

Electronics & Communication Engineering

Subject code: **EC1291**

Subject: **ANALOG AND DIGITAL COMMUNICATION**

Sem : IV

Branch: CSE

2 Mark Questions and Answers

UNIT 1

AMPLITUDE MODULATION : Transmission and Reception

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

3. Define depth of modulation.

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

$$m = E_m / E_c$$

4. What are the degrees of modulation?

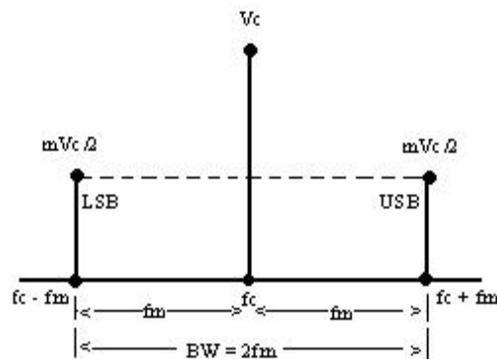
Under modulation. $m < 1$

Critical modulation $m = 1$

Over modulation $m > 1$

5. Define Amplitude Modulation

It is the process by which the amplitude of the carrier wave is changed in accordance with the instantaneous value of the message signal.



7. Define modulation index for AM

It is defined as the ratio of the maximum modulating voltage to the maximum

carrier voltage. It is also called as 'Depth of modulation'.

$$m = V_m / V_c$$

8. What is the relation between total power and carrier power?

$$P_t = P_c (1 + m)$$

P_t : Total power

P_c : Carrier power

m : Modulation index

9. What is the need for modulation?

Ease of transmission

Multiplexing

Reduced noise

Narrow bandwidth

Frequency assignment

Reduce the equipments limitations.

10. 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

11. What is single tone and multi tone modulation?

If modulation is performed for a message signal with more than one frequency

component If modulation is performed for a message signal with one frequency

then the modulation is called single tone modulation.

12. 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: $I_t = I_c (1 + m^2/2)^{1/2}$
 $8.93 = 8(1 + m^2/2)^{1/2}$
 $m = 0.701$
 $I_t = 8 (1 + 0.8^2/2)^{1/2}$
 $I_t = 9.1A$

13. A 400W carrier is modulated to a depth of 75 %. Calculate the total power in the modulated wave

Solution :

$P_c = 400 \text{ W}$
 $m = 0.75$
 $P_t = ?$
 $P_t = P_c (1 + m^2/2)$
 $P_t = 400 (1 + 0.75^2/2)$
 $P_t = 512.5 \text{ W}$

14. What is the relation between total power and carrier power?

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

15. What is the bandwidth of AM?

$$\text{Bandwidth} = 2f_m$$

16 Compare linear and non-linear modulators.

Linear modulators

Non-linear modulators

1. Heavy filtering is not required.
2. These modulators are used in level high level modulation.
3. The carrier voltage is very much greater than modulating voltage.

1. Heavy filtering is required
2. These modulators are used in low level Modulation.
3. The modulating signal voltage is greater than the carrier signal

17. 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.

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

$$\begin{aligned} m &= 0.3; P_c = 8 \text{ kw} \\ P_t &= P_c(1 + m^2/2) \\ &= 8.36 \text{ kw} \end{aligned}$$

19. 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.

20. Define sensitivity.

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

21. Define selectivity.

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

22. Define stability.

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

23. 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.

24. What is intermediate frequency?

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

$$IF = f_s - f_o \text{ when } f_s > f_o \text{ (or)}$$

$$IF = f_o - f_s \text{ when } f_o > f_s$$

25. 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.

16 marks

1. Explain AM modulator circuits in detail?

1. Low level AM modulator

Diagram

Explanation

2. Medium power modulator

Diagram

Explanation

2. Explain AM transmitters in detail?

1. Low level transmitters AM modulator

Diagram

Explanation

2. High level transmitters AM modulator

Diagram

Explanation

3.Explain the various receiver parameters?

1.Selectivity

2.Sensitivity

3.Dynamic range

4.Insertion loss

5.Noise temperature

4.Explain the circuit of TRF receiver?

