CPE 316

Communication Principle

- Element of Communication System
- ~~System~~ Signal Analysis
- Modulation
- Communication channel
- Noise
- Antenals

1) Wired Communication!

This refers to the transmission of data over a wire-based communication technology. Examples include telephone networks, cable television or internet access and fibre-optic communication. Most wired networks use Ethernet ~~cables~~ cables to transfer data between Connected PCs.

2) Wireless Communication!

This is a method of transmitting information or signal from one point to another without using any connection like wires, cables or any physical medium.

Generally, in a communication system, information is transmitted from transmitter to receiver that are placed over a limited distance.

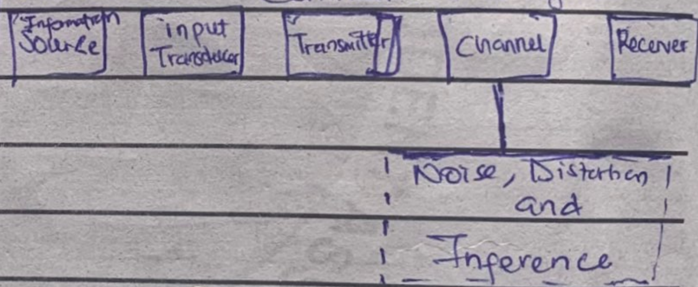
Also, In wireless Communication, the Signal is sent through air or free space which uses transmitter antennae.

ELEMENT OF COMMUNICATION SYSTEM.

Communication Channel is the process whereby electric signal is transferred from one point called the Source to another point called the destination.

* Origin of Communication system.

Element of Communication System.



Information source could be analog or digital.

* Find out the function of each element of communication system.

Types of Communications

1) Wired
2) Wireless

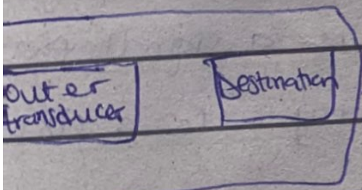
Category of Communication are also analog and digital

state 10 differences between analog and digital communication.

Fundamental limitation in electrical Communication.

1) Time bandwidth limitation

Transmitting a large amount of information in a small amount of time requires wide band signal to represent the information and wide band system to accomodate the signals.



2) Noise limitation:

Successfull communication depends on how accurately the receiver (determine or distinguish between wanted or Unwanted signals. Noise is inevitable in all electrical communication system since there is always thermal noise associated with Conductor.

3) Equipment limitation.

Equipment can also be a limitation in the sense that using a wrong equipment can limit information.

Classification or Types of Communication systems!

1) Analog Communication!

This is a communication system where the information signal sent from point A to point B can only be described as an analog signal.

2) Digital Communication!

This is a communication system where the information signal sent from A to B can be fully described as a digital signal

NOTE! A wire is a metal drawn out into the form of a thin flexible thread or rod that carry signals, current and so on from one end to another.

07/06/2023

SIGNAL ANALYSIS.

Signal is an event which serves or at least is capable of starting or inciting some actions

An electrical signal may be either a current or voltage waveform which varies with time and is used to carry information from one point to another

In communication systems, the information from the source is usually in the form of coded symbols or words. These symbols/words are converted into electrical signals by the input transducer. Hence it is the electrical signal that is processed and transmitted over the chanel to the receiving head

Signals can be grouped/categorised into two:

1) Random and Deterministic Signals
2) Periodic and Non-Periodic Signals

1) Random and Deterministic Signals

A Random signal is one in which there is some degrees of uncertainty before it actually occurs.

A Deterministic signal is referred to as non-random signal. They are signal in which there is no uncertainty in its values

Mathematical expressions can be written mostly for Deterministic signals and very difficult for a Random signal

2) Periodic and Non-Periodic Signal.

A period signal is a signal that repeats itself exactly after a fixed length of time.

Period: time it takes to make a complete circle

Therefore A signal $f(t)$ is periodic if there is a number T such that:

$$f(t) = f(t + T) \text{ for all } t \quad (1)$$

The smallest possible value of T that satisfies the equation (1) is called the period

A Non-period signal is any signal for which there is no value of T satisfying equation (1)

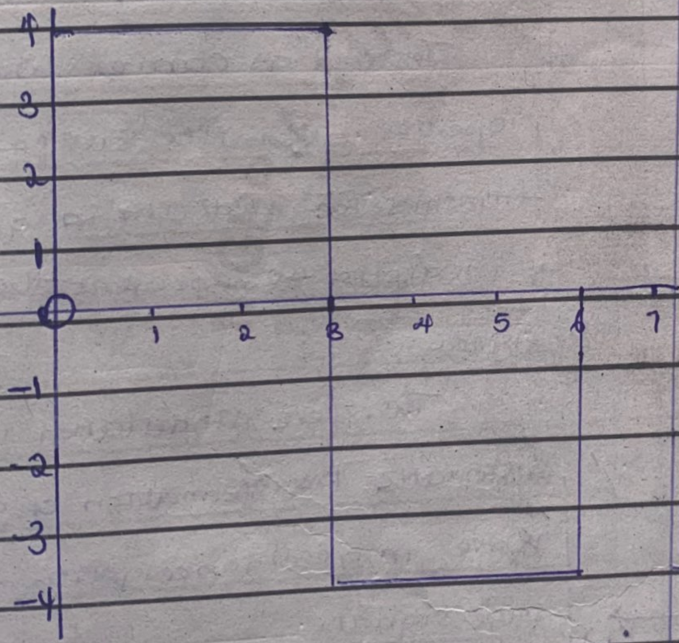
Examples

(1)

