

B.Tech.

Third Semester Examination, 2020-21

Digital and Analog Communication (EE-217-F)

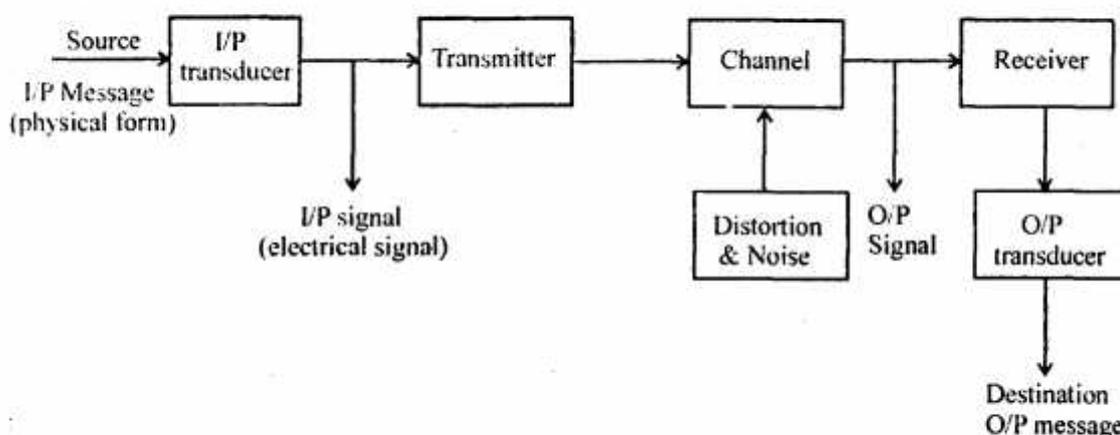
Note : Attempt any *FIVE* questions out of eight.

Q. 1. (a) Draw and explain the basic block diagram of communication system.

Ans. First block is a transducer. Basically, transducer is a device which is used to convert one physical quantity to the other. The source originates a message in physical forms, such as a human voice, a picture etc. Transmitter modifies the message signal for effective transmission such as amplification & coding etc.

Channel is a medium through which T_x output is sent to the R_x . The R_x reprocesses the signal received from the channel as coding, demodulation etc.

Destination is the unit to which the message is communicated. The noise may be introduced at the T_x or at the R_x or in channel. S/N ratio should be as large as possible for efficient communication.



Q. 1. (b) Explain various properties of Fourier transform.

Ans. (i) Linearity :

$$F[a_1g_1(t) + a_2g_2(t)] \leftrightarrow a_1G_1(f) + a_2G_2(f)$$

(ii) Time Shifting :

If $F[g(t)] \leftrightarrow G(f)$

Then $g(t - t_0) \leftrightarrow G(f)e^{-j\omega t_0}$

(iii) Frequency Shifting :

If $F[g(t)] = G(f)$

Then $g(t)e^{j\omega t_0} \leftrightarrow G(f - f_0)$

(iv) Scaling :

If $F[g(t)] \leftrightarrow G(f)$

Then $F[g(at)] \leftrightarrow \frac{1}{|a|} G / f(a)$

(v) Duality :

If $F[g(n)] \leftrightarrow G(f)$

Then $F[G(t)] \leftrightarrow g(t)$

(iv) Integration Property :

$$F[g(t)] \leftrightarrow G(f)$$

Then $F\left[\int_{-\infty}^t g(t) dt \leftrightarrow \frac{1}{j\omega} G(f)\right]$

Provided $G(0) = 0$.

Q. 2. (a) What are the properties of signal? Compare analog signal with digital signal.

Ans. Signal : Signal may be defined as any ordinary function of time. The value of signal at any time may be real or complex.

Analog signals are characterized by data whose values vary even a continuous range. The example, the temperature arm. Pressure of a certain location can vary over a continuous range & can assume an infinite number of possible values.

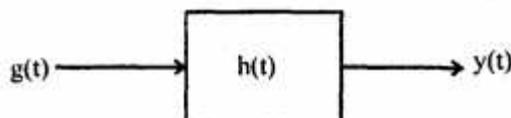
Digital messages are constructed with a finite number of symbols. For example, printed language consists of 26 letters, 10 numbers, a space & several punctuations inarus. Thus, a text is a digital message constructed from about 50 symbols.

