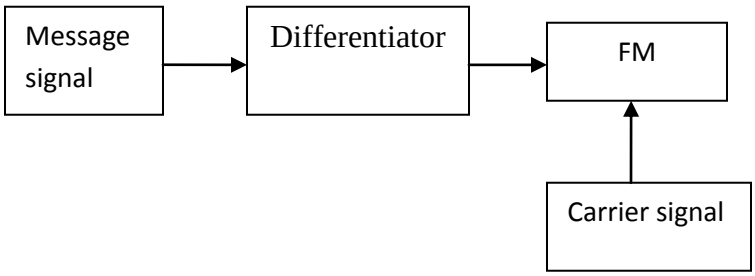
9. Define phase modulation.

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.

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



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



12. What are the types of Frequency Modulation?

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.

13. 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.

14. 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

15. Compare WBFM and NBFM.

WBFM	NBFM
Modulation index is greater than 1	Modulation index less than 1
Frequency deviation 75 KHz	Frequency deviation 5 KHz
Bandwidth 15 times NBFM	Bandwidth 2fm
Noise is more suppressed	Less suppressing of noise

16. List the properties of the Bessel function.

The properties of the Bessel function is given by,

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

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

$J_0(\beta)=1$

$J_1(\beta)=b/2$

$J_n(\beta)=0, n>2.$

iii) $\sum_{n=\infty}^{\infty} 1 J_n^2(\beta)=1$

17. Give the average power of an FM signal.

The amplitude of the frequency modulated signal is constant .The power of the FM signal is same as that of the carrier power. P=1/2 E_c^2

18. Define phase deviation.

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

19. Define frequency Deviation.

The maximum departure of the instantaneous frequency from the carrier frequency is called frequency deviation

.

20. State the Carson's rule.

An approximate rule for the transmission bandwidth of an FM Signal generated by a single tone-modulating signal of frequency f_m is defined as

$B = 2\,\Delta f(1+1/b)$

21. Define the deviation ratio D for non-sinusoidal modulation.

The deviation ratio D is defined as the ratio of the frequency deviation Df, which corresponds to the maximum possible amplitude of the modulation signal m(t),to the highest modulation frequency .

$$D = {\Delta f}/{f_m}$$

22. What is the use of crystal controlled oscillator?

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

23. What are the disadvantages of FM system?

1. A much wider channel is required by FM.
2. FM transmitting and receiving equipments tend to be more complex and hence it is expensive

24. 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.

25. What are the types of FM detectors?

Slope detector and phase discriminator.

26. What are the types of phase discriminator?

Foster seely discriminator and ratio detector.

27. 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.

UNIT 3- NOISE THEORY

1. Define probability.
The probability of occurrence of an event A is defined as,

$$P(A) = \frac{No\ of\ possible\ \ favorable\ \ outcomes}{Total\ \ of\ equally\ \ likely\ \ outcomes}$$

2. What are mutually exclusive events?

Two possible outcomes of an experiment are defined as being mutually exclusive if the occurrence of one outcome precludes the occurrence of the other.

3. Define probability density function.
Probability density function is defined as $f_x(x)$ is defined in terms of cumulative distribution function $F_x(x)$ as

$$f_x(X) = \frac{dfx\,(X)}{dX}$$

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

4. Give the classification of noise.
Noise is broadly classified into two types. They are External noise and internal noise.

5. What are the types of External noise?
External noise can be classified into
1. Atmospheric noise
2. Extraterrestrial noises
3. Man –made noises or industrial noises

6. What are types of internal noise?

Internal noise can be classified into

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

7. 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 emanating from the sun. Cosmic noise is the noise received from the center part of our galaxy, other distant galaxies and other virtual point sources.

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 flicker noise.

Flicker noise is the one appearing in transistors operating at low audio frequencies. Flicker noise is proportional to the emitter current and junction temperature and inversely proportional to the frequency.

10. State the reasons for higher noise in mixers.

1. Conversion transconductance of mixers is much lower than the transconductance of amplifiers.

2. If image frequency rejection is inadequate, the noise associated with the image frequency also gets accepted.

11. 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.

12. Define noise figure.

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

13. Explain thermal noise.

Thermal noise is the name given to the electrical noise arising from the random motion of electrons in a conductor.

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 – obsolute temperature

B – Bandwidth

15. 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.

16. 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.

17. Give the expression for equivalent noise temperature in terms of hypothetical temperature.

The expression for equivalent noise temperature in terms of hypothetical Temperature is $T_e = (F- 1) T_0$

Where, F is the noise figure and T_0 absolute temperature.