A signal f(t) is defined by the expression

$$F(t) = \begin{cases} 4; & 0 \le t \le 3 \\ -4; & 3 \le t \le 6 \end{cases}$$

Sketch the signal and determine the period



It goes back to the origin after 6 seconds

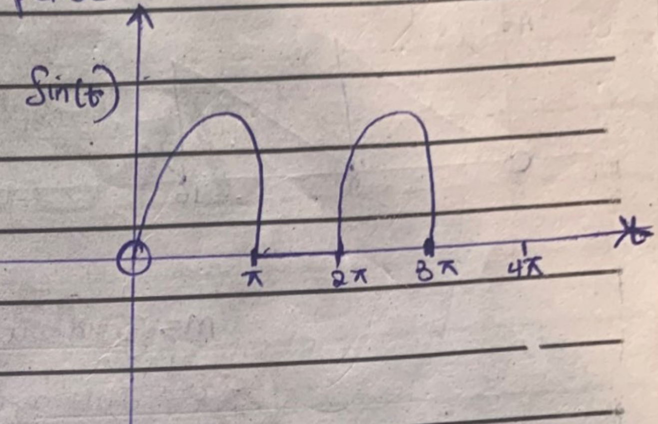
$\therefore$ The Period = 6.

(2)

A signal f(t) is defined by the following expression

$$f(t) = \begin{cases} \sin t; & 0 \le t \le \pi \\ 0; & \pi \le t \le 2\pi \\ \sin t; & 2\pi \le t \le 3\pi \end{cases}$$

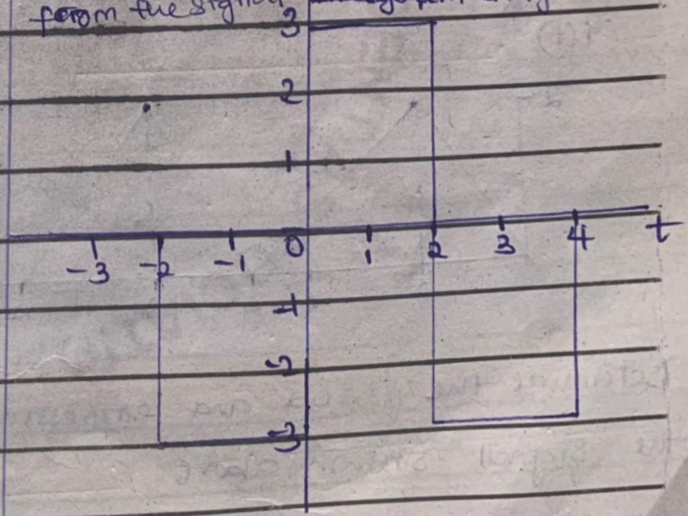
Sketch the signal and determine its period



Period = 2π

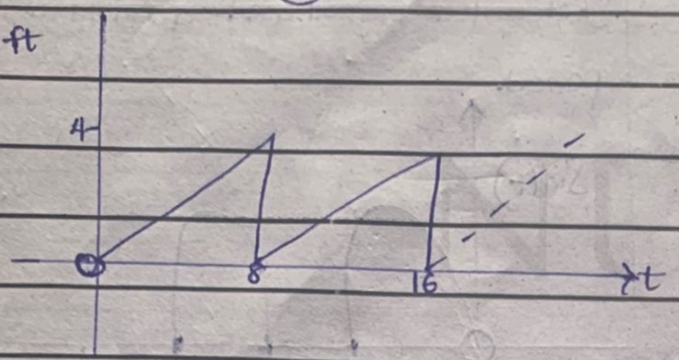
(3)

Determine the expression, ~~and period~~ period from the signal ~~diagram~~ diagram below!



$$f(t) = \begin{cases} -3; & -2 \le t \le 0 \\ 3; & 0 \le t \le 2 \\ -3; & 2 \le t \le 4 \end{cases}$$

Period = 4



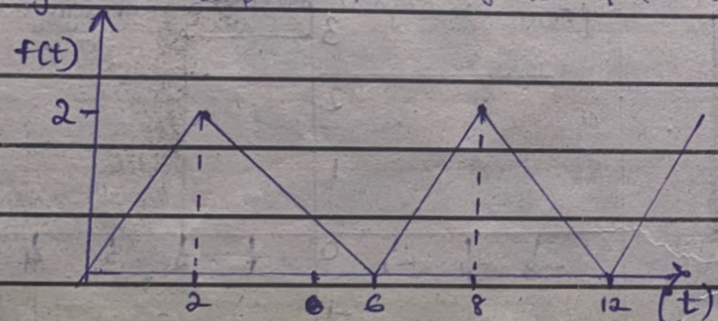
m = gradient/slope.

c = Intercept.

$f(t) = mt + c$

$f(t) = \frac{1}{2}t$

Assignment! Determine the period and expression for the signal shown above



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the

In this case, the signal repeats after every 6 units, hence the period is 6. Now between $t = 0$ and $t = 2$, $F(t) = t$.

