SAT SUN MON TUE WED THU FRI
Date :

(4) 1a) What are meant by data & data communication? What are the different form of data that can be communicated?

Sol^n. Data:- Refers to any digital information that can be processed by a computer or other digital device. This can include text, numbers, images, audio and video as well as other types of digital information.

Data Communication:- Refers to the process of transmitting data from one device to another one over a network or other communication channel. This can include wired or wireless networks, the internet and other communication technology.

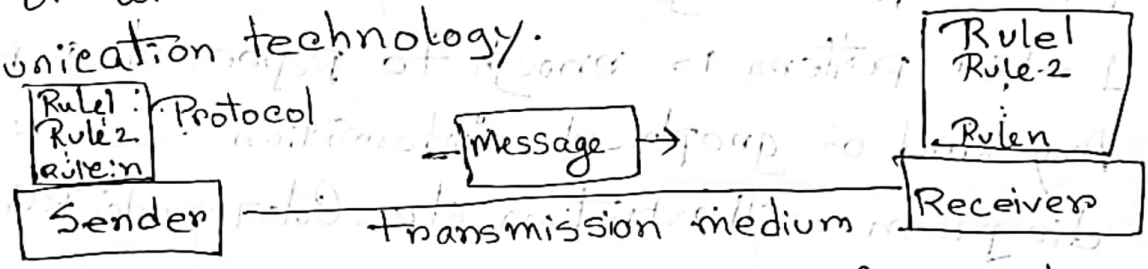



Figure: Components of data Communication

There are several different forms that can be communicated, including:-

1. Text data:- This includes any kind of alphanumeric characters, such as letters, numbers, and symbols, that can be represented using the ASCII or Unicode character sets. Text is represented as a bit pattern. Different sets of bit patterns have been designed to represent text symbol. Each set is called a code, the process of representing symbols is called coding. There are UNICODE, ASCII (127 char)

SAT SUN MON TUE WED THU FRI

Date :

2. Numeric data: This includes any kind of numerical value also represented by bit pattern Number is directly converted to binary number to simplify mathematical operation.

3. Images: Images are also represented by bit pattern. Consists of matrix of pixels (picture element) which are small dot. The size of pixel depends on the resolution. ~~The size of the~~ After an image is divided into pixel, each pixel is assigned a bit pattern. For image with only black-white dots a 1-bit pattern is enough to represent a pixel. Any kind of graphical information such as photographs, diagram, illustration etc. Color mode: RGB, CMY

4. Audio data:- Refers to recording or broadcasting of sound and music. It is continuous, not discrete. When we use microphone to change voice or music to an electric signal, we create a continuous signal.

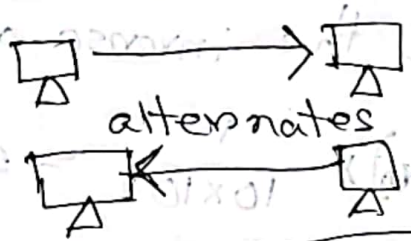
5. Video:- Refers to recording or broadcasting of a picture or movie, or it can be a combination of images; each a discrete entity, arranged to convey the idea of motion.

6. Binary data :- Any kind of digital information that is represented using a series of ones & zeros.. Computer codes, machine language.

7. Metadata :- Includes any kind of additional information that is associated with other types of data, such as time stamps, author info, etc

So, these are different forms of metadata.

2020 1 (b) Distinguish between half-duplex & full-duplex transmission modes. (2)
2

| Transmission mode | Half-duplex | Full-duplex |
|---|---|---|
| 1. Communication | Bi-directional but NOT simultaneous | Bi-directional & Simultaneous |
| 2. Transmission | Occurs in both direction but not at the same time | Occurs in both direction at the same time |
| 3. Signal flow | Transimisson Alternates | Transmission remain Simultaneous |
| 4 Figure |   |  at same time send & receive |
| 5. Example | Walkie-talkie, two way radio | telephone conversation, Conferencing LAN, WAN |

SAT SUN MON TUE WED THU FRI

Date :

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1 (e) Given a receiver with effective noise temp 100° and 10MHz bandwidth. Find the thermal ~~size~~ noise level at receiver's output.

(2.75)

Soln: Given temp = 100°C = 100 + 273 = 373K

We know, $N = KTB$

$= 1.38 \times 10^{-23} \times 373 \times 10 \times 10^{6}$

$= 5.1474 \times 10^{-14}$ Watts/Hz

Here,
k = Boltsman Constant
$= 1.38 \times 10^{-23}$ J/K

bandwidth = 10 MHz
$= 10 \times 10^{6}$ Hz

$NdBW = 10 \log_{10} \frac{N}{1W}$

$= 10 \log_{10} \frac{5.1474 \times 10^{-14}}{1 W}$

$= -132.88$ dB W

2 (a) What is length of a bit in a channel with the propagation speed of $2 \times 10^{8}$ m/s if the channel bandwith is (i) 10 Mbps (ii) 100 Mbps (iii) 1 Gbps.

(5)

bit length = propagation speed × bit duration

bit duration is the inverse of bandwidth

(i) bit length = $(2 \times 10^{8}) \times \frac{1}{10 \times 10^{6}} = 20$ m

This means a bit occupies 20 m on a transmission medium.

(ii) bit length $= (2\times10^8) \times \frac{1}{100\times10^6} = 2$ m

(iii) bit length $= (2\times10^8) \times \frac{1}{1\times10^9} = 0.2$ m

2020 2 (b) Suppose a periodic composite signal is generated by combining 5 harmonies of 2 kHz signal. Calculate (3) bw and draw the frequency spectrum.

Sol^n The bandwidth of a composite signal is the difference between highest and lowest frequency contained in that signal.

Given, the first harmonic is main signal i.e 2KHz

" 2nd " " $2\times 2$KHz = 4 KHz.

" 3rd " " $3\times 2$KHz = 6 KHz.

" 4th " " $4\times 2$KHz = 8 KHz.

" 5th " " $5\times 2$KHz = 10 KHz.

∴ Band width of the signal = $10-2 = 8$ KHz.

The frequency spectrum will have 5 discrete frequency component, spaced by interval of 2KHz. The amplitude of each component will depend of its harmonic number, and will decrease as the hermonic number increases.

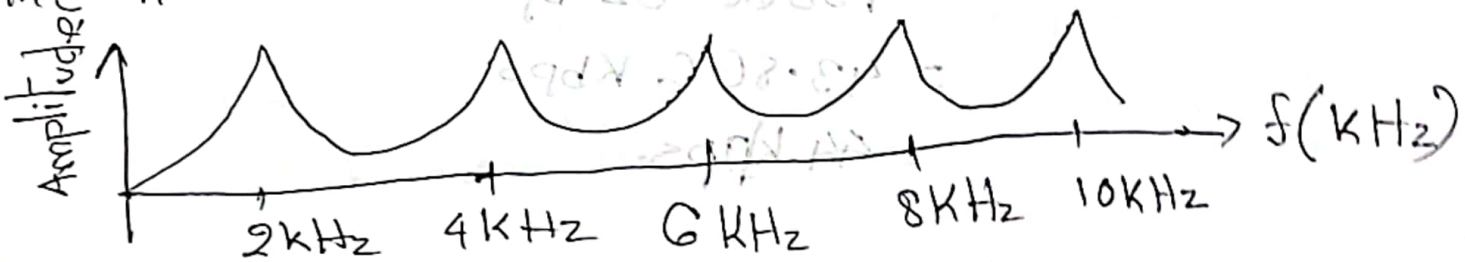



Figure: Frequency Spectrum

2020
2(c) (2)

A sine wave is offset 1/6 cycle with respect to time 0. What is its phase in degree and radian? (2)

Soln:
We know, 1 complete cycle = 360°
∴ 1/6 cycle is $\frac{1}{6} \times 360° = 60°$
In radian $= 60 \times \frac{\pi}{180}$ rad $= \frac{\pi}{3}$ rad $= 1.047$ radian.