Q. 2. (b) What is ESD and PSD? Derive expressions for both.

Ans. Every Spectral Density is defined as energy per unit BW :

$$ESD = |G(f)|^2$$

Proof:



$$y(t) = g(t) * h(t)$$

$$Y(f) = G(f) \cdot H(f)$$

$$E = \int_{-\infty}^{\infty} |Y(f)|^2 df$$

$$= \int_{-\infty}^{\infty} |G(f) \cdot H(f)|^2 df$$

$$= \int_{f_m}^{+f_m} |G(f)|^2 df$$

$$= |G(f)|^2 \int_{f_m}^{f_m} df$$

$$= |G(f)|^2 2f_m$$

$$\frac{E}{2f_m} = |G(f)|^2$$

$$\frac{E}{B} = |G(f)|^2$$

$$ESD = |G(f)|^2$$

Hence solved.

PSD : Power Spectral Density is defined power per unit BW. Let us signal $g(t)$ is defined as follows :

$$g(t) = \begin{cases} g(t) & -T/2 \leq t < T/2 \\ 0 & \text{Otherwise} \end{cases}$$

$$P = \lim_{T \rightarrow \infty} \frac{1}{T} \int_{-T/2}^{T/2} |g(t)|^2 dt$$

$$= \lim_{T \rightarrow \infty} \frac{1}{T} \int_{-\infty}^{\infty} |G(f)|^2 df$$

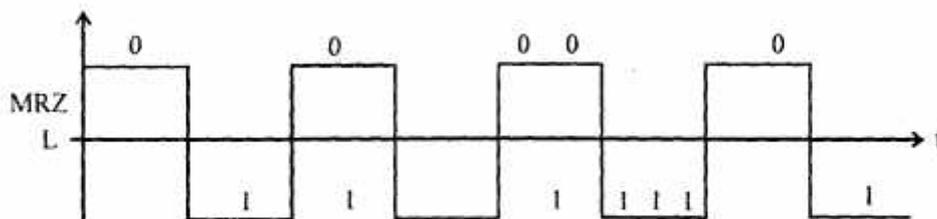
$$P = \lim_{T \rightarrow \infty} \frac{1}{T} |G(f)|^2 \Big|_{-\infty}^{\infty} df$$

$$\frac{P}{\int_{-\infty}^{\infty} df} = \lim_{T \rightarrow \infty} \frac{1}{T} |G(f)|^2$$

$$PSD[g(f)]^2 = \lim_{T \rightarrow \infty} \frac{|G(f)|^2}{T}$$

Q. 3. (a) What is data encoding? How NRZ coding is implemented?

Ans.



Data encoding is a method to convert the data into signal form because we can not limit data until it is converted into signal.

MRZ-1

(Non = Return to zero inversion).

In this technique, bits are not represented by +ve & -ve voltage. It is represented in between of +ve & -ve voltages.

If bit is zero, there is no change, but if next bit is one, the change takes place.

Hence, the existence of 1 in data bit stream allows the receiver to resynthesize its timer to the actual arrival of the transmission.

Q. 3. (b) How differential manchester encoding is different from other?

Ans. Differential manchester encoding :

1. DM combines the ideas of RL & MRZ-I. There is always a transition at the middle of the bit but the bit values are determined at the beginning of the bit & the transitions at the middle of the bit is used for synchronization.
2. DM scheme overcomes several problems associated with NRZ-L and NRZ-I. There is no baseline wandering.
3. There is no DC component because each bit has a +ve & -ve voltage distribution. The only drawback is signal rate.

Q. 4. (a) Define and explain Shannon limit theorem.

Ans. It is commonly known as Shannon-Hartley capacity theorem.