Since the gradient of that line is 1 and the intercept is 0

i.e $F(t) = t ; 0 \leq t \leq 2$

Between $t = 2$ and $t = 6$

$F(t) = \frac{-t}{2} + 3$

thus we obtain : $F(t) = \frac{-t}{2} + 3 ; 2 \leq t \leq 6$

$$\therefore F(t) = \begin{cases} t ; 0 \leq t \leq 2 \\ -\frac{t}{2} + 3 ; 2 \leq t \leq 6 \end{cases}$$

MODULATION

Inorder to transmit information, some form of frequency transformation is necessary. The reason is that most input signals cannot be sent directly over the channel as they come from the transducer.

Instead a carrier wave whose properties are better suited to the transmission medium in question is modified to represent the message signal.

Therefore Modulation is the systematic transformation of a carrier wave in accordance with the message signal.

The carrier wave is generally a radio wave frequency signal. To a very large extent, the success of a communication system in any given mission depends on the modulation.

Modulation can be grouped into 2 basic types according to their kind of carrier wave

They are: i) Analog modulation
2) Digital modulation.

1) Analog Modulation.

This uses sinusoidal wave as their major carrier signal being a continuous process. analog modulation is suited to signals that are continually varying with time.

Usually the carrier is at the frequency much higher than any of the frequency components contained in a modulating signal

2) Digital Modulation:

This uses a discrete or pulse strain as the carrier signal

There are 2 most important method of analog modulation : i) Amplitude modulation
ii) Angle modulation

For Digital modulation we have!
i) Pulse modulation

Reasons for Modulation.

1) For ease of Radiation
2) For frequency assignments
3) To reduce noise and interference
4) For Multiplexing.
5) To overcome equipment limitation

Pimpe, Read the photocopy note in order to understand the reasons for modulation

Power Relation in the Amplitude Modulation Wave.

It is known that the carrier component of the modulated wave has the same amplitude as the unmodulated carrier

$$\text{power} = \frac{V^2}{R}$$

for a one ohm (1Ω) resistor, the average power of the signal is the voltage squared of it. The power associated with an AM signal may be derived by knowing that the

Voltage amplitude of the modulating signal is:

$$y(t) = V_c + \frac{mV_c}{2}$$

For the 1Ω resistor, carrier power is equal to:

$$V_c^2 = P_c$$

$$P_s = 2\left[\frac{mV_c}{2}\right]^2 = \frac{m^2V_c^2}{2}$$

$$= \frac{m^2P_c}{2}$$

Where P_s = Side band power

~~Total power = $P_t = P_c + m^2P_c$~~

Total power:

$$P_t = P_c + \frac{m^2P_c}{2} = P_c\left[1 + \frac{m^2}{2}\right]$$

$$\frac{P_t}{P_c} = 1 + \frac{m^2}{2} \quad \text{——— (1)}$$

Take note!

$$\text{Power} = \frac{V^2}{R} \text{ or } I^2R$$

$$\text{Side band power} = 2\left[\frac{mV_c}{2}\right]^2$$

$$P_s = \frac{m^2V_c^2}{2}$$

Note: $V_c^2 = P_c$ for the 1Ω resistor

Carrier power

$$P_s = \frac{m^2P_c}{2}$$

Total power (P_t)

$$P_t = P_c + \frac{m^2P_c}{2} = P_c\left[1 + \frac{m^2}{2}\right]$$

$$\frac{P_s}{P_t} = \frac{m^2}{m^2+2}$$

$$\frac{P_s}{P_c} = \frac{m^2}{2}$$

$$\frac{P_t}{P_c} = 1 + \frac{m^2}{2}$$

1

The antenna current of an amplitude modulated transmitter is 10 A when only the carrier is sent but increases by 20% when the carrier is sinusoidally modulated, find the percentage modulation and determine the antenna current when the dept of modulation is 60%

Solution.

Total power = $P_t = I_t^2 R$ ~~and~~

Carrier power = $P_c = I_c^2 R$

Hence $\frac{P_t}{P_c} = \left(\frac{I_t}{I_c}\right)^2 = 1 + \frac{m^2}{2}$

$\frac{m^2}{2} = \left(\frac{I_t}{I_c}\right)^2 - 1$

$m = 2\left[\left(I_t/I_c\right)^2 - 1\right]^{1/2}$

$I_c = 10A$

$I_t = 10 + (\frac{20}{100} \times 10) = 10 + 2 = 12A$

$m = 2\left[\left(\frac{12}{10}\right)^2 - 1\right]^{1/2}$

$m = 2$

$m = 93.8\%$

(ii) If $m = 60\%$ find I_t.

$\frac{0.60}{2} = \left(\frac{I_t}{10}\right)^2 - 1$

~~$86 = \frac{I_t^2}{100} - 1$~~, $0.30 = \frac{I_t^2}{100} - 1$

~~$3000 = I_t^2 - 1$~~ $30 = I_t^2 - 1$

~~$I_t = \sqrt{3001}$~~ $I_t^2 = \sqrt{31}$

Ans = 10.836

14/06/2023

(2)

A Broadcast radio transmitter radiates 20KW when the modulation percentage is 80, how much of this is carrier power?