2020
2(d) (2.25)

We measure the performance of a telephone line having 4kHz of bandwidth. When a signal is 10V, the noise is 5 mV. What is the maximum data rate supported by this telephone line?

Soln:
Given, signal power = 10V
noise power = 5 mV $= 5 \times 10^{-3}$ V.
We know, SNR $= \frac{\text{Signal Power}}{\text{Noise Power}} = \frac{10}{5 \times 10^{-3}} = 2000$ V.
As the channel is noisy, According to shannon's theorem –
Data rate $= B \log_2 (1 + SNR)$
$= 4 \times 10^3 \log_2 (1 + 2000)$
$= 4 \times 10^3 \log_2 (2001)$.
$= 43866.02$ bps
$= 43.866$ Kbps
$= 44$ kbps.

SAT SUN MON TUE WED THU FRI

Date :

2020

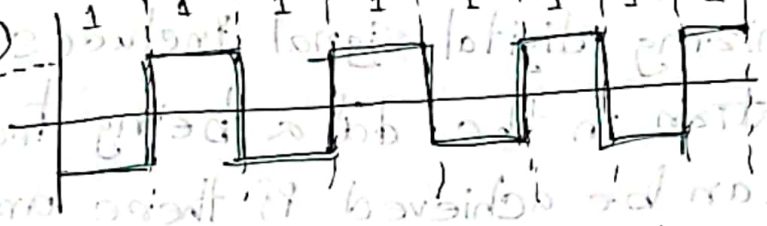
3.(a) Draw the graph of the AMI and MLT-3 scheme for each of the following data streams, assuming that the last signal is positive.

(3) (i) 11111111 (ii) 01010101 (iii) 00011000

Soln We know, in AMI (Alternate Mark Inversion)

0 → Zero voltage. 1 → Alternate voltage

(1) 1 1 1 1 1 1 1 1



(2) 0 1 0 1 0 1 0 1

(3) 0 0 0 1 1 0 0 0

Bit 0 → No trans

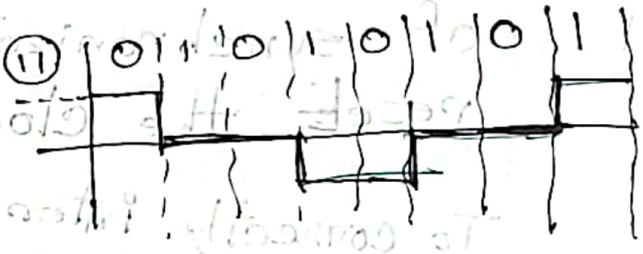
Bit 1 → (Current level NOT 0) → 0

Bit-1 → Current level 0 → opposite of last non-zero level

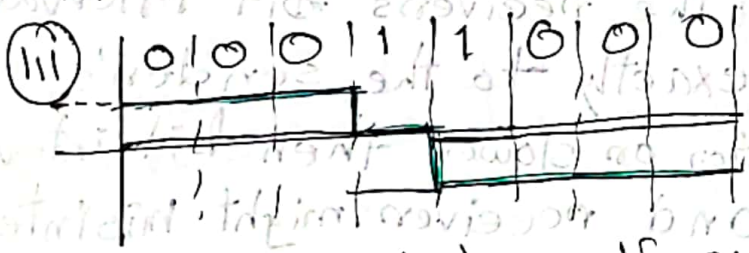
MLT-3 (Multiline transition)

(1) 1 1 1 1 1 1 1 1

(ii) 0 1 0 1 0 1 0 1



(iii) 0 0 0 1 1 0 0 0



3(b) (3+5) What is meant by self-synchronization? Mention the name of a line coding technique that can achieve self-synchronization. Explain your answer with example.

6

SAT SUN MON TUE WED THU FRI

Date :

Sol^n Self-Synchronization : The synchronization of long strings of 1s and 0s through the coding method. It is used to recover the timing of the transmitted data, without the use of an external clock or timing signal.

A self-synchronizing digital signal includes timining information in the data being transmitted. This can be achieved if there are transiton in the signal that alert the receiver to the beginning, middle, or end of the pulse. If the receiver's clock is out of synchronization, these points can reset the clock

To correctly interpret the signal received from the sender, the reciver's bit intervals must correspond exactly to the sender's bit interval. If faster or slower then bit interval are not matched and receiver might misinterpret the signal.

The line coding scheme that has Self-synchro-nization are —

Bipolar Biphase also known as Manchester and Differential Manchester, Multilevel 8B6T, 4D-PAM5.

In Manchester encoding scheme has the property that each bit transition occurs at the midpoint of the bit interval. The receiver can use the transition in the signal to recover the timing information without the need for an external clock or timing signal. 0 is high to low. And 1 is to represent low to high. The transition occurs at the midpoint of each interval, which allows the receiver to use them to recover the timing information.

For example consider Manchester bit sequence

10110001

By detecting the transition in the manchester encoded signal, the receiver can accurately recover the timing information & decode the transmitted data. This makes Manchester encoding an useful technique for achieving self-synchronization in digital communication system

10

2020

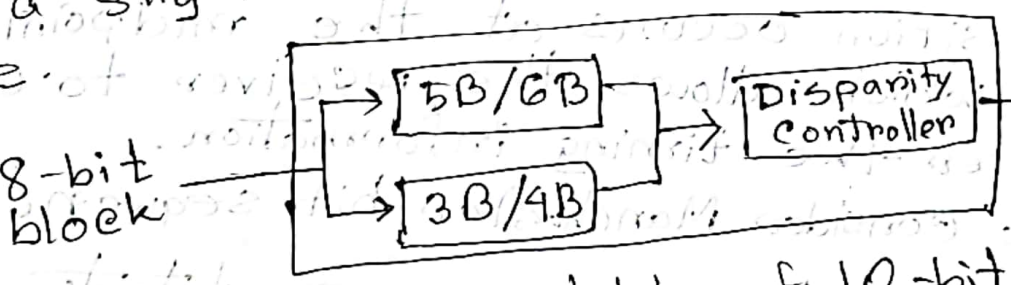
3 (a) Explain how 8B/10B block coding scheme co
(2) achieve error detection.

Ans. Block coding scheme achieve error detection by following 2 conditions:-

① The receiver can detect the change in the original codeword.

② The receiver has (or can find) a list of valid codewords.

In 8B/10B encoding, each 8-bit block of data is mapped to 10 bit code word, resulting in a slight overhead in the transmitted data rate.




The five most significant bits of 10-bit block are fed in 5B/6B encoder; the 3 least significant bits are fed into a 3B/4B encoder.

The coding table maps each 8 bit data block to a unique 10 bit codeword. The coding table is designed in such a way that any single bit error in the transmission data will result in a codeword that is not valid.

Date

This allows receiver to detect the presence of an error in the transmissited data simply by checking whether the received codeword is valid. The DC balanced signal is designed to have a balanced number of 0's and 1's over a certain Interval.

4@ 2's List three different technique in serial transmissia and explain the difference.

Soln:- Serial transmission is of 3 types -
① Asynchronous, ② Synchronous ③ Isochronous

Asynchronous - We send 1 start bit (0) at the beginning and 1 or more stop bits (1s) at the end of each byte. There may be a gap between each byte.

