UNIT-I AMPLITUDE MODULATION

(2 Marks Questions and Answers)

1. 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?

(i) Amplitude modulation.
(ii)Angle Modulation
1. Frequency modulation
2. Phase modulation.

3. Define the term modulation index for AM.

Modulation index is the ratio of amplitude of modulating signal (Em) to amplitude of carrier (Ec) i.e.m = mEC

4. What are the degrees of modulation?

a) Under modulation (m < 1)
b) Critical modulation (m=1)
c) Over modulation(m>1)

5. What is the need formodulation?

Needs for modulation:

a) Ease of transmission
b) Multiplexing
c) Reduced noise
d) Narrow bandwidth
e) Frequency assignment
f) Reduce the equipments limitations.

6. Give the Classification of Modulation.

There are two types of modulation. They are a)Analog modulation
b)Digital modulation

Analog modulation is classified as follows (i)Continuous wave modulation (ii)Pulse modulation

Continuous wave modulation is classified as follows

(i)Amplitude modulation
(ii) Double side band suppressed carrier
(iii)Single side band suppressed carrier
(iv)Vestigial side band suppressed carrier

7. What is the difference between modulation?

In high level modulation, the modulator amplifier operates at high power levels and delivers power directly to the antenna. In low level modulation, the modulator amplifier performs modulation at relatively low power levels. The modulated signal is then amplified to high power level by class B power amplifier. The amplifier feeds power to antenna.

8. Define Detection.

Detection is the process of extracting modulating signal from the modulated carrier. Different types of detectors are used for different types of modulations.

9. Define Amplitude Modulation.

In amplitude modulation, the amplitude of a carrier signal is varied according to variations in amplitude of modulating signal.

The AM signal can be represented mathematically as, $e_{AM} = (E_c + E_m \sin \omega_m t) \sin \omega_c t$ and the modulation index is given as, $m = E_m / E_C$

10. What is Super Heterodyne Receiver?

The super heterodyne receiver converts all incoming RF frequencies to a fixed lower frequency, called intermediate frequency (IF). This IF is then amplitude and detected to get the original signal.

11. 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.

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

S.No	AM signal	DSB-SC	SSB-SC
1	Bandwidth = 2fm	Bandwidth = 2fm	Bandwidth = fm
2	Contains USB,LSB,Carrier	Contains USB,LSB	USB,LSB
3	More Power is required for transmission	Power required is less than that of AM.	Power required is less than AM &DSB-SC

0. How will you generating DSBSC-AM?

There are two ways of generating DSBSC-AM such as a).Balanced modulator b).Ring modulators

15. What are advantages of ring modulator? a).Its output is stable.

b). It requires no external power source to activate the diodes. c).Virtually no maintenance.

d). Long life.

16. 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. The devices used for demodulation or detection are called demodulators or detectors. For amplitude modulation, detectors or demodulators are categorized as,

a) Square-law detectors b) Envelope detectors

17. Define Multiplexing.

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

18. Define Frequency Division Multiplexing.

Frequency division multiplexing is definedas many signals are transmitted simultaneously with each signal occupying a different frequency slot within a common bandwidth.

19. Define Guard Band.

Guard Bands are introduced in the spectrum of FDM in order to avoid any interference between the adjacent channels. Wider the guard bands, Smaller the interference.

20. Define SSB-SC.

(i) SSB-SC stands for Single Side Band Suppressed Carrier

(ii) When only one sideband is transmitted, the modulation is referred to as Single side band modulation. It is also called as SSB or SSB-SC.

21. Define DSB-SC.

After modulation, the process of transmitting the sidebands (USB, LSB) alone

and suppressing the carrier is called as Double Side Band-Suppressed Carrier.

2 are the disadvantages of DSB-FC?

Power wastage takes place in DSB-FC

)DSB-FC is bandwidth inefficient system.

23. Define Coherent Detection.

During Demodulation carrier is exactly coherent or synchronized in both the frequency and phase, with the original carrier wave used to generate the DSB-SC wave. This method of detection is called as coherent detection or synchronous detection.

24. What is Vestigial Side Band Modulation?

Vestigial Sideband Modulation is defined as a modulation in which one of the sideband is partially suppressed and the vestige of the other sideband is transmitted to compensate for that suppression.

25. What are the advantages of signal sideband transmission?

a) Power consumption

b) Bandwidth conservation c) Noise reduction

26. What are the disadvantages of single side band transmission?

a) Complex receivers: Single side band systems require more complex and expensive receivers thnconventiaonal AM transmission.

b) Tuning difficulties: Single side band receivers require more complex and precise tunig than conventional AM receivers.

27. Compare linear and non-linear modulators?

S.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.
	The carrier voltage is very much	The modulating signal voltage is very much

28. 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' and f2' and which new signal bears, in recoverable form the same information as was borne by the original

2 are the two situations identified in frequency translations?