Solution.

Total power $(P_t) = 20KW$

$m = 80\% = 0.8$

$\frac{P_t}{P_c} = 1 + \frac{m^2}{2}$

$\frac{20}{P_c} = 1 + \frac{0.8^2}{2}$

$40 = P_c(1 + 0.8^2)$

$40 = 1P_c + 0.64P_c$

$40 = 1.64P_c$

$P_c = \frac{40}{1.64}$

$P_c = \frac{P_t}{1 + m^2/2}$

$= \frac{20 \times 10^3}{1 + \frac{(0.8)^2}{2}}$

$= 15.15KW$

(3)

The output of an AM transmitter is 24KW when the modulation depth is 100% calculate the output power when:

i) the carrier power is unmodulated
ii) when after modulation to a depth of 60%, one side band is suppressed and the carrier component is reduced by 26dB

Solution.

$P_t = 24KW = 24 \times 10^3$

$m = 100\% = 100/100 = 1$

i) $P_c = \frac{P_t}{1 + m^2/2} = \frac{24 \times 10^3}{1 + \frac{1^2}{2}}$

$= \frac{24 \times 10^3}{1 + 0.5}$

$= 16{,}000$

$= 16KW$

NOTE: when the carrier is unmodulate, the output power is equal to the carrier power

ii) for 60% modulation $= 60/100 = 0.6$

Power in one sideband $= \frac{m^2 P_c}{4}$

$= \frac{0.6^2 \times 16 \times 10^3}{4} = 144$

If the power in the reduced carrier is P_c', then:

$10 \log_{10}\left(\frac{P_c}{P_c'}\right) = 26$ or $\frac{P_c}{P_c'} = 398$

$\therefore P_c' = \frac{16 \times 10^3}{398} = 40.2W$

Hence the total power is:

$1440 + 40.2$

$= 1480.2W$

(4)

A 400W carrier is modulated to a depth of 75%, find the total power in the modulated wave. If the transmitter power had been 10kW and the depth of modulation is 60%, what would be the carrier power

Solution.

$pt = ?$ $\quad Pc = 400w \quad m = 75\% = 0.75$

$Pt = pc(1 + m^2/2)$

$pt = 400(1 + 0.281)$

$Pt = 400(1.281)$

$pt = 512.4$

$P_t = 10KW = 10 \times 10^3 \quad m = 60\% = 0.60$

$Pc = \frac{10 \times 10^3}{1 + \frac{0.60^2}{2}} = \frac{10 \times 10^3}{1 + 0.18}$

$= \frac{10 \times 10^3}{1.18}$

$= 8474.6w$

$= 8.4KW$

(5)

With 75% modulation an AM transmitter produces 10KW power, how much of these power is suppressed prior to transmission.

Solution.

$m = 75\% = 75/100 = 0.75$

$P_t = 10kw = 10 \times 10^3$

$Pc = \frac{10 \times 10^3}{1 + \frac{0.75^2}{2}} = \frac{10 \times 10^3}{1 + 0.281}$

$Pc = 7.81KW$

Power in one sideband $= \frac{m^2 pc}{4}$

$= \frac{0.75^2 \times 7.81 \times 10^3}{4}$

$= 1.098 \times 10^3 W$

$= 1.098 KW$

Suppressed power in %

$= \frac{\text{Total power} - \text{power in side band}}{\text{Total power}} \times 100\%$

$= \frac{10{,}000 - 1096}{10{,}000} \times 100\%$

$= 89\%$

(6)

The power dissapated by an AM sign is 100W when its depth of modulatio is 40%. What modulation depth is required to increase the power to 120W?

Solution

When modulation is:

$P_t = 100W$ when $m = 0.4$

$P_t = 120W$

$P_c = \frac{100}{1+\frac{0.4^2}{2}} = \frac{100}{1.08}$

$= 92.59W$

$P_t = P_c\left(1+\frac{m^2}{2}\right)$

$120 = 92.59 + 92.59\frac{m^2}{2}$

$120 - 92.59 = 46.295m^2$

$\frac{27.41}{46.295} = m^2$

$m^2 = 0.592$

$\therefore m = 0.769 \simeq 0.77$

$= 77\%$

1) Twisted pair Cable

twisting allows each wire to have approximately the same noise environment and they are of two types:

a) Unshielded Twisted Pair cable (UTPC): is the most common type of communication medium in use today

b) Shielded Twisted Pair Cable (STPC): Consists of insulated twisted pair cable encased in a metal foil. In STPC, it is more expensive than the unshielded twist pair cable, because it is less succeptible to noise

COMMUNICATION CHANNELS.

Signals travel from Transmitter to Receiver through a path and this path is called the MEDIUM or MEDIA and it can be:

1) Guided media

2) Unguided media

1) Guided media:

These are those that provide a conductor from one device to another.

2) Unguided media:

This is also known as WIRELESS MEDIA. They transport magnetic waves without using physical conductor. Instead of using cables, signals are broadcast either through air or in a few cases through water and thus are available to any one who has a device capable of receiving them. Examples are Radio, Microwave, satellite etc.

There are 3 popular Guided media which are:

1) Twisted Pair Cable

2) Co-axial Cable

3) Optic fibre

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(FUOYE CHAPTER)

2) Co-axial Cables: They carry signals of higher frequency ranges than twisted point cables. Even though both of them transmit data in the form of an electric current.