18. Give the Friss formula in terms of noise temperature.

The Friss formula in terms of noise temperature is

$T_e = T_1 + T_2 / G_1 + T_3 / G_1 G_2 + \ldots\ldots\ldots$

$G_1 , G_2 , \ldots$ Gain of amplifiers

19. What is called image frequency?

Image frequency is defined as the signal frequency plus twice the intermediate frequency. This has the effect of two stations being received simultaneously and hence it is undesirable.

$f_{si} = f_s + 2 f_i$

f_{si} - image frequency

It can be eliminated by providing adequate image signal selectivity between antenna and mixer input.

20. What is intermediate frequency?

Intermediate frequency (IF) is defined as the difference between the signal frequency and the oscillator frequency.

$IF = f_s – f_o$ when $f_s > f_o$ (or)

$IF = f_o – f_s$ when $f_o > f_s$

21. Define Partition noise.

In an electron tube having one or more positive grids, this noise is caused by irratic partition of the cathode current among the positive electrodes. In a transistor, the partition noise is created from the random fluctuation in the division of current between the collector and base.

22. Give the expression for noise voltage when several sources are cascaded.

Enr = Sqrt (4 KTB (R1 + R2 + …..))

Where R1 , R2 --- are the resistances of the noise resistors.

K – Boltz man constant

T – absolute temperature

B – Bandwidth

23. Define random variable

Random variable is defined as a rule or mapping from the original sample space to a numerical sample space subjected to certain constraints. Random variable is also defined as a function where domain is the set of outcomes _es and whose range is R, is the real line.

24. Define Random process.

A Random process X (s,t) is a function that maps each element of a samples space into a time function called sample function. Random process is a collection of time functions.

25. Give the Laws of probability.

Additive law of probability

Case i

When events are mutually exclusive , P (A∪B) =φ

$$P(A \cup B) = P(A) + P(B)$$

Case ii

When events are not mutually exclusive

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

Multiplication law of probability:

Case i When events are independent

$$P(A \cap B) = P(A)\,P(B)$$

Case ii When events are dependent

$$P(A \cap B) = P(A)\,P(B/A)$$
$$= P(B)\,P(A/B)$$

UNIT 4 -PERFORMANCE OF CW MODULATION SYSTEMS

1. What is frequency translation?

Suppose that a signal is band limited to the frequency range extending from a frequency f1 to a frequency f2. The process of frequency translation is one in which the original signal is replaced with a new signal whose spectral range extends from f1' to f2' and which new signal bears, in recoverable form the same information as was borne by the original signal.

2. What are two situations identified in frequency translations?

The two situations identified in frequency translation are

i Up conversion

In this case the translated carrier frequency is greater than the incoming carrier frequency

ii Down conversion

In this case the translated carrier frequency is smaller than the incoming carrier frequency.

Thus, a narrowband FM signal requires essentially the same transmission bandwidth as the AM signal.

3. Define Tracking.

Tracking is the process of correctly tuning a number of tunable circuits in a receiver.

. What is TRF receiver?

Tuned Radio Frequency is also called straight receiver. Here the receiver operates in straight forward manner without frequency conversion.

4.What are the advantages of superheterodyne receiver over TRF?

The advantages of superheterodyne receiver over TRF are high selectivity ,improved sensitivity throughout the carrier frequency band..It eliminates image frequency.

5.What is the figure of merit of DSBSC system ?

The figure of merit of DSBSC signal is unity.

6.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.

7.What is Capture effect?

When the interference signal and FM input are of equal strength, the receiver fluctuates back and froth between them .This phenomenon is known as the capture effect.

8.What is 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.

9.How is threshold reduction achieved in FM system?

Threshold reduction is achieved in FM system by using an FM demodulator with negative feedback or by using a phase locked loop demodulator.

10. What is Pre-emphasis?

The premodulation 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.

11. Define de-emphasis.

The filtering at the receiver to undo the signal pre-emphasis and to suppress noise is called de-emphasis.

12.Define Sampling theorem.

A band limited signal of finite energy, which has no frequency components higher than fm Hertz may be completely recovered from a knowledge of its samples taken at the rate of 2fm samples per second.

13.What do you infer from the receiver output of a coherent detector?

The output equation y(t)=1/2Cacm(t) +1/2nı(t) indicates that the message signal and in-phase noise component of the filtered noise appear additively at the receiver output. The quadrature component of the narrow band noise is completely rejected by the coherent detector.

14.When is the figure of merit of SSBSC system 1?

For the same average transmitted signal power and the same average noise power in the message bandwidth ,an SSB receiver will have exactly the same output signal to noise ratio as a DSB-SC receiver when both receivers use coherent detection for the recovery of the message signal.