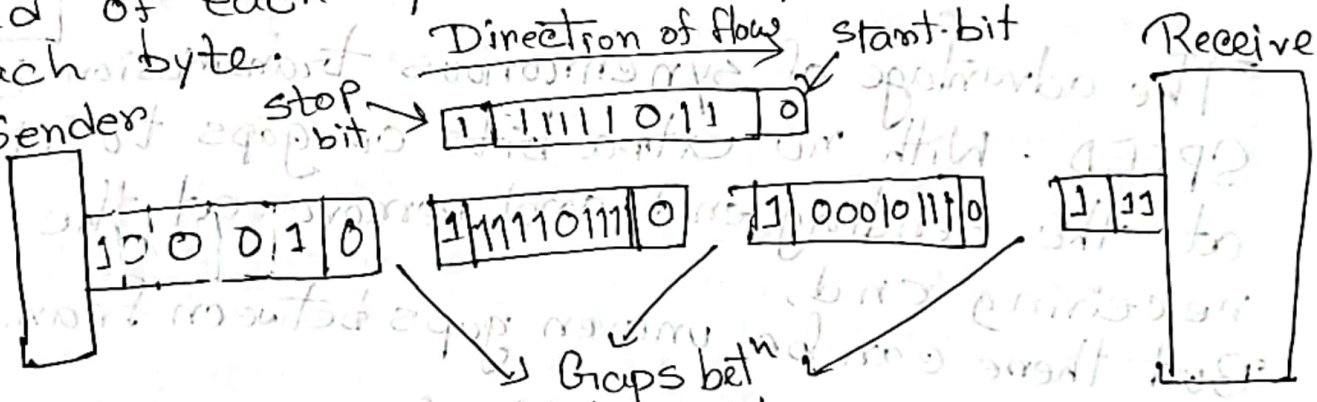


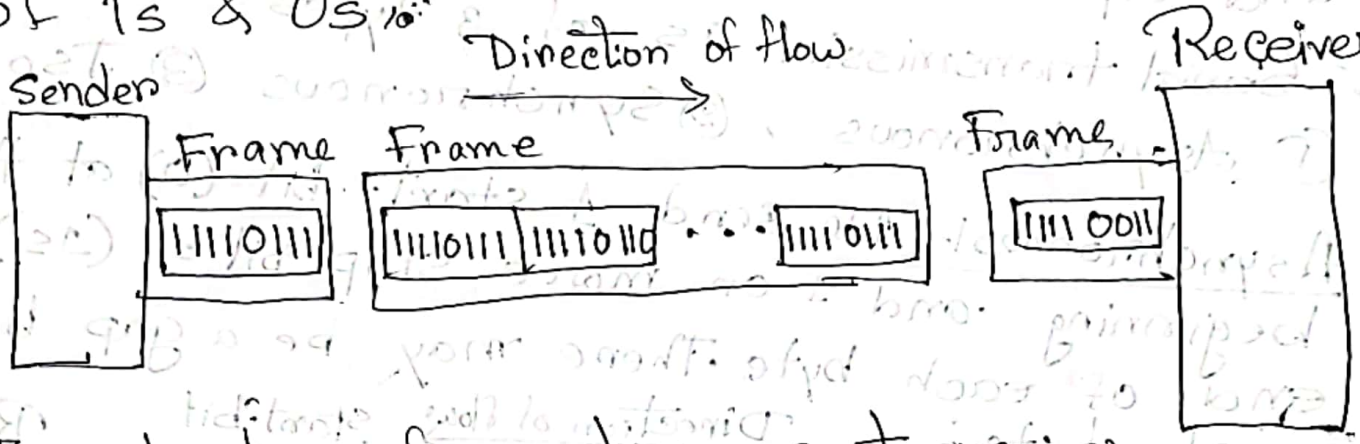

Figure: Asynchronous

The data are asynchronous at the byte level. but the bits are still synchronized; their duration are the same

SAT SUN MON TUE WED THU FRI

Date :

Synchronous: We send bits one after another without start or stop bits or gaps. ~~It is the~~ The bit stream is combined into longer "frames" which may contain multiple bytes. The receiver spe separate the bit stream into bytes for decoding purposes. Data are transmitted as an unbroken strings of 1s & 0s.




The advantage of synchronous transmission is SPEED. With no extra bits or gaps to introduce at the sending end and remove at the receiving end.
But there can be uneven gaps between frames.

Isochronous: We cannot have uneven gaps between frames. Transmission of bits is fixed with equal gaps. In real-time audio and video, uneven delay can not be ~~exce~~ acceptable. So, synchronous transmission fails. ~~For~~ TV images ~~are~~ broadcasts at same rate using isochronous data transmission.

(b) What is the Nyquist sampling rate for each of the following signals?

(i) A low-pass signal with bandwidth of 300 KHz.

(ii) A band-pass signal with bandwidth of 300 KHz. Its lowest frequency is 100 KHz.

i) Low passband signal, $f_1 = 0$ Hz, $f_h = f_1 + BW = 0 + 300 = 300$ KHz

∴ Nyquist Rate = $2 \times 300$ K Hz

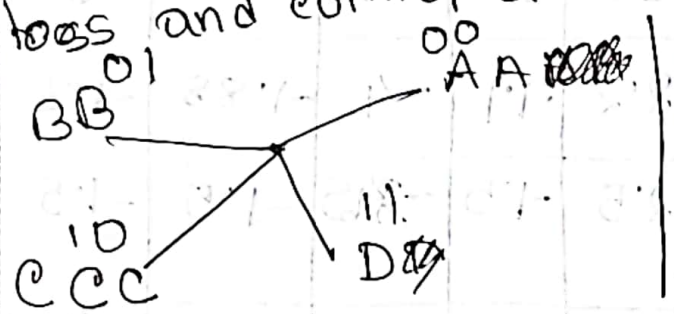
= 6,00,000 sample per second

ii) Bandpass signal, $f_h = f_1 + BW = 100K + 300K = 400$ KHz

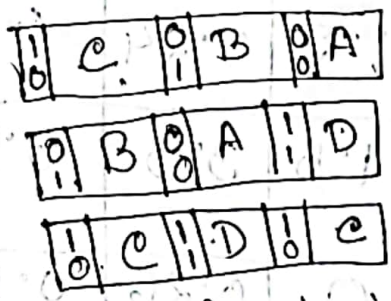
∴ Nyquist Rate = $2 \times 400K = 800000$ sample per second

(c) Why addressing is needed in statistical TDM?

Ans: Addressing is necessary in statistical TDM to ensure that each data is correctly routed to its destination. An addressing machine is needed to identify the source and destination of each data packet and route packet correctly. Without address it will be difficult for the receiver to distinguish bet$^n$ the packet from different sources, resulting in data loss and corruptions.




Frame of size 3




We do addressing to keep track of which source is, sending data packet in the transmission channe We can utilize the frame slots here