3) Fibre Optic:

→ They are made up of glass/plastic inner core surrounded by cladding all encased in an outside Jacket

→ They carry data in the form of light and they have high noise resistance

→ They have low attenuation

→ They have high bandwidth capability

Components of Fibre Optics.

1) Core:

This is a cylindrical glass that forms the central part of the optical fibre where Light signals are transmitted. The core is made up of high purity glass and has a higher refractive index than the cladding. This makes the light to pass only through the core.

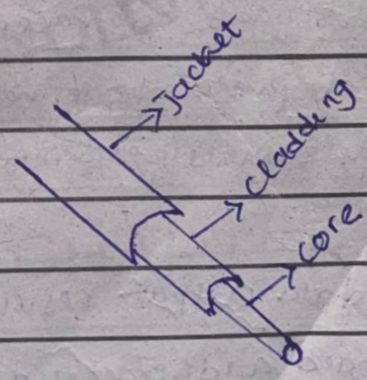
2) Cladding:

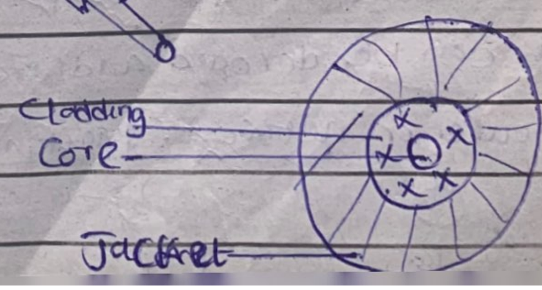
This is the outer coating layer that surrounds the core and reflects light back into the core, preventing the light from leaking out of the core. Cladding is made from less pure glass and has a lower refractive index than the core which helps to keep the light signals in the core and ensure that they travel along the fibre with minimal loss or dispersion

3) Jacket

This is the outer protective layer of the optical fibre that is made up of a tough, flexible polymer material such as PVC or plastic.

The Jacket also known as a sheat protects the core and cladding from mechanical damage, moisture and abraision





Mode of Operation of fibre Optics.

1) Electrical data input enters data into fibre optic system

2) The transmitter accepts and converts the input electrical signals to optical signals and then send the optical signal by modulating a light source output, also by varying with intensity

3) The signal is passed through the optical fibre where the light signals travel through the core of the fiber from one end to another by a property known as total internal reflection

4) Reciever : is the optical to electrical converter at the end of the glass strand : In the receiver the optical signals are received by photo detector or photo diode which converts the optical signals back into an electrical signal

5) The Electrical data output result which can be decoded and processed by a router or network switch

Types of Fibre Optics

1) Multi-Mode
2) Single-Mode

1) Multi-Mode

This has a relatively large core that enables multiple modes or paths for light to travel down through the fibre

The multiple-mode fibres are limited in terms of speed and distance because the multiple paths tend to interfere with each other in these fibres

2) Single-Mode

This has a much smaller core therefore there is only one effective path through which light can propagate hence optical networks requiring high speed and spanning great distance use single-mode fibre.

Assignment

2) Compare and contrast Multi-Mode fibre with single Mode fibre

3) list 5 advantages and 5 disadvantages of Fibre Optics.

Factors to Consider before Transmission.
1) Speed
2) Bandwidth
3) attenuation
4) Security
5) Cost
6) Electromagnetic Interference

TRANSMISSION MODE.

There are 3 main types:
1) Simplex mode
2) Half Duplex mode
3) Full Duplex mode

1) Simplex mode

The communication is uni-directional. In this type of mode, only one of the 2 stations can transmit, the other can only receive e.g Keyboard & monitor, Radio

2) Half Duplex mode:

Each station can both transmit and receive but not at the same time so when one is sending at the moment the other can only receive and vice-versa. e.g Walkie-Talkie

3) Full Duplex mode:

Both stations can transmit and receive simultaneously e.g GSM Telephone

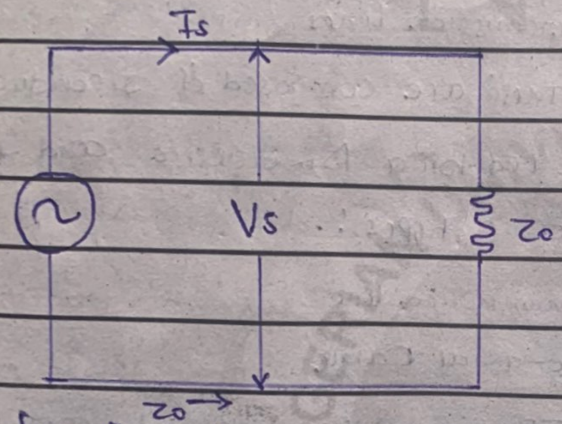
Transmission Lines

These are composed of 2 conductors separated by a Di-electric and they are of 2 types:
1) Two-Wired line
2) Co-axial Cable

In transmission lines, the conductors have their Resistance (R) and Inductance (L) uniformly distributed along their length as well as capacitance (C) and leakance (G) uniformly distributed between them. R, L, C and G are known as primary constants expressed in unit of Ohms, Henry, Farad and Siemen respectively.