Diagram

Explanation

5. Explain the operation of Super heterodyne receiver?

Diagram

Explanation

UNIT II

ANGLE MODULATION: Transmission and Reception

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

2. Define modulation index of frequency modulation.

It is defined as the ratio of maximum frequency deviation to

the modulating frequency. $\beta = \delta f/f_m$

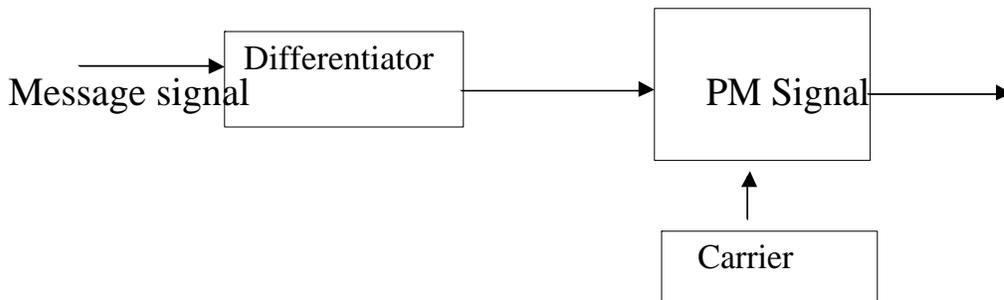
3. What do you mean by multitone modulation?

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

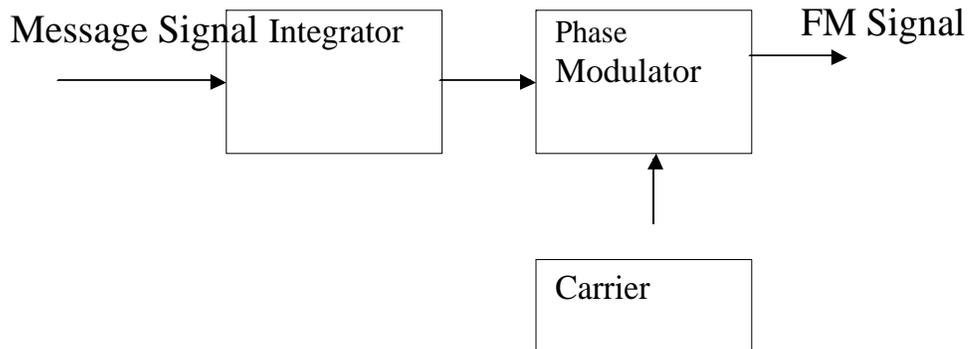
4. Define phase modulation.

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.

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



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



7. What are the types of Frequency Modulation?

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

8. 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.

9. 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 a 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

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

$$J_0(\beta) = 1$$

$$J_1(\beta) =$$

$$J_n(\beta)$$

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. $P = 1/2 E_c^2$.

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 is defined as

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

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

The deviation ratio D is defined as the ratio of the frequency deviation Δf , 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 effect of increasing modulation index in FM?

In FM, the total transmitted power always remains constant. But with

17. How do you get FM using PM system?

The frequency modulated wave can be obtained from PM system. This is done by integrating the modulating signals before applying it to the phase modulators.

18. Differentiate between narrow band and wide band FM signal.

S.No	WBFM	NBFM
1.	Modulation index is greater than one.	Modulation index is less than one
2.	Frequency deviation=75KHz	Frequency deviation=5KHz
3.	Modulating frequency range from 30 Hz to 15 KHz.	Modulating frequency=3KHz.
4.	Bandwidth 15 times NBFM.	Bandwidth = 2 FM.
5.	Noise is more suppressed.	Less suppressing of noise.
6.	Use: Entertainment and broadcasting.	Use: Mobile communication.

19. Why is FM superior to AM in performance?

i). In AM system the bandwidth is finite. But FM system has infinite number of sidebands in addition to a single carrier.

ii). In FM system all the transmitted power is useful whereas in AM

iii). Noise is very less in FM, hence there is an increase in the signal to noise ratio.

20. What is the use of crystal controlled oscillator?

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

21. 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

22. 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

23. What are the types of FM detectors?

Slope detector and phase discriminator.

24. What are the types of phase discriminator?

Foster seely discriminator and ratio detector.

25. 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.

16 Marks

1.

(1) Direct FM generation

(2) Indirect FM generation

(1) Direct FM generation

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

- (a) Varactor diode implementation of angle modulation.
- (b) Reactance tube implementation of angle modulation.