SAT SUN MON TUE WED THU FRI

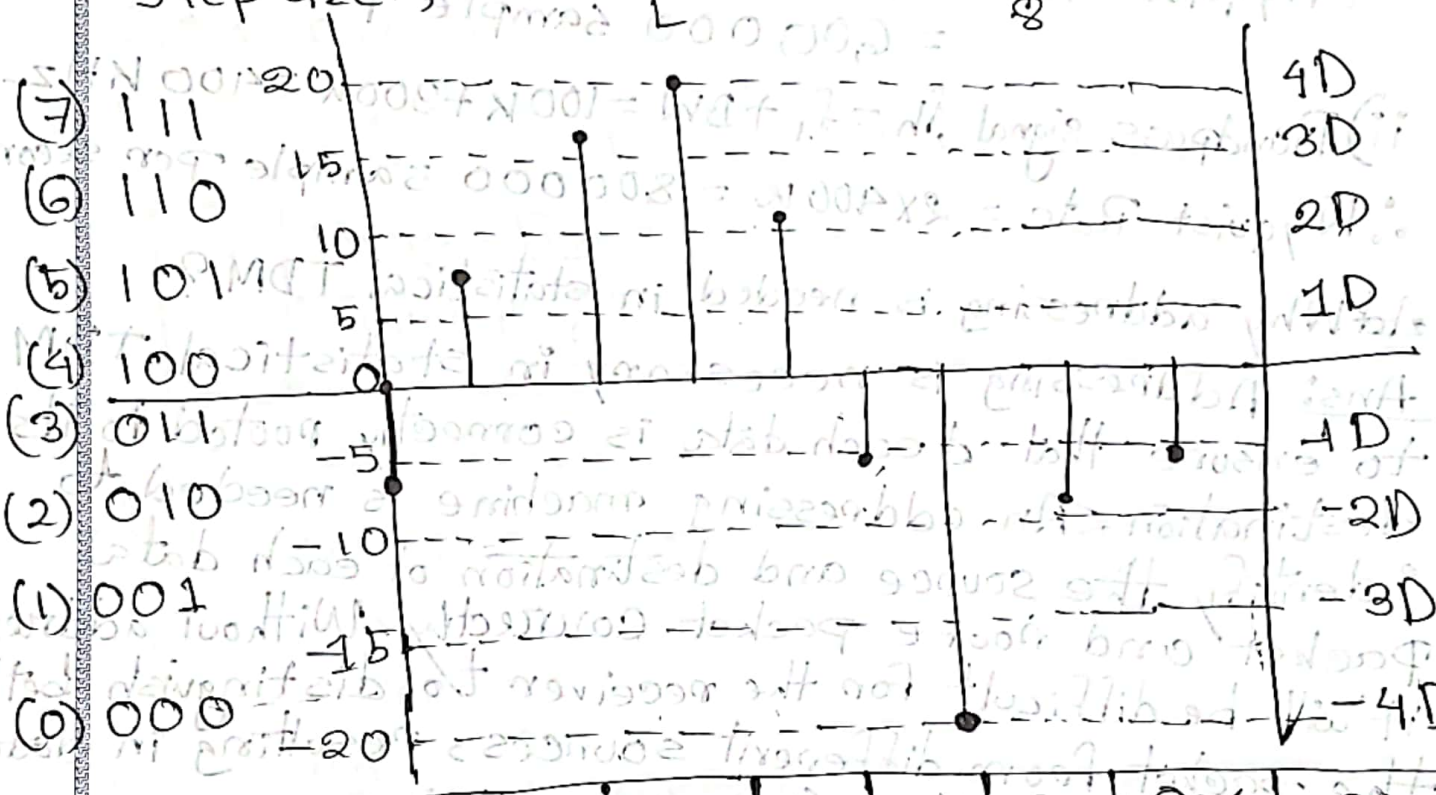
Date :

2020

4(b) Suppose we have 9 sampled amplitudes as −6·1, 7·5, 16·2, 20, 11, −5·5, −20, −9·4 and −6 in PCM. We decides to have 8 quantization levels Find the output encoded words (bit stream) after quantization by drawing necessary figures.

Soln Quantization level = 8, $V_{max} = 20$ $V_{min} = -20$

Step size, $\Delta = \frac{V_{max} - V_{min}}{L} = \frac{20 - (-20)}{8} = 5$




| Amplitude | −6·1 | 7·5 | 16·2 | 20 | 11 | −5·5 | −20 | −9·4 | −6 |
|---|---|---|---|---|---|---|---|---|---|
| Normalized value | −1·22 | 1·5 | 3·24 | 4 | 2·2 | −1·1 | −4 | −1·88 | −1·2 |
| Normalized Quantized value | −1·5 | 1·5 | 3·5 | 3·5 | 2·5 | −1·5 | −3·5 | −1·5 | −1·5 |
| Error | −0·28 | 0 | 0·26 | −0·5 | 0·3 | −0·4 | 0·5 | 0·38 | −0·3 |
| Q. Code | 2 | 5 | 7 | 7 | 6 | 2 | 0 | 2 | 2 |
| Encoded | 010 | 101 | 111 | 111 | 110 | 010 | 000 | 010 | 010 |

SAT SUN MON TUE WED THU FRI

Date :

Normalize PAM values = $\frac{\text{actual value}}{\Delta}$

Normalized quantized value = the mid value of the point =

For 5 to 10, $\frac{10-5}{2} + 5 = 1 \cdot 5$

For 10 to 15, $\frac{15-10}{2} + 10 = 2 \cdot 5$

~~∴ mid value of layer (2)~~

Quantized error = (Normalized Quantized value - Normalized PAM value)

∴ Output encoded words (bit stream) :-

010101 111 111 110010 000010 010

## 2020 ~~Set~~ Section-B

2020 5 (a) Define carrier signal & explain it's role in analog transmission.

2.5 Sol: A carrier signal is a single-frequency signal that has one of it's characteristics like an amplitude, frequency or phase. Its role in analog transmission is changed to represent the baseband signal.

SAT SUN MON TUE WED THU FRI

Date :

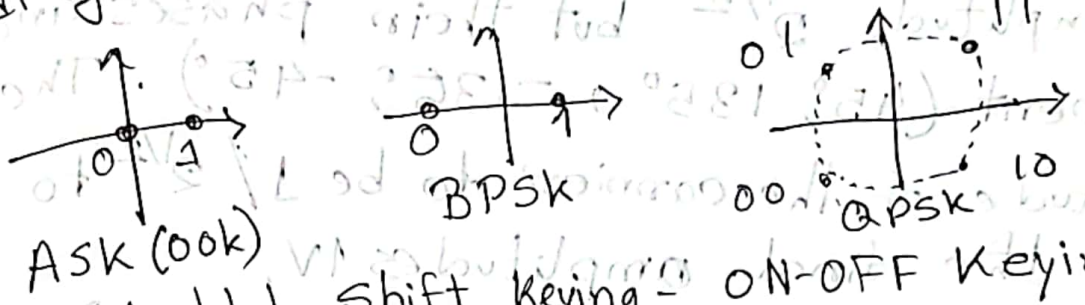
Its normally a high frequency signal used for digital-to-analog or analog-to-analog modulation. One of the characteristic of the carrier signal (amplitude, frequency, or phase) is changed according to the modulating data.

After the transfering of data signal to sender by demodulation process carrier signal is separated from the information -bearing signal.

2026
5(b) Draw the constellation diagram for ASK, BPSK, QPSK signals. Mention the information that can be deduced by analyzing each of the diagram.

3

Soln




For Amplitude Shift Keying - ON-OFF Keying, we are using only an in-phase carrier. Therefore, the two points should be on the x-axis. Binary 0 has an amplitude of 0V; binary 1 has an amplitude of 1V (for example). The point are located at the origin and at 1 unit.

Binary Phase shift keying uses only an in-phase carrier. However, we use a polar NRZ signal for modulation. It creates two types of signal elements, one with amplitude 1 and the other with amplitude -1. This can be stated in other words. BPSK creates two different signal elements, one with amplitude 1 V and 180° out of phase.

Quadrature PSK uses two carrier, one in-phase and other quadrature. The point representing 11 is made of two combined signal elements, both with an amplitude of 1V. One element is represented by an in-phase carrier, the other element by a quadrature carrier. The amplitude of the final signal element sent for this 2-bit

data element is $2^{1/2}$, and the phase is 45°. The argument is similar for the other three points. All signal elements have an amplitude $2^{1/2}$ but their phases are different (45°, 135°, -135°, -45°). The amplitude of the carrier to be $1/2^{1/2}$ to make the final amplitudes 1V.

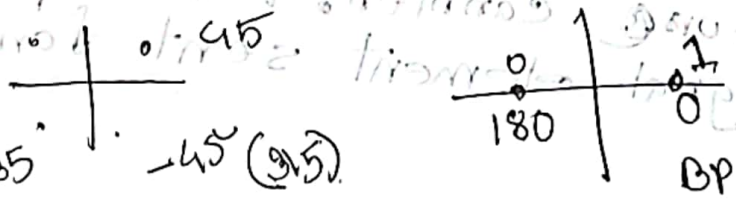
2020
5(c) Explain how a Quadrature PSK (QPSK) can be implemented with two separate Binary PSK (BPSK) with necessary diagram
3

Soln: To implemen QPSK with 2 BPSK we need to split input binary data stream into two separate stream.