Characteristic Impedance (Z_0)

The characteristic Impedance of a transmission line is defined as the input impedance of an infinite le of that line or alternatively as the input Impedance of a line which itself is terminated in its characteristics Impedance.



from these diagram it can be shown that!

$$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}} \text{ ohm}$$

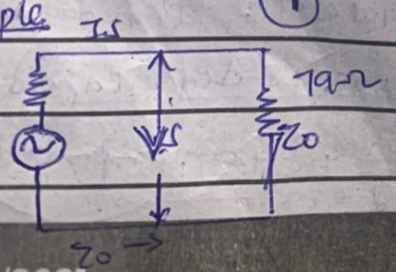
$$= \sqrt{\frac{L}{C}}$$

at high frequency with $\omega L > R$ and $\omega C > G$

Also note! $I_s = \frac{V}{(R+r)} = \frac{V}{(Z_o + r)}$

$V_s = I_s \times R_s$

Example (1)



the figure before shows a circuit with a generator of Emf 1V and internal resistance of 79Ω connected to a transmission line having L to be ~~3mH per kilometer~~ 3mH/km and ~~C=0.048~~ $C = 0.048\,\mu F/km$ terminated in its characteristics impedance, determine!

(i) the sending current

(ii) the sending end voltage

Solution

$r = 79\Omega$, $V = 1$

$C = 0.048 \times 10^{-6}$ F/km

$L = 3 \times 10^{-3}$ H/km

$$Z_o = \sqrt{\frac{L}{C}} = \sqrt{\frac{3\times10^{-3}}{0.048\times10^{-6}}}$$

$Z_o = 250$

$$I_s = \frac{V}{Z_o + r} = \frac{1}{250 + 79}$$

$I_s \approx 3.04\times10^{-3} A \simeq 3.04 mA$

$V_s = I_s \times R_s = 3.04\times10^{-3} \times 79$

$V_s = 0.24V$

NOTE! In the case of an air-spaced two wired line:

$Z_0 = 276 \log_{10}\left(\frac{D}{r}\right)$ ohms

where D = spacing between the centre of the two conductors

r = radius of each conductor

Z_0 = of the order of a few 100 ohms

In the case of an air-spaced co-axial line!

$Z_0 = 138 \log_{10}\left(\frac{R}{r}\right)$ ohms

where R = inner radius of the outer conductor

r = outer radius of the inner conductor

Z_0 = of the ore of 50–75 Ω

Also with a continous insulation (of di-electric relative permitivity (ε_r)) between the conductor, the characteristics impedance would be reduced by a factor of $\sqrt{\frac{1}{\varepsilon_r}}$ i.e the characteristics impedance at this stage would be divided by $\sqrt{\varepsilon_r}$

(2)

A coaxial line has a continous polythene di-electric of relative permitivity 2·3 between an outer conductor of 8·48mm diameter and an inner conductor of 1·42mm diameter. Computes its characteristics impedance.

Solution

$R = 8.48/2 = 4.24 \times 10^{-3}$

$r = 1.42/2 = 0.71 \times 10^{-3}$

$Z_0 = 138 \log_{10}\left(\frac{R}{r}\right)$ ohms

$Z_0 = 138 \log_{10}\left(\frac{4.24 \times 10^{-3}}{0.71 \times 10^{-3}}\right) \Omega$

$Z_0 = 138 \log_{10} \quad \Omega$

$Z_0 = 107.1$

$Z_0 = \frac{Z_0}{\sqrt{\varepsilon_r}} = \frac{107.1}{\sqrt{2.3}}$

$= 70.62 \Omega$

Assignment

Write short note on;
1) AF Cables.
2) Coaxial Cables.
3) Flexible Cables.
4) Sub-Marine Cables.

FEEDERS.

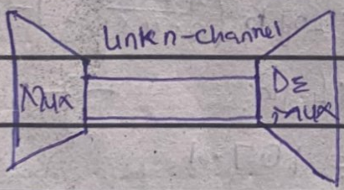
Feeders are used to transfer Rf signals from one end to another. They are also called transmission lines.

MULTIPLEXING.

It is the set of technique that allows the simultaneous transmission of multiple signal across a single data link.

Reason for Multiplexing?

→ We multiplex because of the limited bandwidth.



NOTE! A-lines share the bandwidth of one link.

Techniques of Multiplexing

1) Frequency Division Multiplexing:

It divides the signals into their different frequencies

2) Time Division Multiplexing!

It allocates time to different signals to avoid collision.

3) Wavelength Division Multiplexing!

It shares or divides signals according to their wavelength.

4) Code Division Multiplexing!

It allows signals to pass at the same time giving each of them different codes.

Assignment 2

Tabulate the differences between the four multiplexing techniques and state their area of applications.

Current Relation in Amplitude Modulation Wave

$$\frac{P_{AM}}{P_c} = \frac{I_t^2 R}{I_c^2 R} \Rightarrow \left(\frac{I_t}{I_c}\right)^2 \Rightarrow 1 + \frac{m^2}{2}$$

$$\frac{I_t}{I_c} = \sqrt{1 + \frac{m^2}{2}}$$

Note!

I_c = Unmodulated Carrier current

I_t = Total or Modulated Current of the Antenna.