Diagram - explanation

Analysis

(2) Indirect FM generation

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

Diagram - explanation

Analysis

2. Explain the Indirect method of FM generation

It is used to generate WBFM signal

Block Diagram - Operation

First generate the NBFM signal and generate WBFM signal. Frequency multipliers, local oscillators and mixers do the generation of WBFM signal.

Analysis

3. Explain in detail the Foster seeley Discriminator.

It is used for FM Detection

Circuit Diagram – Operation

Advantages

1. It is much easier to design
2. Only two tuned circuits are necessary and they are tuned to same frequency
3. Linearity is better

Disadvantages:

It requires Amplitude limiting circuit

4.Explain direct FM transmitters in detail?

1.Crosby method

2.PLL method

5.Explain Indirect FM transmitter in detail?

Armstrong transmitter

Diagram & Explanation

UNIT III

DIGITAL TRANSMISSION AND DATA COMMUNICATION

1. What is meant by PCM?

The analog signal is sampled and converted to a fixed length, serial binary number for transmission. The binary number varies according to the amplitude of the analog signal.

2. Define quantizing process.

The conversion of analog sample of the signal into digital form is called quantizing process.

3. What are the two fold effects of quantizing process.

1. The peak-to-peak range of input sample values subdivided into a finite set of decision levels or decision thresholds

2. The output is assigned a discrete value selected from a finite set of representation levels are reconstruction values that are aligned with the treads of the staircase.

4. Define delta modulation

Delta modulation is the one-bit version of differential pulse code modulation.

5. Define adaptive delta modulation

The performance of a delta modulator can be improved significantly by making the step size of the modulator assume a time- varying form. In particular, during a steep segment of the input signal the step size is increased. Conversely, when the input signal is varying slowly, the step is

reduced , In this way, the step size is adapting to the level of the signal. The resulting method is called adaptive delta modulation (ADM).

6.Name the types of uniform quantizer?

1. Mid tread type quantizer.
2. Mid riser type quantizer.

7.Define quantization error?

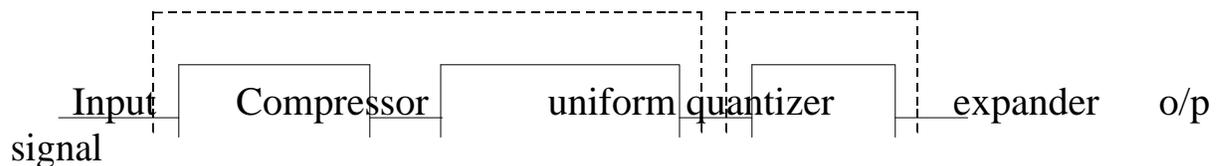
Quantization error is the difference between the output and input values of quantizer..

8.what do you mean by companding? Define compander.

The signal is compressed at the transmitter and expanded at the receiver. This is called as *companding*. The combination of a compressor and expander is called a *compander*.

9. Draw the block diagram of compander?

Block diagram:



1. μ law companding

2. A law companding

11. What is PAM?

PAM is the pulse amplitude modulation. In pulse amplitude modulation, the amplitude of a carrier consisting of a periodic train of

rectangular pulses is varied in proportion to sample values of a message signal.

12. What is Inter symbol interference?

The transmitted signal will undergo dispersion and gets broadened during its transmission through the channel. So they happen to collide or overlap with the adjacent symbols in the transmission. This overlapping is called Inter Symbol Interference.

13. How eye pattern is obtained?

The eye pattern is obtained by applying the received wave to the vertical deflection plates of an oscilloscope and to apply a saw tooth wave at the transmitted symbol rate to the horizontal deflection plate.

14. Define Data

Information is the knowledge or intelligence that can be processed, organized and stored is called data.

15. What is ISO?

ISO is International Organization for standardization. It creates set of rules and standards for graphics, document exchange and related technologies.

16. Define DTE?

equipment used at the stations to adapt the digital signals to analog signals from the computers and terminals to a form suitable for transmission

17. Define DCE?

DCE is the Data communication Equipment that converts digital signal to analog signal and interfaces the DTE to the analog transmission medium.