It shows the system capacity (C) by unit Gaussian noise (Agnes) is a function of the average received signal power S, the average noise power N & the BWB. These are related as :

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

$$[M = \eta\beta]$$

Hence,

$$C = B \log_2 \left[1 + \frac{S}{\eta\beta} \right]$$

$$\frac{C}{B} = \log_2 \left[1 + \frac{S}{\eta\beta} \right]$$

Let us consider a case, $R = C$, mean channel capacity is equal to rate of information.

$$\frac{C}{B} = \log_2 \left[1 + \frac{CB^2}{\eta\beta} \right]$$

Because

$$\left[\frac{S}{\eta} = \frac{C - E_b}{\eta} \right]$$

Where E_b is bit energy.

$$1 + \left(\frac{E_b}{\eta} \right) \left(\frac{C}{B} \right) = 2^{C/B}$$

$$\frac{E_b}{\eta} = \frac{B}{C} (2^{C/B} - 1).$$

Q. 4. (b) What is delay distortion? How it affects the data rate of channels?

Ans. In distortions, power is almost same of received signal as transmitted but wave shape of received signal is changed. Distortion is occur when transmitted signal is a composite signal of different frequencies like in T.V. signal. T.V. signal is transmitted as composite signal of voice & picture.

In T.V. signal, voice signal has its own frequency & picture signal has its own frequency, so naturally both have different speed & time delay, thats why they arrive at the receiver with different speed & time delay, thats why they arrive at the receiver with different time delay & received compost signal get distorted.

Q. 5. (a) Explain the different modes of communication.

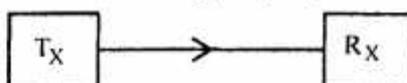
Ans. Communication mode is used to define the direction of information flow between to linked devices.

Communication modes :

- Simplex
- Half duplex
- Full duplex
- Full/full duplex

Simplex : Data T_x is unidirectional, message or information can sent in only one direction.

Commercial N broad casting, Radio broadcasting (AM, FM) are the example.

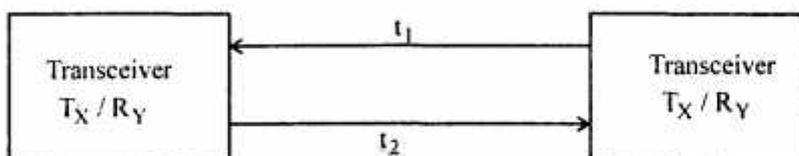


T_x = Transmitter

R_x = Receiver

Half Duplex : Data T_x is possible in both direction but in one direction at a time.

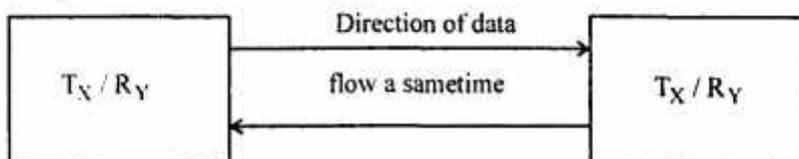
Example : Walkee-Talkee.



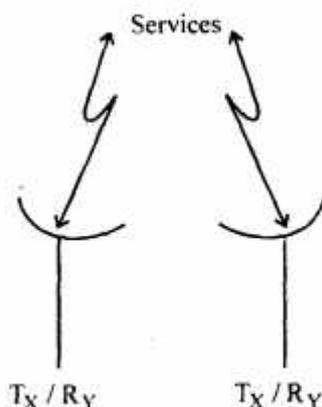
Half Duplex Mode

Full Duplex : Data T_x is possible in both sides at the same time.

Example : Telephone communication cellphone communication.



Full/Full Duplex : T_x is possible in both direction at same time, but not between the same & stations. Generally employed in multiphone circuit.



No direct lines

Q. 5. (b) Explain what is a protocol? Also clearly explain the concept of sliding window protocol.

Ans. By using soep, source can transmit continuously frame to destination without waiting of acknowledgment & R_x acknowledges only some of the frames, using ∞ single acts to conform the receipt multiply data. The sliding window refers the imaginary boxes at the both ends. Let us examine how these forks. Let S is sender & R is receiver, S & R are connected via a full duplex aims, R allocates buffer space of W frames. It means R can send W frames without waiting for any ACK signal by R_x . R sends ack to S, that includes the sequence number of frame expected & this ACK also announces that R is prepared to receive the near W frames beginning with number specified.

The number scheme modules n which means frame are number 0 to $n-1$, modules 8 means, frames are numbered 0 to 7. As 0, 1, 2, 3, 4, 5, 6, 7, 0, 1, 2, 3, 7.

Q. 6. (a) Explain ISDN.

Ans. ISDN (Integrated Subscriber Digital Network) : Integrated services, sometimes called Int serv, is a flow based QOS model, which means that a user needs to create a flow, a kind of virtual circuit, from the source to the destination & inform cell routers of the resource requirement.