15.Compare the noise performance of AM receiver with that of DSB-SC receiver.

The figure of merit of DSB-SC or SSB-SC receiver using coherent detection is always unity, the figure of merit of AM receiver using envelope detection is always less than unity. Therefore noise performance of AM receiver is always inferior to that of DSBSC due to the wastage of power for transmitting the carrier.

16.What is the figure of merit of a AM system with 100 percent modulation?

The figure of merit of a 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.

.

17.What are the characteristics of a receiver?

The characteristics of a receiver are sensitivity, selectivity, fidelity, signal to noise ratio.

18.Why is equivalent noise temperature used for noise measurement?

For low noise devices the noise figure is close to unity, which makes the comparison difficult and hence it is preferable to use equivalent noise temperature.

19.What is the function of amplitude limiter in FM system?

The function of amplitude limiter in FM system is used to remove the amplitude variations by clipping the modulated wave at the filter output almost to the zero axis .The resultant wave is rounded off by another BPF that is an integral part of the limiter thereby Suppressing the harmonics of the carrier frequency.

20. What are components in a frequency discriminator?

Frequency discriminator has got two components .Slope detector or differentiator with a purely imaginary frequency response that varies linearly with frequency. It produces output where the amplitude and frequency vary with the message signal. An envelope detector that recover the amplitude variations and produces message signal.

21.What is a post detection filter?

The post detection filter named as "base-band low pass filter" has a bandwidth that is just large enough to accommodate the highest frequency component of the message signal.

UNIT 5- INFORMATION THEORY

1. 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.

2. 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.

3. 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.

4. Explain Shannon-Fano coding.

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

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.

5. What are the types of Correlation?

The types of Correlation are Cross Correlation and Auto Correlation

6. What is the difference between Correlation and Convolution?

1. In Correlation physical time 't' is dummy variable and it disappears after solution of an integral. But in convolution 'i' is a dummy variable.
2. Convolution is a function of delay parameter 't' but convolution is a function of ' t'.

3. Convolution is commutative but correlation is noncom mutative.

7. Define Signal.

A signal is defined as any physical quantity carrying information that varies with time. The value of signal may be real or complex. The types of signal are continuous signal and discrete time signal.

8.Define entropy.

Entropy is the measure of the average information content per second. It is given by the expression

$$H(X) = \sum IP(xi) \log_2 p(xi) \quad \text{Bits/sample.}$$

9.Define mutual information.

Mutual information I(X,Y) of a channel is defined by

I(X,Y)=H(X)-H(X/Y) bits/symbol

H(X)- entropy of the source

H(X/Y)- conditional entropy of Y.

10.State the properties of mutual information.

1. I(X,Y)=I(Y,X)
2. I(X,Y)>=0
3. I(X,Y)=H(Y)-H(Y/X)
4. I(X,Y)=H(X)+H(Y)-H(X,Y).

11.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

12.Define information rate.

If the time rate at which source X emits symbols is r symbols per second. The information rate R of the source is given by

R=r H(X) bits/second

H(X)- entropy of the source

13.What is data compaction?

For efficient signal transmission the redundant information must be removed from the signal prior to transmission .This information with no loss of information is ordinarily performed on a signal in digital form and is referred to as data compaction or lossless data compression.

14.State the property of entropy.

$1.0 < H(X) < \log_2 K$, is the radix of the alphabet X of the source.

15.What is differential entropy?

The average amount of information per sample value of x(t) is measured by

$H(X) = -\int_{-\infty}^{\infty} fx(x) \log fx(x) dx$ bit/sample

H(X) –differential entropy of X.

16. What is the channel capacity of a discrete signal?

The channel capacity of a discrete signal C= max I(X,Y)
P(xi)

I(X,Y)-mutual information.

17. 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. he design of a variable length code such that its average cod word length approaches the entropy of the DMS is often referred to as entropy coding.

18.State Shannon Hartley theorem.

The capacity 'C' of a additive Gaussian noise channel is $C=B \log_2 (1+S/N)$

B= channel bandwidth ,S/N=signal to noise ratio.

19.What is the entropy of a binary memory-less source?

The entropy of a binary memory-less source $H(X)=-p_0 \log_2 p_0-(1-p_0)\log_2(1-p_0)$

p_0-probability of symbol '0',p1=(1- p_0) =probability of transmitting symbol '1'

20.How is the efficiency of the coding technique measured?

Efficiency of the code =H(X) /L

$L=\sum p(xi)li$ average code word length .li=length of the code word.

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

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

22.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.

23.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

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

For BSC the channel capacity $C=1+p\log_2 p +(1-p)\log_2(1-p)$.

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