1st half is modulated with In-phase BPSK
2nd half is modulated with out-phase i.e. quadrature phase components of the carrier signal. The two modulated signals are then combined by combiner and transmitted over communication channel.

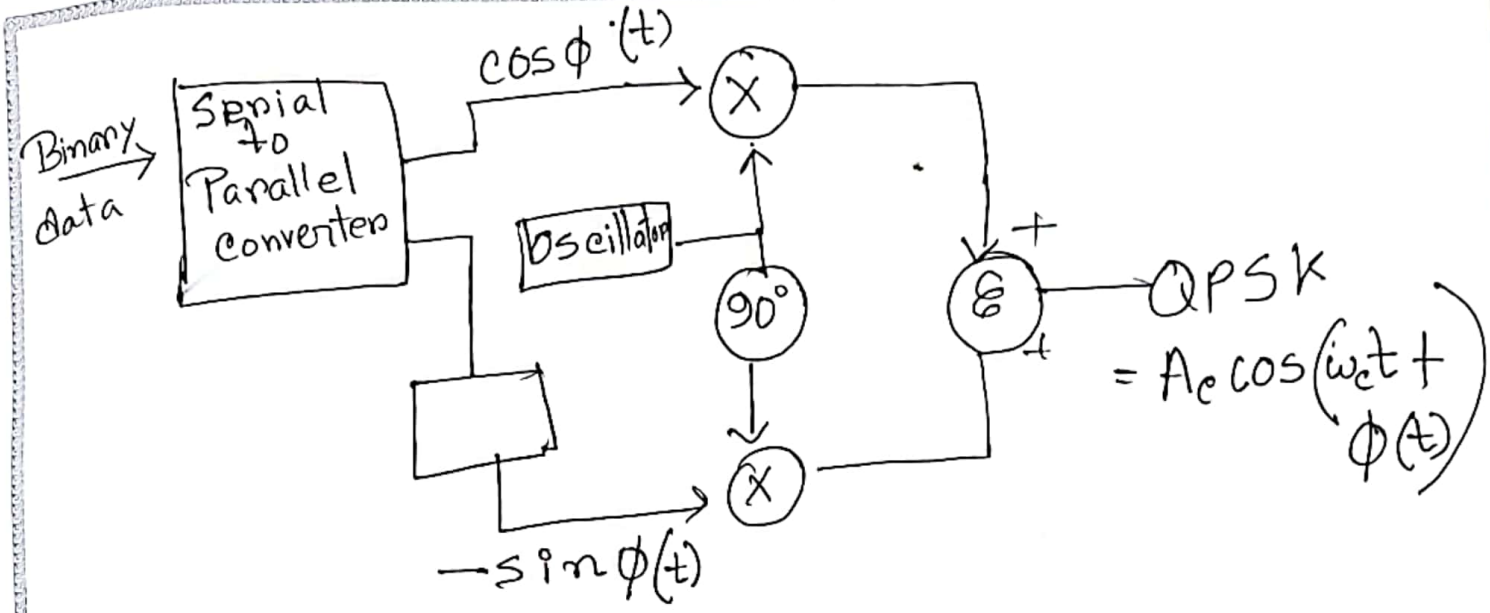
360/4 = 90°

the 4 phases = 45°; 45+90=135°;
135+90° = 225° & 225 +90° = 315°;



SAT SUN MON TUE WED THU FRI

Date :



20

SAT SUN MON TUE WED THU FRI

Date :

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Date :

2020

6@ 75

If the bandwidth of an audio signal is 5 kHz, what will be the required bandwidth of each AM radio station? Find the total number of usable AM stations assuming the allocated carrier frequency range from 530 KHz to 1700 KHz.

Ans: $BW = 5\,kHz$

Required bandwidth, $B_{AM} = 2 \times B_W = 2 \times 5 = 10\ kHz$.

The allocated carrier frequency range for AM radio station is from 530 KHz to 1700 KHz. the total available $= (1700 - 530)\ KHz = 1170\ KHz$

$\therefore$ Total no. of usable station $= \frac{\text{total bandwidth}}{\text{Required bw}}$

$= \frac{1170}{10} = 117$.

6(b) Four channels, two with a bit rate of 300 kbps and two with a bit rate of 150 kbps, are to be multiplexed using multiple-slot TDM with no synchronization bits. Ans. the following questions: i) What is the size of a frame in bits ii) What is the frame rate? iii) What is the duration of each frame? iv) What is data rate

3.

Sol: i) The size of frame in bits $= \frac{300 \times 2}{150} + \frac{150}{50} \times 2 = 18$ bits

ii) Each frame carries 6 bits from 300 kbps each and 3 bits from each 150 kbps. $\therefore$ Frame rate $= \frac{300000}{6} = \frac{150000}{3}$

$= 50000$ frames/s

iii) Frame duration $= \frac{1}{\text{frame rate}}$

$= \frac{1}{50000} = 20\ \mu s$

SAT SUN MON TUE WED THU FRI

Date :

iv) Data rate = 2 X 300 + 2 X 150

= 900 kbps

The output data rate is the sum of input data rates because there are no synchronization bits.

6.(c) Describe the goals of multiplexing. (2).

Soln The method multiplexing is a set of techniques that allows the simultaneous transmission of multiple signals across a single data link.

The goal of multiplexing is to allow multiple users to share same communication channel, making it cost effective and efficient.

6(d) which 3 multiplexing used in analog transmission?

Ans For Analog transmission — ① Frequency division multiplexing

② Wavelength division multiplexing.

③ Time division multiplexing.

Although TDM is used in digital transmission, in system with multiple analog signals are time-interleaved and transmitted over single channel.

TDM in form of PAM - Pulse Amplitude Modulation use in Analog.

SAT SUN MON TUE WED THU FRI

Date :

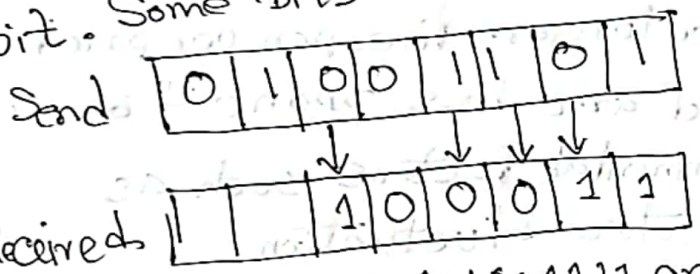
2026

7 @ How does a single bit error differ from a burst error?

1·75

Soln. Single bit error means that only 1 bit of a given data unit (such as a byte, character byte) is changed from 1 to 0 or from 0 to 1.


Burst Error: 2 or more bits in the data unit have changed from 1 to 0 or alternate. A burst error does not mean that errors occurs in consecutive bits, the length of burst is measured from the first corrupted bit to the last corrupted bit. Some bits inbetween may not been corrupted.




7 (b) Given the dataword 10100111 and divison $1011$. Generate CRC codeword at the senden side.

(3)

Bit $\cdot$ 5-1 = 4 0s

$x^3 x^2 1$

```
10111 | 10100111 10000
        10111
        -------
        00011111
          10111
          -----
          010001
           10111
           -----
           001100
            10111
            -----
            11110
            10111
            -----
            01010
             1011
             ----
             0101
```

XOR

∴ CRC Codeword =

10100111 0101

24

2026

SAT SUN MON TUE WED THU FRI

Date :

7 (a) What are the advantages & disadvantage of optical fiber for data communication?

4.

Sol^n

Advantages:-

1. High band width:- Has a much higher bandwidth than copper cables, allowing for higher data transfer rates.

2. Low Attenuation:- Low signal attenuation than copper cables allowing signals to be transmitted over longer distances.

3. Immunity to Electromagnetic Interference:- Optical fibers are immune to EMI and Radio -frequency interference, which can cause signal degradation in copper cables.