A signalling protocol is used to run over IP that provides the signalling mechanism for making a reservations. When a source makes a reservation; it needs to define a flow specification. After the router receives a flow specificant from applications, it decides to admire deny a service.

Basically ISDN combines telephone lines, N cables, digital subscriber lines to a single point.

It has 2 types of channels :

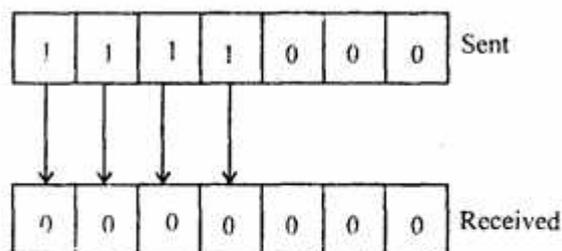
Narrow band channels

Borrow band channels

Number of channels vary of requirements.

If 8 wire is used to transmit a byte in parallel transmission & due to any reason one line is become corrupted then in each byte one bit will be corrupted.

Multiple Bit Error :



Q. 7. (b) What is Huffman encoding? Where it is used?

Ans. Huffman coding is a data compression technique which is based on statistical concern & uses the property in a frame sequence some character occurs more frequently & some character very rapidly.

So instead of using a fixed number of bits per character, we use a different encoding scheme in which the most common characters are encoded using fewer bits than less frequent character.

$$I = -\log P(x) \text{ or } \log \frac{1}{P(x)}$$

To understand this, let's take an example. A dog bites a man, this has very high probability hence very less information to transmit it is very common & occurs frequently.

But if a man bites a dog, it has very less probability & hence more information will spread around very fast but rarely occurs. Now a question arises how a receiver distinguishes & arranges in required sequence if a character is transmitted randomly.

At the transmitter, each character is numbered in a specific manner & this number is transmitted with each character so that the receiver can form the desired sequence after receiving if each character.

Q. 8. (a) How can we compress any data? How is it helpful in cryptography?

Ans. Cryptography is a discipline of mathematics concerned with simulation, securing & recalling issues, particularly encryption, authentication & access control.

Its purpose is to hide the meaning of a message rather than its existence. In modern times, it has also branched out into computer science.

Encryption attempted to ensure secrecy in important communications, such as those of spies, military leaders, & diplomats, but it also had religious parts of their religious castings to avoid near certain persecutions they would have faced had they been observed.

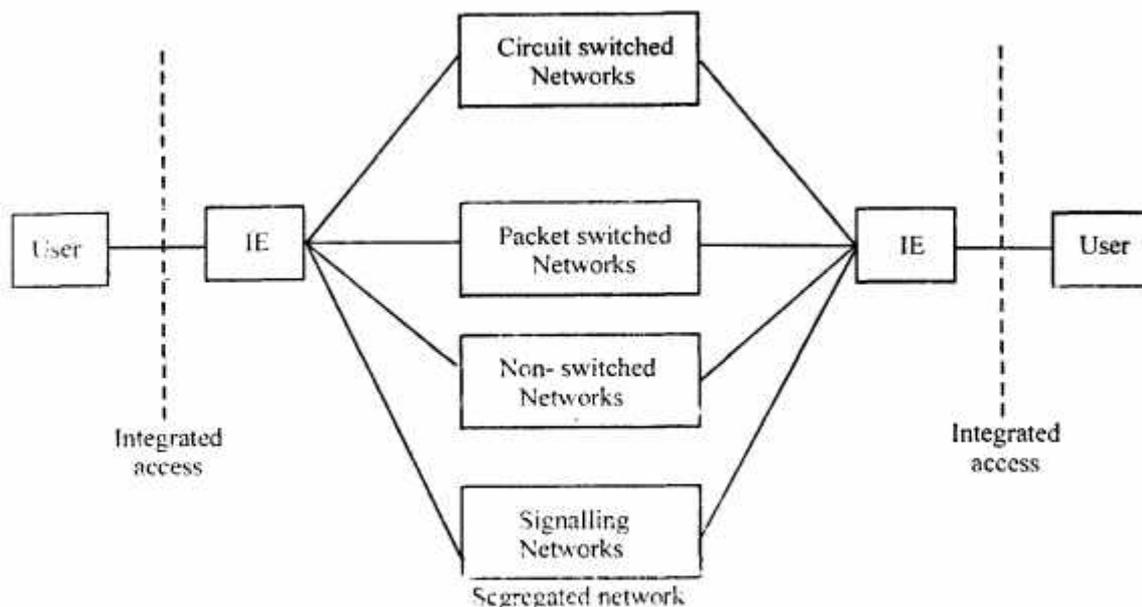
Ciphertexts, produced by classical methods, often contain several statistical information about the plaintext, which can be used to break them.