18. Define Serial by bit?

There is a single transmission line and only one bit can be transmitted at a time is called serial by bit.

19. Define Full duplex?

Transmissions are possible in both directions but they must be within the same two stations.

20. What is meant by error detection?

Error detection is the process of monitoring the received data and determining when the transmission error has occurred.

16 Marks

1. Explain with a neat diagram the operation of PCM?

Diagram

Sampling

Quantization

2. Explain Companding in detail?

1. Analog Companding

2. Digital companding

3. Explain the operation of DPCM in detail?

Diagram

Explanation

4. Explain the types of data communication codes?

1. Baudot code

2. ASCII code

3. EBCDIC code

4. Bar code

5. Explain Data communication hardware in detail?

Line control unit

UART transmitter & receiver

USRT transmitter & receiver

UNIT IV

DIGITAL COMMUNICATION

1. Explain how QPSK differs from PSK in term of transmission bandwidth and bit information it carries?

For a given bit rate $1/T_b$, a QPSK wave requires half the transmission bandwidth of the corresponding binary PSK wave. Equivalently for a given transmission bandwidth, a QPSK wave carries twice as many bits of information as the corresponding binary PSK wave

2. Give the equation for average probability of symbol error for coherent binary PSK.

Average probability of signal error,

$$P_e = 1/2 \operatorname{erfc} \sqrt{E_b / N_0}$$

3. Define QPSK

QPSK is Quadriphase –shift keying. In QPSK the phase of the carrier takes on one of the four equally spaced values Such as $\pi/4$, $3\pi/4$, $5\pi/4$ and $7\pi/4$.

4. Define Dibit.

dibits 10, 00, 01 & 11

5. Give the transmitted signal of Non-coherent binary FSK.

$$S_i(t) = \begin{cases} \sqrt{2E_b/T_b} \cos(2\pi f_i t), & 0 \leq t \leq T_b \\ 0, & \text{elsewhere} \end{cases}$$

$$f_i = f_c + i/T_b$$

6. Give the two basic operation of DPSK transmitter.

1. differential encoding of the input binary wave

2. Phase –shift keying hence, the name differential phase shift keying

7. Define Information Capacity?

Information capacity represents the number of independent symbols that can be carried in the system for a given time.

8. What is the unit of information capacity?

Unit is bits per second

9. Why digital amplitude modulation is commonly called ON –Off Keying?

Carrier is either in ON or Off state so it is called as On Off Keying.

10. Why digital amplitude modulation is called as continuous wave modulation?

When the carrier is being transmitted it has constant amplitude, constant frequency and constant phase.

11. Define Bit rate?

The rate of change at the input to the modulator is called bit rate and is expressed in bits per second.

12. Define Baud?

Baud is the rate of change and is equal to the reciprocal of one signaling element.

Mark frequency and Space Frequency

14. Define Phase reversal keying?

Since Phase of the output carrier shifts between two phases PSK is also called as Phase reversal keying.

15. What is Offset QPSK?

IT is a modified form of QPSK where the bit waveforms on the I and Q channels are offset or phase shifted in phase from each other one by one half of a bit time.

16. What is eight phase PSK?

Eight Phase PSK (8-PSK) is an M-ary encoding technique where $M=8$.

17. What is the need of maximum distance code?

It is used to reduce the number of transmission errors.

18. What is Quad bits?

A 16 bit PSK modulator acts on the incoming data in groups of four bit is called Quad bits.

19. Define DPSK?

DPSK is the difference between two successive signaling element rather than the absolute phase.

20. What is the need for BER?

Bit error Rate is the empirical record of Systems actual bit error performance.

1. Explain the operation of FSK in detail?

1. FSK transmitter

2. FSK receiver

Diagram

Explanation

3. Bandwidth calculation

2.Explain the operation of PSK in detail?

1.PSK transmitter

2.PSK receiver

Diagram

Explanation

3.Bandwidth calculation

3.Explain the operation of QPSK in detail?

1.QPSK transmitter

2.QPSK receiver

Diagram

Explanation

3.Bandwidth calculation

4.Explain the operation of QAM in detail?