Up Conversion: In this case the translated carrier frequency is grea
n the incoming carrier

b) Down Conversion: In this case the translated carrier frequency is smaller than the increasing carrier frequency.

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

30. What is BW for AM wave?

The difference between these two extreme frequencies is equal to the bandwidth of the AM wave.

Therefore, Bandwidth, B = (ωc + ωm) - (ωc-ωm) B = 2ωm

31. What is the BW of DSB-SC signal?

Bandwidth, B = (ωc + ωm) - (ωc-ωm) B = 2ω

It is obvious that the bandwidth of DSB-SC modulation is same as that of general AM waves.

32. What are the demodulation methods for DSB-SC signals?

The DSB-SC signal may be demodulated by following two methods: (i) Synchronous detection method.

(ii) Using envelope detector after carrier reinsertion.

33. Write the applications of Hilbert transform?

(i) For generation of SSB signals,

(ii) For designing of minimum phase type filters, (iii) For representation of band pass signals.

34. What are the methods for generating SSB-SC signal?

SSB-SC signals may be generated by two methods as under:

i)Frequency discrimination method or filter method. (ii)Phase discrimination method or phase-shift method.

UNIT-II ANGLE MODULATION

1. What do you understand by narrowband FM?

When the modulation index is less than 1, the angle modulated systems are called low index. The bandwidth requirement of low index systems is approximately twice of the modulating.

2. 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.

3. Define modulation index of frequency modulation.

It is defined as the ratio of maximum frequency deviation to the modulating

$\beta = \delta f f m$

4. What do you meant by multitone modulation?

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

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 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

7. 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.

8. 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

9. Compare WBFM and NBFM.

S.NO	WBFM	NBFM
1	Modulation index is greater than 1	Modulation index less than 1

2	Frequency deviation 75 KHz	Frequency deviation 5 KHz
3	Bandwidth 15 times NBFM	Bandwidth 2fm
4	Noise is more suppressed	Less suppressing of noise

10. 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 β ,

we have $J_0(\beta) = 1$

$J_1(\beta) = \beta/2$

$J_n(\beta) = 0$, n f 2

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

11. 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.

$P = \frac{1}{2} E_c^2$

12. Define phase deviation.

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

13. Define frequency Deviation.

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

14. 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 (max) is defined as

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∴ BW=2[δ + f m(max)

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

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

$D = \Delta f$ f m

16. What is the use of crystal controlled oscillator?

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

17. 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.

18. 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.

19. What are the types of FM detectors?

The types of FM detectors are
(i) Slope detector and
(ii) Phase discriminator.

20. What are the types of phase discriminator?

The types of phase discriminator are (i) Foster seeley discriminator and (ii) Ratio detector.

21. What are the disadvantages of balanced slope detector?

1. Amplitude limiting cannot be provided
2. Linearity is not sufficient

22. Write the advantages and disadvantages of foster-seely discrimination method?

Advantages:

a) It is much easier to design

b) Only two tuned circuits are necessary and they are tuned to same frequency c) Linearity is better

Disadvantages:

a) It requires Amplitude limiting circuit.

23. What are the applications of phase locked loop?

Phase locked loops are used for various purposes in AM and FM communication. (i)Automatic frequency correction in FM transmitter uses PLL to keep carrier frequency constant.

(ii)PLL is used direct FM Tramitter uses PLL to keep carrier frequency constant.
(iii) PLL is also used in FM demodulators.

24. Differentiate phase and frequency modulation.

S.No	Phase Modulation	Frequency Modulation
1	Phase of the carrier varies as per amplitude variations of modulating signal.	Frequency of the carrier varies as per amplitude variations of modulating signals.
2	Instantaneous phase deviation, $\theta(t) = k\, e_m(t)$	Instantaneous frequency deviation,
		$\theta'(t) = \frac{d}{dt}[\omega_c t + \theta(t)]$
3	Modulation index = k Em	Modulation index = $\frac{k1\, Em}{\omega m}$

25. A 80 MHz carrier is frequency modulated by a sinusoidal signal of 1V amplitude and the frequency sensitivity is 100 Hz/V. Find the approximate bandwidth of the FM waveform if the modulating signal has a frequency of 10 kHz.

Ans: Frequency Sensitivity = 100 Hz/ volt.
Amplitude of modulating signal = 1V
Hence maximum frequency deviation, δ =100 Hz / volt $\times$1V= 100 kHz

Frequency of modulating signal, fm = 10kHz

26. What is diversity reception?

Diversity reception is used when the signal fades into noise level. There are two types of diversity reception:

a) Space diversity
b) Frequency diversity.

a) Space diversity: It uses two or more receiving antennas separated by nine or more wavelengths. These are separate receivers for each antenna. The receiver with strongest signal is selected.

b) Frequency diversity: It uses single receiving antenna which works for two or more frequencies. The frequency which has strong signal is selected.