4. Durability:- Have a longer lifespan compared to copper cables, and are less prone to damage from environmental factors such as moisture and temperature fluctuation.

Disadvantages:-

1. Cost:- Generally more expensive than copper cables.

2. Difficult to install and Maintain:- Installing & maintaining optical fiber cables requires specialized equipment and trained personnel

Date

Teresa Jency Bala

3. Fragility:- Optical fibers are more fragile than copper cables and can be easily damaged if bent too sharply or subjected to excessive force

4. Limited Availability:- Optical fibers may not be at available in all locations, limiting their use for data communication

5. Compatibility:- Optical fibers are not always compatible with existing network infrastructure, requiring additional equipment to be installed.

2020
8 (a)
2

What do you know about frequency bands for satellite communication?

Ans: There are mainly 5 types of satellite frequency bands.

| Band | Downlink, GHz | Uplink, GHz | Bandwidth, MHz |
|---|---|---|---|
| L | 1.5 | 1.6 | 15 |
| S | 1.9 | 2.2 | 70 |
| C | 4 | 6.0 | 500 |
| Ku | 11 | 14.0 | 500 |
| Ka | 20 | 30.0 | 3500 |

The frequency reserved for satellite microwave communication are in gigahertz range. Each satellite sends and receives over two different bands. The

SAT SUN MON TUE WED THU FRI

Date :

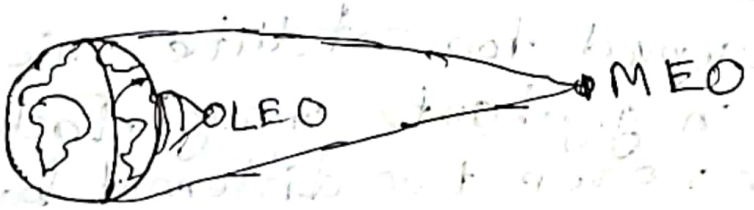
transmission from Earth to satellite is called uplink. The transmission from the satellite to earth is downlink.

2020
3.75 8(b) What is MEO satellite? Describe it with the example of GPS.?

Ans Medium Earth orbits are earth centered orbits that at altitude 2000 km to 35,786 km. They are positioned betn two Van Allen belts. A satellite at this orbit takes approximately 6 to 8 hours to circle the Earth

The most prominent satellite traversing the MEO are GPS & Galileo constellation which power navigation across the world.

This region is very dangerous for human, which is the primary reason for the non existense of ISS (International Space station) or habitable space stations in the MEO as the astronauts are susceptable to high amount of radiation.



SAT SUN MON TUE WED THU FRI

Date :

Satellites orbiting is the MEO are highly shielded with materials such as Gold, Aluminum, and kevlar. which are stacked in layer that keep the radiation at bay. A satellite in an MEO completes around 1-2 orbits in a day. To achieve a 12-hour orbit (2 orbits in a day), an MEO Satellite must be placed at a height of 20,200 km from earths surface.

The GPS (Attitude of 20,200 kilometers), GLONASS (Attitudes of 19,100 kilometer), Galileo (23,222 km). All these are for navigation & communication

2020

8(c) What type of propagation does satellite communication use? How does that mode differ from other

3 propagation modes?

Ans: Space wave communication is used in satellite communication. LOS (Line of slight) wave propagation is used in this mode. The frequency range used is 54 MHz to 4.2 GHz. because if the frequency of radio waves is greater than 54 MHz, then the wave cannot travel along the surface of the earth and also cannot be reflected by the ionosphere.

SAT SUN MON TUE WED THU FRI

Date :

~~Ground Wave Propagation:~~

~~Definition of~~

Satellite communication primarily uses space wave propagation. This mode differs from propagation modes in that it involves transmitting the signal directly from the antenna to a satellite, which then relays the signal back down to the receiver. This is different from ground wave and line of sight propagation, which involve the signal traveling along the earth's surface or in a straight line between the antennas. Sky wave propagation is also different from space wave propagation in that it involves bouncing the signal off the ionosphere rather than transmitting it directly to a satellite.

Date :

## Radio waves :-

① Omni directional in nature, the need to physically align the transmitter and receiver does not rise.

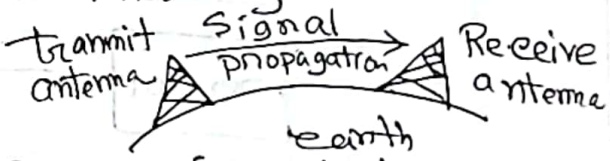
② The frequency of radio wave determines many of the characteristics of transmission

③ At low frequencies, the wave can pass through obstacles easily. however, their power falls with an inverse-squared relation with respect to distance

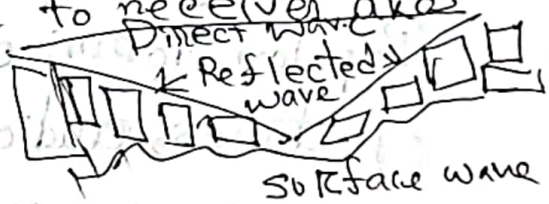
**Radiowave Propagation :-** We use wireless electromagnetic waves as the channel There are 3 categories-

1. Line of sight propagation
2. Ground wave propagation
3. Sky wave propagation

**1. Line of Sight :-** The wave travels a minimum distance of sight. We need to employ an amplifier transmitter to amplify the signal and transmit again.




**2. Ground Wave Propagation :-** such a wave is called as direct wave. The wave may bend due to Earths magnetic field and gets reflected to receiver aka reflected wave. The wave when propagates through earths surface atmosphere is known as ground wave.



SAT SUN MON TUE WED THU FRI

Date :

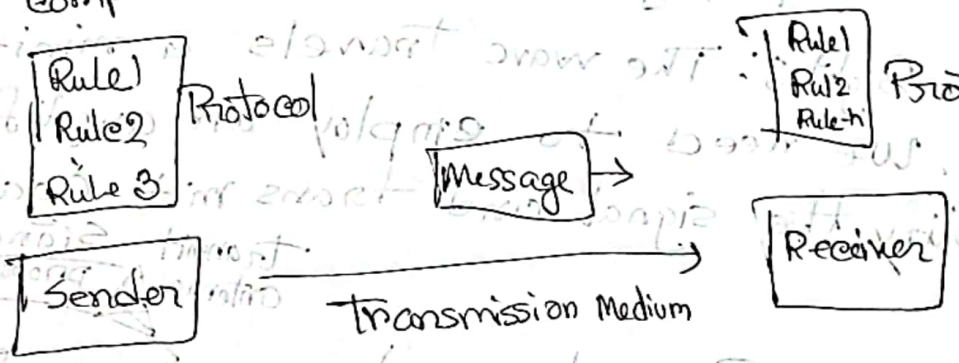
Sky Wave propagation :- Preferred when the wave has to travel a longer distance. So the wave is projected onto the sky and it is again reflected back onto the earth.


Waves are transmitted from the transmitter antenna, are reflected from ionosphere.

## 2019

1@ What is meant by data communication? Explain all the basic components used in data communication system.

Ans:




1. Message :- The message is the info (data) to be communicated. Popular forms of information include texts, numbers, pictures, audio, and video.

2. Sender :- The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera and so on.

Date :

3. Receiver :- The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, TV and so on.

4. Transmission medium :- The physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fibre-optic cable, and radio waves.

5. Protocol :- A protocol is a set of rules that govern data communication. It represents an agreement between communicating devices. Without protocol, two devices may be connected but not communicating, just as a person speaking French to a person who speaks only Japanese.

1. (b) -> 2020 - 16.

1(c) How does digital signal differ from analog signal? A signal has been received that only has values of -1, 0, 1, what type of signal they are? draw the signals.