Symmetric key cryptography refers to encryption methods in which both the sender & receiver share the same key.

In a public key cryptosystem the public key may be freely distributed, while its partner private key must remain secret.

Q. 8. (b) Explain error detection and parity check.

Ans. Error detection is a process of monitoring the transmission & reception. Error detection only determines if the received data is corrupted but not at which position a data bit is corrupted & which data bit is corrupted.



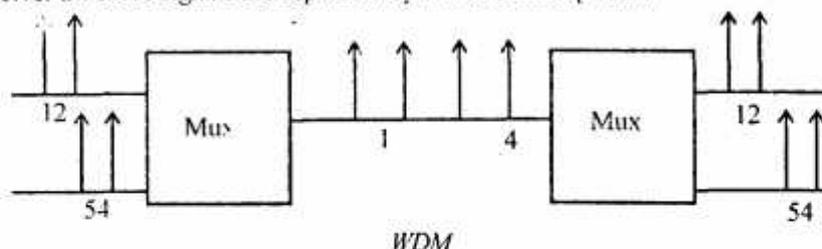
Q. 6. (b) Explain wave-division multiplexing. How it is different from TDM?

Ans. WDM : Logically WDM is same as FDM, the difference is that FDM is separated on the basis of frequency while in WDM, wave is multiplexed on the basis of wavelength.

WDM involves the signal in light form & commonly used in optical fiber & the frequency as well as transwidth is very long.

In WDM, narrowband signal of different sources are combined to make a wider band of light at the transmitter and transmitted on common lines called optical fiber.

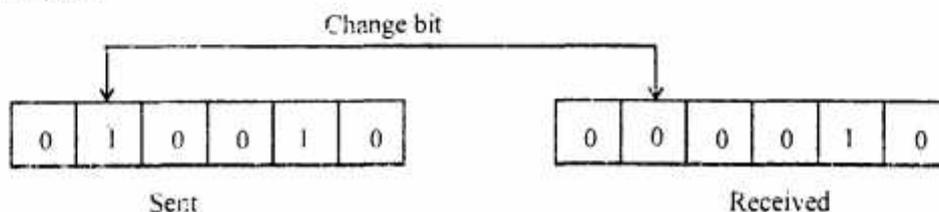
At the receiver aw these signals are separated by use of demultiplexer.



Q. 7. (a) Explain what are transmission errors? How they can be reduced? Suggest measures.

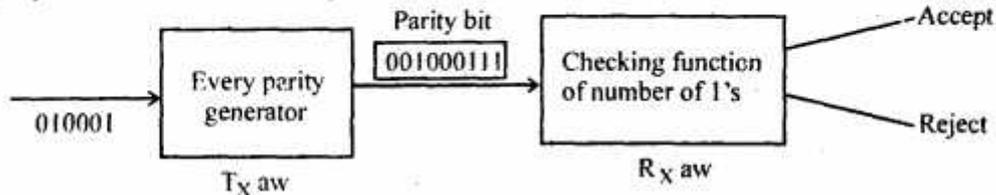
Ans. Errors may be of any type & its can be generated at any position of transmission.

One Bit Error : One bit error or some times called single bit error, is means only one bit of a given data unit has been changed.



in caour notify by error detection techniques.

Parity check is more common & economical methods few the purpose of detection. In this technique, we add a parity bit as redundant bit to original data bit so that numbers of 1's in data bit become even or odd.



D	E	L	H	I
00100010	10100010		00010010	10010011
↓				
parity bit		00110011		
D	E	L	H	I
10100010	10100011	01110011	00010010	10010011

A_0	A_1	
Bit 1	Bit 2	XOR
0	0	0
0	1	1
1	0	1
1	1	0