27. Obtain the bandwidth of the FM signal.

$c(t) = 10 \times \cos[2 \times 10^7 \times \pi t + 8 \cos(1000 \times \pi t)]$

Ans: Compare the given FM signal equation with standard FM signal equation, $c(t) = E_c \cos(\omega_c t + m \cos \omega_m t)$

Here, $m = 8$, $\omega_m = 1000\pi$, Hence $f_m = 1000\pi$ or $f_m = 500$ Hz2π

28. State the disadvantages of FM.

i) Bandwidth requirement of FM is much higher.

ii) FM transmitting and receiving equipment is more complex and costly. iii) Distance of reception is limited only to line of sight.

29. What do you understand by FM stereo multiplexing?

FM stereo multiplexing is used for stereo transmission. It is basically frequency division multiplexing. It is used for FM radio broadcasting. The left and right channel signals are used to generate sum and difference signals. The difference signal frequency modulates the carrier. The difference signal, FM difference signal, FM difference signal and carrier are combined together and sent. Such FM multiplexed signal can be coherently received by stereo as well as mono receiver.

UNIT-III RANDOM PROCESS

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 (i)External noise
(ii)Internal noise.

3. 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

4. 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

5. 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.

6. Define transit time of a transistor.

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

7. 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

8 he reasons for higher noise in mixers.

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

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

9. 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.

10. Define noise figure.

Noise figure is decibel representation of Noise factor. i.e, Noise figure = (Noise factor) dB

Available S

11. Define thermal noise. Give the expression for the thermal noise voltage across a resistor.

The electrons in a conductor possess varying amounts of energy. A small fluctuation in this energy produces small noise voltages in the conductor. These random fluctuations produced by thermal agitation of the electrons is called thermal noise.

12. Define noise temperature. (In terms of hypothetical temperature)

The available noise power is directly proportional to temperature and it is independent of value of resistance. This power specified in terms of temperature is called as noise temperature. It is denoted by Te . It is given as,

$Te = (F - 1)T$

13. What is shot noise?

When current flows in electronic device, the fluctuations number of electrons or holes generates the noise. It is called shot noise. Shot noise also depends upon operating conditions of the device.

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

The Mean –Square value of thermal noise voltage is given by, Vn

TBR K – Boltz man constant, R – Resistance

T – Obsolute temperature, B Bandwidth

15. What is 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. The Power spectral

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 Friss formula in terms of noise temperature.

The Friss formula in terms of noise temperature is,

18. Define noise equivalent bandwidth.

The noise equivalent bandwidth of the filter is defined as the bandwidth of an ideal filter at which the noise power passed by real filter and ideal filter is same.

19. Define noise factor.

Noise factor (F) is defined as the ratio of signal to noise power ratio at the input to signal to noise power ratio at the output

20. Give the characteristics of shot noise.

(i) Shot noise is generated due to fluctuations in the number of electrons or holes. (ii) Shot noise has uniform spectral density.

(iii) Mean square noise current depends upon direct component of current. (iv) Shot noise depends upon operating conditions of the device.

UNIT-IV NOISE CHARACTERIZATION

1. What is FM threshold effect?

As the carrier to noise ratio is reduced, clicks are heard in the receiver output. As the carrier to noise ratio reduces further, crackling, or sputtering sound appears at the receiver output. Near the breaking point, the theoretically calculated output signal to noise ratio becomes large, but its actual value is very small. This phenomenon is called threshold effect.

2. What is capture effect in FM?

When the noise interference is stronger than FM signal, then FM receiver locks to interference. This suppresses FM signal. When the noise interference as well as FM signal are of equal strength, then the FM receiver locking fluctuates between them. This phenomenon is called capture effect.

3. What is meant by figure of merit of a receiver?

The ratio of output signals to noise ratio to channel signal to noise ratio is called figure of merit.,

4. What is the Purpose of re-emphasis and de-emphasis in FM?

The PSD of noise at the output of FM receiver sally increases rapidly at high frequencies but the PSD of message signal falls off at higher frequencies. This means the message signal doesn't utilize the frequency band in efficient manner. Such more efficient use of frequency band and improved noise performance can be obtained with the help of re-emphasis and de-emphasis.

5. What are extended threshold demodulators?

Threshold extension s also called threshold reduction. It is achieved with the help of FMFB demodulator. In the local oscillator is replaced by voltage controlled oscillator (VCO).The VC frequency changes as per low frequency variations of demodulated signal. Thus the receiver
responds only to narrow band of noise centered around instantaneous carrier frequency. This
reduces the threshold of FMFB receiver.