Ans: Analog signal uses a continuous range of values that help to represent information; digital.

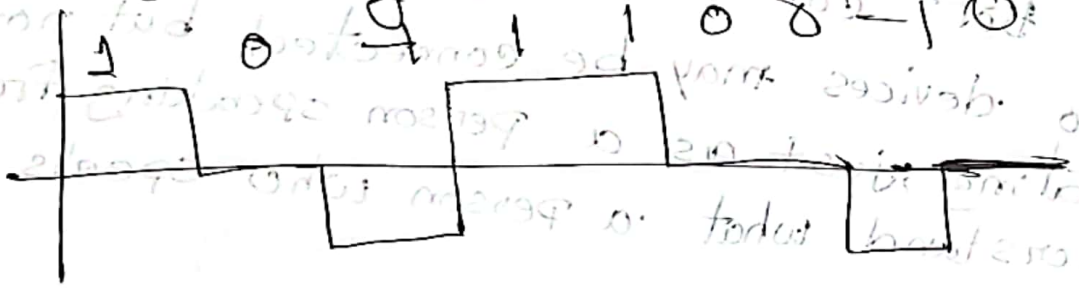
SAT SUN MON TUE WED THU FRI

Date :

Signal uses discrete 0 and 1 to represent information.

Analog signal are presented by sign waves. while Digital are by square waves.

A signal that only has values of -1, 0, 1 are most likely digital signal. As these are commonly used in digital communication systems to represent binary data. This type of signal is also known as a binary signal or a digital baseband signal.




The sequence can be mapped into 0s & 1s only & using line coding.

SAT SUN MON TUE WED THU FRI

Date :

2@ We sends a digital signal from one PC on a LAN to another PC. Is this baseband or broadband transmission?

7.25

Ans: If a digital signal is transmitted over a wired connection within a LAN, it is most likely using baseband transmission. It uses a single channel to transmit digital signals and the entire bandwidth of the channel is occupied by the signal. Ethernet which is commonly used for wired LAN connections uses baseband transmission.

Broadband transmission, uses multiple channels to transmit signals simultaneously. This is commonly used for cable and satellite internet connection.

2(b) How many bits can fit on a link with a 2ms delay. If the bandwidth is i) 1 MBPS ii) 100 Mbps.

S-VI 2

Sol^n We know, $\text{bandwidth} = \frac{\text{Number of bits}}{\text{delay}}$

$\therefore$ Number of bits = bandwidth $\times$ delay

delay = 2 ms
$= 2 \times 10^{-3}$ s

i) Num of bits $= 1 \times 10^6 \times 2 \times 10^{-3}$
$= 2000$ bits

ii) Num of bits $= 100 \times 10^6 \times 2 \times 10^{-3}$
$= 20,0000$ bits.

34

$\log_a x = y$
$a^y = x$

SAT SUN MON TUE WED THU FRI
Date :

2019
2 (c) The attenuation of a signal is -10 dB. What is the final power if it was originally 10 W.

Ans: We know, attenuation $= 10 \log_{10} \frac{P_2}{P_1}$

$\Rightarrow -10 = 10 \log_{10} \frac{P_2}{P_1}$

$\Rightarrow -1 = \log_{10} \frac{P_2}{10}$

$\Rightarrow 10^{-1} = \frac{P_2}{10}$

$\Rightarrow \frac{1}{10} = \frac{P_2}{10}$

$\Rightarrow P_2 = 1 \text{ W}.$

019
2 (d) A network actually sends 12000 frames per minute with each carrying an average of 10000 bits. The throughput of the network is one-fifth the bandwidth. What is the bandwidth of the network

Ans. We know,
$\text{throughput} = \frac{\text{no of frame} \times \text{bit size}}{\text{time}}$

$= \frac{12000 \times 10000}{60}$

$= 2 \text{ Mbps}.$

$\therefore$ The bandwidth $= 5 \times 2 = 10 \text{ Mbps}.$

SAT SUN MON TUE WED THU FRI

Date :

2019

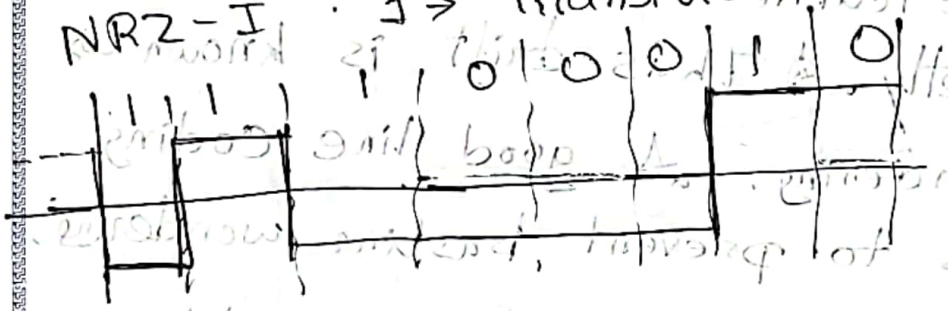
3@ Draw the digital signal encoded using NRZ-L and NRZ-I for bit stream 11100010. Mention the problem occured for this bit combination with each technique. (Last non-zero signal level has been positive).

3½

Ans. Considering last non-zero level positive

NRZ-L : 1 → Negative, 0 → Positive


NRZ-I : 1 → Transition, 0 → No-transition.



36

SAT SUN MON TUE WED THU FRI

Date :

2019

3(b) Define baseline wandering and mention its effect on digital transmission.

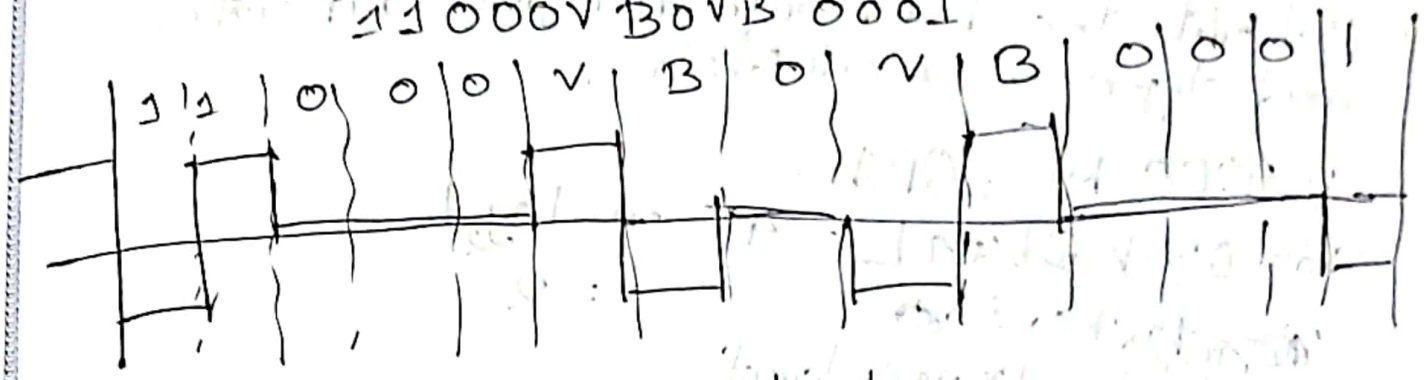
Ans: In decoding a digital signal the receiver calculates a running average of the received signal power. The average is called the baseline. The incoming signal power is evaluated against this baseline to determine the value of the data element. A long string of 0s or 1s can cause a drift in the baseline and ~~at mat can~~ this drift makes difficulties for the receiver to decode correctly. This drift is known as baseline wandering. A good line coding scheme needs to prevent basline wondering.

19

(c) (i) Draw the resulted signal of scrambling the sequence "1000000000001 using BSZS and HDB3 scrambling technique. (Last non-zero signal level has been positive).