They are both in RMS value [R => Resistance

1

The antenna current of an AM transmitter is 9A, when only the carrier is sent, but it increases to 8.93A, when the carrier is modulated by a single sine wave. find the percentage modulation and determine the antenna current when the percentage of modulation changes to 0.8 (80%)

Solution

$$\left(\frac{I_t}{I_c}\right)^2 = 1 + \frac{m^2}{2}$$

$$\frac{m^2}{2} = \left(\frac{I_t}{I_c}\right)^2 - 1$$

$$m^2 = 2\left[\left(\frac{I_t}{I_c}\right)^2 - 1\right]$$

$$m = \sqrt{2\left[\left(\frac{I_t}{I_c}\right)^2 - 1\right]}$$

$I_t = 8.92$ and $I_c = 8$

$$m = \sqrt{2\left[\frac{8.92}{8}\right]^2 - 1}$$

$m = 70.1\%$

$$I_t = I_c\sqrt{1 + \frac{m^2}{2}}$$

$$= 8\sqrt{1 + \frac{0.8^2}{2}}$$

$I_t = 9.19$ Amp

2

A certain transformer radiates 9kW with a carrier unmodulated and 10.125kW when the carrier is sinusoidally modulated!

i) Calculate the modulation index if another sine wave is simultaneously transmitted with modulation index of 0.4

ii) Determine the total radiated power

Assignment 1

1) AF Cable (Audio-Frequency)

This is a cable used to transfer analog or digital signals from an audio source to an amplifier or powered speaker

2) Co-axial cable

This is a cable that transmits data in form of an electric current. It carries signals of higher frequency ranges than twisted pair cables.

3) Flexible Cables.

or 'Continuous flex' cables are electrical cables specially designed to cope with the tight bending radii and physical stress associated with moving applications such as inside cable carries.

4) Sub-Marine Cables.

Is a cable laid on the sea bed between land-based stations to carry telecommunication ~~signals~~ signals across ocean, seas, lakes and lagoons.

Assignment 2

A) Classification of Amplitude Modulation.

i) DSBFC (Double Sideband Full Carrier):

This is a conventional form of amplitude modulation where both the upper and lower sidebands are transmitted along with a full carrier signal.

ii) DSBSC (Double Sideband Suppressed Carrier)

The signal is completely suppressed to conserve bandwidth; only the upper and lower sidebands containing the modulating signal are transmitted.

iii) SSB (Single Side Band):

This transmits only one of the sidebands (either upper or lower) along with the carrier while suppressing the other sideband.

iv) VSB (Vestigal sideband):

This is a variation of SSB modulation that transmits most of one sideband and a small portion of the other sideband

B) Short notes on Unguided Media

i) Radio Waves:

These are electromagnetic waves with frequencies ranging from a few kilohertz (kHz) to several gigahertz (GHz). They are commonly used for wireless communication including radio broadcasting, television transmission, mobile communication & WiFi

ii) Micro waves!

They are electromagnetic waves with frequencies typically ranging from 1 GHz to 300 GHz. They have shorter wavelengths compared to radiowaves and are commonly used for point-to-point Communication and Satellite communication.

iii) Satellite!

This involves the use of artificial satellites in spaces to relay Communication signals between two or more Earth-based stations. They are used for television broadcasting, long-distance communication, Internet connectivity and global positioning.

iv) Cellular!

This is based on a network of interconnected base stations that provides wireless Coverage over specific geographical areas called cells. They are commonly used for mobile telephony, text messaging, data transfer and internet access.

c) Similarities and Differences between Multimode fibre and Single mode fiber

Similarities:

-> Both have a Core-cladding structure for light propagation

-> Both types adhere to industry standards and specifications

-> fibre optics connectors used in multimode fibre and single mode fibre are the same

Differences!

-> Multimode fibre has a larger core diameter while single-mode fiber has a smaller core diameter

-> Multimode fibre supports multiple modes of light propagation leading to modal dispersion, while single-mode fibre supports only a single mode

-> Multimode fibre has higher bandwidth but lower data rates compared to single-mode fiber, which has lower bandwidth but higher data rates.

CPE 316

Assignment 2 continuation:

D] List 5 Advantages and Disadvantages of Optical Fibre Cable.

Advantages:

1) optical fibres offer high bandwidth and low attenuation for efficient long-distance data transmission.

2) They are immune to electromagnetic interference, providing reliable performance in noisy Environments.

3) They provide enhanced security due to their resistance to eavesdropping and unauthorised access.

4) They are lightweight, flexible and non-flammable, facilitating easier installation and handling.

5) Optical fiber cables are ideal for applications requiring high speed and high-capacity data transmission.

Disadvantages:

1) Optical fibers cables are generally more expensive to install and maintain to copper cables.

2) They are fragile and require careful handling to avoid damage during installation and maintenance

3) Optical fibers have limited flexibility posing challenges in certain installation scenarios.