6. What is threshold effect with respect to noise?

When the carrier to noise ratio reduces below certain value, the message information is lost. The performance of the envelope detector deteriorates rapidly and it has no proportion with

7 pre-emphasis and de-emphasis.

e-emphasis: It artificially emphasizes the high frequency components befor
m n. This equalizes the low frequency and high frequency portions of the PS
c band is occupied.

De-emphasis: This circuit attenuates the high frequency components. The attenuation characteristic is exactly opposite to that of pre-emphasis circuit. De-emphasis restores the power distribution of the original signal.
The signal to noise ratio is improved because of pre-emphasis and de-emphasis circuits.

10. Define superheterodyne

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.

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. 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)m

2 . The use of FM offers improved noise performance over AM when (3 2)m f 2 f1 − modulation index in FM

3 m f

13. What is threshold effect in an envelope detector? Explain.

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 input SNR is below a certain level, called threshold level, the noise dominates over the message signal, threshold is defined as value of the input signal to noise ratio (So/No) below which the output signal to noise ratio (Si/Ni) deteriorates much more rapidly than the input signal to noise ratio. The threshold effect in an envelope detector whenever the carrier power-to-noise power

UNIT-V INFORMATION THEORY

1. What is entropy?

Entropy is also called average information per message. It is the ratio of total information to number of messages. i.e.,

Entropy, H = Total information
Number of messages

2. What is channel redundancy?

Redundancy (γ) = 1 – code efficiencyRedundancy should be as low as possible.

3. Name the two source coding techniques.

The source coding techniques are, a) prefix coding b) Shannon-fano coding c) Huffman coding

4. When is the average information delivered by a source of alphabet size 2, maximum?

Average information is maximum, when the two messages are equally likely, i.e., 1 Then the maximum average information is given as,
2 p1 = p2 —

5. Write down the formula for mutual information.

The mutual information is defined as the amount of information transferred when xi is transmitted and y_j is received. It is represented I (x , y). And it is given as,

Average mutual information is defined as the amount of source information gained per received symbol. It is denoted by I (X ;Y).

6. What is memory less source? Give an example.

The alphabets emitted by memory less source do not depend upon previous alphabets. Every alphabet is independent. For example a character generated by keyboard represents memory less source.

7. Explain the significance of the entropy H(X/Y) of a communication system where X is the transmitter and Y is the receiver.

a) H(X/Y) is called conditional entropy. It represents uncertainty of X, on average, when Y is known.

b) In other words H(X/Y) is an average measure of uncertainty in X after Y is received.

c) H(X/Y) represents the information lost in the noisy channel.

8. What is prefix code?

In prefix code, no codeword is the prefix of any other codeword. It is variable length code. The binary digits (codewords) are assigned to the messages as per their probabilities of occurrence.

9. Define information rate.

Information rate(R) is represented in average number of bits of information per second. It is calculated as,

$R = r H$ Information bits / sec

10. Calculate the entropy of source with a symbol set containing 64 symbols each with a probability pi =1 64 .

Here, there are M = 64 equally likely symbols. Hence entropy of such source is given as,$H = \log 2 M = \log 2 64 = 6$ bits / symbol

11. State any four properties of entropy.

a) For sure event or impossible event entropy is zero. b) For M number of equally H max = log 2

M likely symbols, entropy is log2 M

c) Upper bound on entropy is

d) Entropy is lower bound on average number of bits per symbol.

12. Give the expressions for channel capacity of a Gaussian channel.

Channel capacity of a Gaussian channel is given as,

$C = B \log 1+S^2$ bits / sec N

Here B is Channel bandwidth
S is signal power

1 the channel coding theorem for a discrete memory less channel.

S of the theorem:

ven a source of 'M' equally likely messages, with M >>1, which is
g information at a rate. Given channel with capacity C. Then if,R≤ C

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

Explanation: This theorem says that if R ≤ C ; it is possible to transmit information without any error even if noise is present. Coding techniques are used to detect and correct the errors.

15. 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

16. State Shannon Hartley theorem.

Channel capacity 'C' of a Gaussian channel is given as,

$$C = B \log_2 \left(1 + \frac{S}{N}\right) \text{ bits / sec}$$

Here B is Channel bandwidth
S/N Signal to noise ratio.

17. Explain Shannon-Fano coding.

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

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

Step 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.

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

18. Define bandwidth efficiency.

The ratio of channel capacity to bandwidth is called bandwidth efficiency. i.e,

$$\text{Bandwidth efficiency} = \frac{\text{Channel capacity (C)}}{\text{Bandwidth (B)}}$$

19. Define channel capacity of the discrete memory less channel.

The channel capacity of the discrete memory less channel is given as maximum average mutual information. The maximization is taken with respect to input probabilities p(xi) i.e.,

$$C = \max_{p(x_i)} I(X;Y)$$