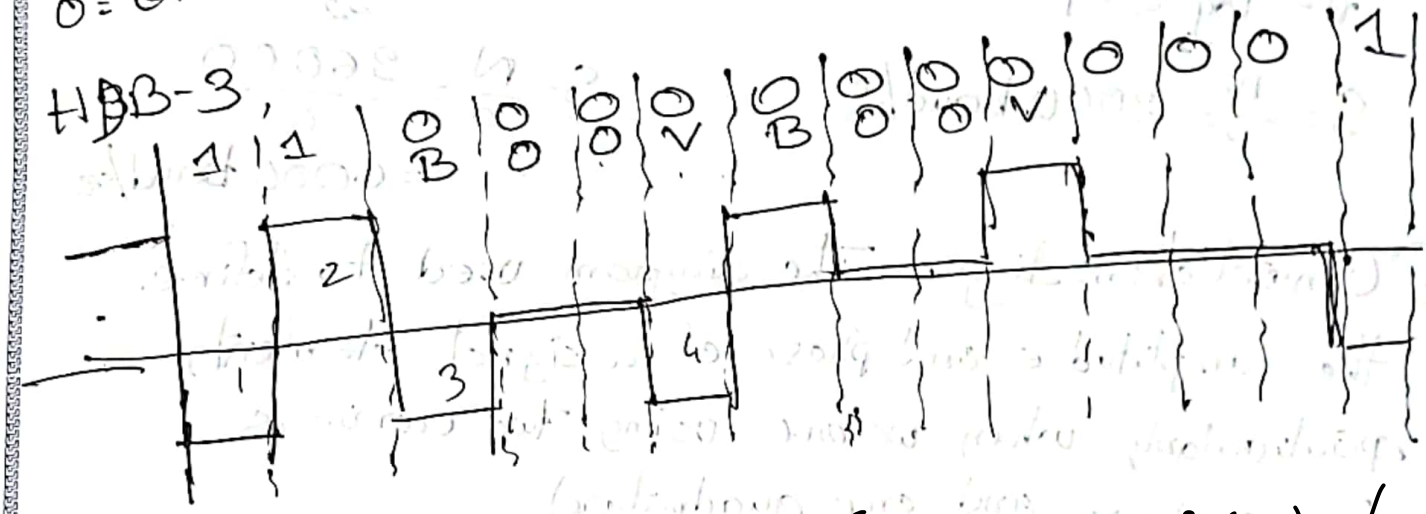
Soln. The last non-zero signal level is positive.

B8ZS. 1100000 0000 0001 =
1100V B0VB 0001




V = Same as last non-zero level
B = opposite of last
1 = "
0 = ~~transition~~ 0.

HBB-3,




1 = alter
0 = ~~No change~~ 0

V = Same
B = Alter

0000 → 000V / B00V
odd / even

2019 - 4 a, c → cannot solve
2019 - 4b - 2020 = 4a

SAT SUN MON TUE WED THU FRI

Date :

## Section- B

2019- 5 a → 2020 5a

2019 5 b Calculate the baud rate for given bit rate and type of modulation.

i) 4000 bps, QPSK.

For QPSK, $L = 4$ $\quad r = \log_2 L$

$= 2$

bit rate = baud × no. of element

$\therefore S = \frac{N}{r} = \frac{4000}{2} = 2000$ signal/sec

ii) 3000 bps, FSK

$r = \log_2 2 = 1$

$S = \frac{N}{r} = 3000$ baud/sec

(iii) 36000 bps, 64-QAM

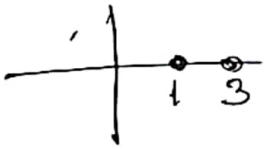
$r = \log_2 64 = 6$

$S = \frac{N}{r} = \frac{36000}{6}$

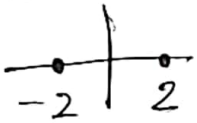
$= 6000$ baud/sec

5 c) Constellation diagram: The diagram used to define the amplitude and phase of a signal element, particularly when we are using two carriers (one inphase and one quadrature).

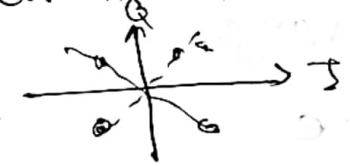
① ASK with peak value 1 and 3



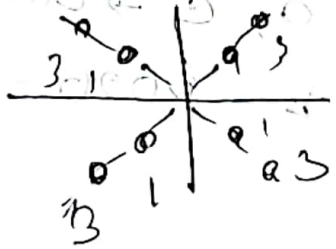

② BPSK with peak value 2




③ QPSK with peak - 3




④ QPSK with peak - 1 & 3 and 4 diff phase



2019-6@ - 2020-6c

6(b) We need to use synchronous TDM and combine 40 digital sources, each of 100 kbps. Each o/p slot carries 1 bit from each source, but one extra bit is added to each frame for synchronization.

i) What is Size of output frame in bits?

40 x 1 + 1 = 41 bits/frame

ii) What is the output frame rate?

Frame rate = $\frac{100}{1}$ k-frames/sec = 100 kframe/s

iii) Output data rate = Frame rate X frame size = 100 x 41 = 4.1 Mbps.

2019 - 6c → 2020 6b, 2019 - 6d → 2020 - 6d

20.

2019-7 (a) Why error correction more difficult than detection?

Soln:- Error correcting involves not only identifying the presence of errors but also correcting them. To correct the error in data frame, the receiver must know exactly which bit in the frame is corrupted.

7(b) data word = 10011, divisor = 1011

$$\begin{array}{r} 1011 \overline{)\,10011000} \\ 1011 \\ \hline 1010 \\ 1011 \\ \hline 100 \end{array}$$

∴ CRC = 10011100

Single bit error -

$$\begin{array}{r} 1011 \overline{)\,100.10100} \\ 1011 \\ \hline 1001 \\ 1011 \\ \hline 1000 \\ 1011 \\ \hline 11 \end{array}$$

B.W = Speed / distance

40

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Date :.....

# ⑥ Calculate bw of light. propagation speed = $2 \times 10^8$ m

i) 1000 to 1200 nm

$$B.W = \frac{2\times10^8}{1000\times10^{-9}} - \frac{2\times10^8}{1200\times10^{-9}} = 33\times10^{12} = 33\ THz$$

(ii) 1000 to 1400 nm

$$BW = \frac{2\times10^8}{1000\times10^{-9}} - \frac{2\times10^8}{1400\times10^{-9}} = 57\times10^{12} = 57\ THz$$

8 (a) What is satellite Communication? (b) had do you (2) know about satellite orbits.

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Date :

8(b) What is VSAT? What are the uses & characteristics of VSAT

Ans: VSAT stands for very small aperture terminal. is a small-sized earth station used in the transmit/receive of data, voice and video signals over a satellite communication network, excluding broadcast television.

It uses small dish antennas to establish a two-way communication link between a remote site and a central hub station via satellite.

VSAT technology is often used for various applications, includi

1. Internet access: Used to provide internet access in remote location where traditional wired or wireless communication are not available or practical

2. Business network: Connect remote business location & establish private network.

3. Telecommunication: VSAT technology is used by telecommunication companies to provide voice & data service to remote location.

4. Military & Government Communication: Used to provide secure & reliable communication in remote location

Characteristics of VSAT technology include -

1. Small Antenna Size: VSAT system use small dish antennas typically ranging in size from 0.75 meters to 2.4 meter in diameter.

2. Two-Way Communication: VSAT systems provides two-way communication between remote site and a central hub station via satellite.

3. High Reliability: VSAT tech. is designed to provide reliable and uninterrupted communication even in adverse weather condition.

4. Scalability: Can be easily scaled up or down to meet changing communigation requirement

5. Wide Coverage area: VSAT system can provide communication coverage over large geographic areas, including remote and hard-to-reach locations.

6. Cost-effective: VSAT technology can be more cost-effective than traditional wired or wireless communication solutions.