1.QAM transmitter

2.QAM receiver

Diagram

Explanation

3.Bandwidth calculation

1.Squaring loop

2.Costas loop

3.Remodulator

UNIT V

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES

1. Define pseudo-noise (PN) sequence.

A pseudo-noise sequence is defined as a coded sequence of 1s and 0s with certain autocorrelation properties. It is used in spread Spectrum communications. It is periodic in that a sequence of 1s and 0s repeats itself exactly with a known period.

2. What does the term catastrophic cyclic code represent ?

'000' is not a state of the shift register sequence in PN sequence generator, since this results in a catastrophic cyclic code i.e. once the 000 state is entered, the shift register sequence cannot leave this state.

3. Define a random binary sequence.

A random binary sequence is a sequence in which the presence of a binary symbol 1 or 0 is equally probable.

4. State the balance property of random binary sequence.

In each period of a maximum length sequence, the number of 1s is always one more than the number of 0s. This property is called the balance property.

5. Mention about the run property

Among the runs of 1s and 0s in each period of a maximum length sequence, one half the runs of each kind are of length one, one fourth are of length two, one eighth are of length three, and so on as long as these functions represent meaningful numbers of runs. This property is called the run property.

6. Give the correlation property of random binary sequence.

The autocorrelation function of a maximum length sequence is periodic and binary valued. This property is called the correlation property.

7. Mention the significance of spread spectrum modulation.

An important attribute of spread-spectrum modulation is that it can provide protection against externally generated interfering (jamming) signals with finite power. The jamming signal may consist of a fairly powerful broadband noise or multitone waveform that is directed at the receiver for the purpose of disrupting communications. Protection against jamming waveforms is provided by purposely making the information bearing signal occupy a bandwidth far in excess of minimum bandwidth necessary to transmit it.

8. What is called processing gain ?

Processing Gain (PG) is defined as the ratio of the bandwidth of spread message signal to the bandwidth of unspread data signal (ie).

$$\text{Processing Gain} = \frac{\text{BW (spreaded signal)}}{\text{BW (Unspreaded signal)}}$$

9. What is called jamming effect ?

signals intentionally since these signals are in the frequency band of transmission, they interfere the required signal. Hence it becomes difficult to detect the required signals. This is called jamming effect.

10. What is Anti jamming ?

With the help of spread spectrum method, the transmitted signals are spread over the wide frequency band. Hence these signals appear as noise.

Then it becomes difficult for the jammers to send jamming signals. This is called antijamming.

11. What are the three codes used for the anti jamming application ?

1. Golay code (24, 12)
2. Expurgated Golay (24, 11)
3. Maximum length shift register code.

12. What is called frequency hop spread spectrum ?

In frequency hop spread spectrum, the frequency of the carrier hops randomly from one frequency to another frequency.

13. What is slow frequency hopping ?

If the symbol rate of MFSK is an integer multiple of hop rate (multiple symbols per hop) then it is called slow frequency hopping

14. What is fast frequency hopping ?

If the hop rate is an integer multiple of symbol rate (multiple hops per symbol) then it is called fast frequency hopping.

15. What are the two functions of fast frequency hopping ?

1. Spread Jammer over the entire measure of the spectrum of Txed signal.
2. Retuning the Jamming signal over the frequency band of Txed signal.

16. What are the features of code Division multiple Access ?

1. It does not require external synchronization networks.
2. CDMA offers gradual degradation in performance when the no. of users is increased But it is easy to add new user to the system.
3. It offers an external interference rejection capability.

17. What is called multipath Interference ?

The interference caused by the interfacing of the signal from the indirect path with the signal of direct path is called multipath interference.

18. Define FDMA?

FDMA divides the total available radio frequency spectrum into individual channels.

19. Define TDMA?

TDMA divides each radio channel into time slots one for each user.

20. Give the advantage of TDMA over FDMA?

1. Interleaving samples in the time domain allows for a threefold increase in the number of subscribers using a single channel.

2. Easy Encryption and decryption

16 Marks

1. Explain the DS spread spectrum technique?

Diagram

Explanation

2. Explain the FH spread spectrum technique?

1. Fast FH

Diagram

Explanation

3. Explain the properties of PN sequences?

the balance property

run property

correlation property

4..Explain the source coding of speech for wireless communication?

Types

Diagram

Explanation

5.Explain the types of Multiple access techniques?

1.TDMA

2.FDMA

Diagram

Explanation