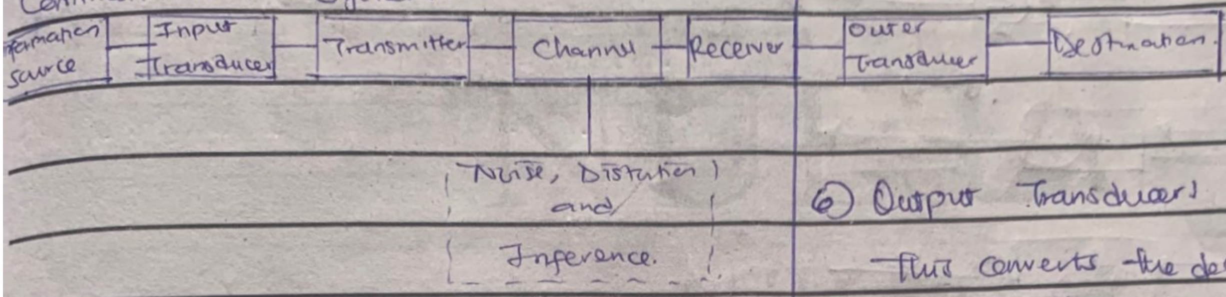
4) Specialized equipment is needed for optical fiber systems, increasing complexity and cost

5) Troubleshooting and repairing optical fiber cables may require specialized Knowledge and equipment, making it more challenging compared to copper cables.

CPE 316.

Assignment 3.

1) Functions of Each of the Elements of Communication System:



1) Information source:

This is the origin of the message or data to be communicated.

2) Input Transducer:

This is responsible for converting the information from the source into a suitable electrical or electromagnetic signal

3) Transmitter:

This processes and encodes the electrical or electromagnetic signal from the Input transducer into a form suitable for transmission through the chosen Communication channel.

4) Channel:

This is the medium through which the encoded signal is transmitted from the transmitter to the receiver.

5) Receiver:

This is responsible for receiving and decoding the transmitted signals from the chanel

6) Output Transducer:

This converts the decoded electrical or electromagnetic signal from the receiver into a form suitable for the destination or end-user.

7) Destination:

This is the intended receipient or end-user of the communicated Information.

B) Diff between Analog & Digital Communication

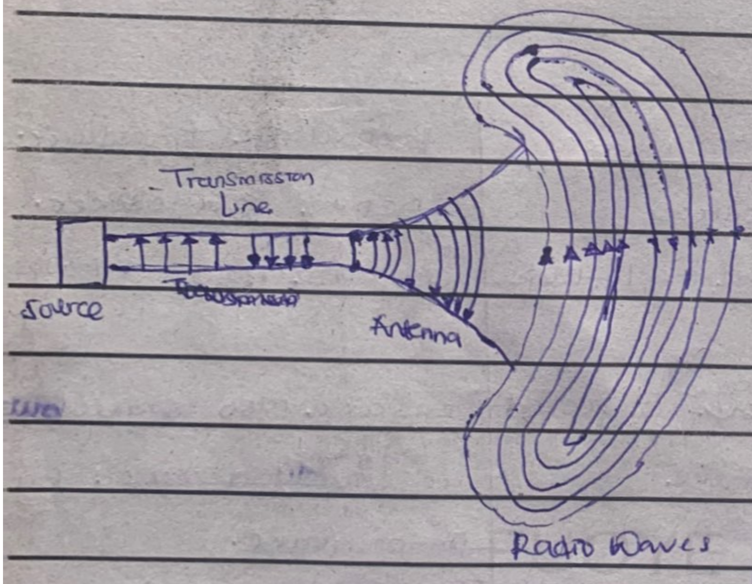
Digital Communication	Analog Communication.
1) This represents information as discrete values	This represents information as continuous and varying quantities
2) They are less susceptible to noise and can be reliably transmitted	They are more prone to noise which can degrade the signal.
3) Higher Bandwidth efficiency	Lesser bandwidth efficiency
4) It enables error detection and correction techniques for accuracy	It does not have built-in error correction mechanisms
5) They can be expensive especially for certain applications with lower data requirements	They are often simpler and more cost-effective to Implement

CPE 316

ANTENNA.

An antenna (or sometimes called as an Aerial) is an electrical device that converts electric power into electromagnetic waves (or simply radio waves) and vice-versa.

Free space is when a signal from a transmission line or the guiding device like a coaxial cable is given to an antenna that converts the signal into electromagnetic energy to be transmitted through space.



Antenna can be used for:

1) Transmission of electromagnetic radiation.
2) Reception of electromagnetic induction

1) Transmitting Antenna:

This will collect electrical signals from a transmission line and convert them into radio waves.

2) Receiving Antenna:

This will accept radio waves from the space and convert them to electrical signals and gives them to a transmission line.

Reasons why we use Antennas.

1) They provide a simple way to transfer signals (or data) where other methods are impossible.
2) Antennas are used as a gateway for wireless communication.

Types of Antennas

1) Wire Antennas
   - Short dipole Antenna.
   - Dipole Antenna.
2) Log Period Antennas
   - Log period Dipole Array.
   - Log-Periodic Antennas.

3) Aperture Antennas

-> Slot Antenna

-> Horn Antenna.

4) Microstrip Antennas

-> Rectangular Microstrip patch Antenna

-> Quarter-wave Patch Antenna

5) Reflector Antenna

-> Flat-plate Reflector Antenna

-> Corner Reflector Antenna

-> Parabolic Reflector Antenna

Characteristics of Antenna.

1) Effective length.
2) Effective Aperture.
3) Directivity and gain.
4) Radiation Intensity
5) Radiation efficiency and power gain